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**Japanese applications of the  
Green Building Challenge and Tool  
between 1996 and 2002**

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## ***ABSTRACT***

This research determines that the Green Building Tool (GBTool) may be sufficiently flexible to be implemented in Japan. Even so, the locally developed system has been adopted as the preferred building environmental assessment method for Japan.

Pressing building environmental concerns in Japan are identified, and performance criteria for building assessment tools in Japan established. A distinction is drawn between building performance assessment criteria and assessment tool performance criteria. This is central to understanding Japanese attitudes towards the GBTool.

The Japanese Green Building Challenge (GBC) process is discussed - including the testing, customisation and use of the GBTool and the subsequent development of a Japanese alternative (CASBEE – the Comprehensive Assessment System for Building Environmental Efficiency). A comparative assessment of the GBTool and CASBEE system for Japanese commercial application is undertaken.

User-friendly tools that can slot into existing building processes and regulations are most suitable for commercial use in Japan. Building professionals prefer a set of tools designed for use in specific building stages – such as CASBEE. The study consequently finds that the GBTool is suitable for research, but has limited commercial application because of the size of the assessment framework.

The development of a Japanese tool for nationwide implementation has been a consensus based decision-making process. The development of assessment frameworks acceptable to local users may enable the promotion of building environmental priorities while addressing established commercial building concerns.

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University of Cape Town

## ***INTRODUCTION***

### **1.1 CONTEXT OF THE STUDY**

This environmental management study assesses the use of building environmental assessment tools in Japan, within the broader context of international initiatives in the field.

The study of Japanese initiatives in this field is particularly significant to the understanding of global environmental management initiatives, both political and technical, given Japan's role as a leading player in the use of increasingly scarce natural resources, as well as its leading role in attempting to manage natural and built environments.

In more specific terms this study addresses Japan's involvement in the Green Building Challenge (GBC) and the development of a Japanese alternative to the Green Building Tool (GBTool), the Comprehensive Assessment System of Building Environmental Efficiency (CASBEE). It describes attempts to develop CASBEE as a building environmental assessment tool applicable to national conditions. The use of the GBTool as a basis for the development of the CASBEE management system undergirds its general usefulness, while the adoption of the CASBEE management system as a Japan-specific system superseding the GBTool undercuts the argument that generic systems are useful beyond the research and development stages of environmental management.

## 1.2 BACKGROUND TO THE STUDY

The need to improve the relationship between human beings and their environment has become more widely recognised after international meetings such as the Earth Summit in Rio in 1992, resulting in Agenda 21, and the Kyoto Conference on Climate Change in 1997 (Edwards, 1999). Such forums have highlighted the environmental impact of human development. This increased awareness has led to environmental management initiatives in many sectors of society.

Environmental management is the execution of planned controls in relation to care of the Earth (Fuggle & Rabie, 1998), by way of observing, assessing and recommending ways of implementing development to reduce its impact on the environment.

Building environmental performance assessment is one such management process. Some individual countries have developed specific environmental assessment tools for use according to their particular environmental, climatic, economic, political and social conditions. The United Kingdom (UK), for example, developed the BREEAM system and the United States of America (USA) the LEED system (Cole, 1998). CANMET in Canada has developed a generic assessment system for international use known as the Green Building Challenge (Cole, 1998). This utilises a building environmental assessment package - the Green Building Tool.

Developers of the GBC, commenting on diverse possible approaches to the GBTool have said that even though the GBC is an international initiative encouraging international building environmental assessment comparison, it additionally offers countries the chance to research and develop nationally applicable assessment tools specially suited to their national programmes, cultures or environmental needs (Cole & Larson, 2000). Japan has been successfully customizing the GBTool for use and has been developing an offshoot of the GBTool for local use.

### **1.2.1 Environmental management in Japan**

Japan, like other countries, has until recently neglected its environmental management, specifically in the building sector. As recently as 1996, only a limited number of firms in the Japanese manufacturing industry implemented environmental management, and even fewer in the construction industry. A survey conducted by the Institute of Building Energy and Environmental Conservation in 1996 (Yashiro, 2001), showed that 45 percent of firms (developers, general contracting firms, house builders and pre-fabricated house producers) in the construction industry did not know what environmental management entailed. Yashiro (2001) suggests that sectors of the construction industry showed little interest or concern for the environmental consequences of the industry. This changed rapidly after 1996, with a growing awareness about the environment (Yashiro, 2001).

Yashiro (2001) suggests a number of reasons for the change in the attitude towards environmental management. There has been increasing pressure from clients and interested parties, especially from other industries. Market initiatives have utilised environmentally conscious designs for the purpose of promotion. The construction industry has also become aware of the magnitude of environmental risk and the financial costs of environmental degradation. More recent survey results have shown that construction practitioners have recently changed their attitudes towards project and construction management. The environment has become an important issue that needs to be taken into account in any development (Yashiro, 2001).

### **1.2.2 The GBC in Japan**

A team from Japan became involved with the Green Building Challenge in 1996, around the time when environmental management was predominantly unknown in the Japanese construction industry. Japan has been testing the Green Building Tool on buildings since 1996 to the present date.

Up until 2001, the Japanese GBTool investigation was undertaken by academics in alliance with prominent players in the construction and energy fields, with the Ministry

of Construction<sup>1</sup> only participating in GBC meetings as an interested party (Kimata, 1999). From 2001, the leadership and running of the GBTool testing was transferred from academia and business to Government, under the Ministry of Land Infrastructure and Transport (MLIT).

This management shift implies a move towards wide scale implementation of built environment management in the country, linking research, legislation, and regulatory initiatives. Government leadership also implies a certain containment of the process, as the state itself is a major stakeholder in the building sector.

It was announced in 2002 that a joint government - academia project had been set up to establish a Comprehensive Assessment System of Building Environmental Efficiency, to be standardised throughout Japan, named CASBEE. The project assesses various types of buildings including offices, schools and multi-unit residential buildings (Iwamura, 2002). This process also means that Japan as a nation is closer to implementing a national built environmental management plan than most other developed nations.

### **1.3 PROBLEM STATEMENT**

The problem statement investigated in this research is that the GBTool is sufficiently flexible to be implemented as the preferred building environmental assessment method in Japan.

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<sup>1</sup> The Ministry of Construction in Japan was renamed the Ministry of Land, Infrastructure and Transport (MLIT) at the beginning of 2002 and will be referred to as MLIT henceforth in this report.

#### 1.4 SCOPE OF THE STUDY

This research project identifies pressing building environmental issues in Japan and describes the initiatives that have been made to reduce the building industry's impact on the environment. Given the present state of built environment management in Japan as a whole, the study focuses on policy and research initiatives at a national level, rather than on technical questions, or matters of implementation.

This research of the Japanese building environmental situation is from a Western outsider's perspective. The limited nature of the study precludes more detailed discussion of the technical characteristics of the assessment tools, as well as the case studies involved.

Research issues are not investigated in detail because of the time frame of the project and the limited nature of the resources available. The status quo of the Japanese building environmental situation was investigated by interview, questionnaire and e-mail correspondence.

The literature review on the GBC and GBTool building environmental assessment method, from an international and Japanese perspective, was limited to documents available in English.

The research identifies the main building environmental issues in Japan, linked to the construction industry and the Japanese measures taken to cope with environmental problems and improve the situation.

The research project identifies how the Japanese have used the GBC and GBTool, describing customisation to the assessment criteria after first use, to suit the Japanese context. The Japanese involvement in the GBC, the testing, use and customisation of the

GBTool by the Japanese teams and the consequent development of a Japanese assessment system, soon to be implemented nationally, are also examined in this project.

The research concludes with an overview on how the Japanese GBC teams, government, and academia have developed a Japanese building environmental assessment tool as a consequence of their GBC process.

This study underscores why an assessment tool needs to fit into established national, environmental and industry paradigms for it to be used in a country as intended.

Much, for instance, could be made of the uniqueness of the Japanese construction industry, for example, in relation to its role in the national economy, its unique scale, its particular relation to government, its vast global impact, its particular management and social practices, and its place in the boom and bust cycles of the past 30 years. These aspects, however, fall outside the scope of this study.

Making a building environmental assessment tool usable for different building phases in a building's life cycle, particularly for the tool users, is critical, if a tool is to be used actively within industry beyond the research phase. Another important factor in the acceptability and success of a building environmental assessment tool is that it should not disrupt the economic process of building construction in a country.

## **1.5 AIMS**

This research project aims to illuminate the Japanese process of testing, customisation, and use of the GBTool in Japan. The project also aims to identify why the Japanese decided to develop a new building environmental assessment system for national implementation after they had already satisfactorily customised the GBTool to suite the Japanese building environmental context.

The central question of the project is why a Japanese tool was developed when the GBTool assessment criteria were modified to be satisfactory for Japanese use. This research report concludes that the GBTool's structure was unsuitable for Japanese use and this is where the GBTool and the new Japanese system differ.

## **1.6 OBJECTIVES**

Contributing to the main aim of the research are the following objectives:

- To understand the building environmental issues of the Japanese construction industry that need to be addressed by a building environmental performance assessment tool in relation to the Japanese use, testing and customisation of the GBTool.
- To understand the process of the Japanese use and customisation of the GBTool, the limitations of the GBTool in the Japanese context, and consequent development of a Japanese building environmental assessment system.
- To discuss the implications of the Japanese experience for the further development of building assessment tools in other countries.

## **1.7 RESEARCH QUESTIONS**

The research questions to be addressed in this project are as follows:

- Does the GBTool meet Japanese environmental priorities for building?
- After customising the GBTool to suite building environmental performance requirements, why did Japan opt to develop a new building environmental assessment tool instead of using the GBTool?
- Does the assessment framework (tool structure) as opposed to the assessment criteria impact on the implementation value of a building environmental assessment tool?

## **1.8 METHODOLOGY**

The report was researched and written in Japan. It depended strongly on accessing local stakeholders in the GBC process.

Japanese papers, conference reports and unpublished papers by various Japanese academics that were translated into English were interesting and useful in understanding the Japanese perspective on critical building environmental issues and the Japanese understanding of what sustainability means in the built environment.

Useful insights from various role players were gained from two sets of interviews (see questionnaires in Appendices 2 and 3) to gather information on specific issues pertaining to sustainability in the built environment, the use of the GBC and GBTool in Japan and comparative information on the GBTool and the newly developed Japanese building environmental assessment system.

Role players interviewed included professionals, academics, government officials and industry representatives involved in the building industry or associated with the Japanese GBC. Details of correspondence and interviews are contained in Appendix 1.

Furthermore, a meeting was held in Tokyo with the Japanese GBC Team in order to exchange information about the South African building industry and the Japanese GBC.

## **1.9 REPORT STRUCTURE**

In chapter one, the study's intended aims and objectives have been stated. An international building assessment tool's suitability for national use is discussed.

In chapter two, Japanese building environmental priorities, and the state of the Japanese building industry are discussed, outlining Japanese assessment tool performance requirements. This information provides a benchmark against which the GBTool's appropriateness for Japan can be measured. Japanese formulations of the notion of sustainability are briefly examined. Existing building environmental management initiatives in Japan are outlined.

In chapter three, the way the Japanese have engaged with the GBC process as well as their applications of the GBTool are discussed. This chapter outlines the degree to which the generic GBTool is considered applicable in the Japanese context.

In chapter four, the development of a Japanese alternative to the GBTool is discussed. The use of the GBTool in Japan in relation to the Japanese building environmental performance assessment priorities stated in chapter two is evaluated.

In chapter five, the research questions are revisited and the problem statement is discussed. Conclusions in relation to the role of the GBTool in Japan are made. The value of the Japanese GBC process for other countries is discussed.

# ***ESTABLISHING PERFORMANCE CRITERIA FOR BUILDING ENVIRONMENTAL ASSESSMENT TOOLS IN JAPAN***

## **2.1 INTRODUCTION**

Issues of sustainability as well as environmental policy and management in Japan are influential factors affecting the national context in which building environmental assessment tools function. These issues are important in establishing the assessment tool's performance criteria.

This chapter identifies central Japanese building environmental concerns, thereby outlining appropriate performance assessment criteria for buildings. This is done in keeping with the Japanese paradigm of sustainability and environmental management.

Building environmental issues addressed in this chapter include: energy consumption, resource use, limited land area, construction waste and global environmental impacts. Further issues include: short building lifecycle, and the environmental quality of buildings in relation to building users.

Japanese building performance is generically determined in terms of the GBTool parameters at category, criteria and sub-criteria levels. Performance requirements for building environmental assessment tools in Japan are also discussed, setting priorities to be addressed by any building assessment tool for Japan. Hence requirements for the suitability of assessment tools to Japan are outlined. Assessment tool performance requirements discussed in this chapter include political, economic, social, cultural, use and user requirements.

### 2.1.1 The Japanese sustainability paradigm and environmental management.

The general Japanese attitude towards sustainability is partly derived from the Japanese culture of reverence for nature influenced by Shinto and Buddhist religions. This complements the contemporary Western understanding of sustainability. The notion of *Kangkyōsei*<sup>1</sup> underlies much of the Japanese social fabric, and informs cultural formulations of the more modern Western notion of sustainability. Government and industry quantify sustainability in relation to the built environment in terms of the global issues of resource and energy efficiency, limited capacity of space (Japan's habitable land area in relation to population, impacting on building area and outdoor space available per capita), building life cycle and the global supply chain of materials (Ikaga *et al.*, 2000).

The building profession represented by the Architectural Institute of Japan (AIJ) has embraced the notions of weak and strong sustainability. The notion of weak sustainability looks at short (10 years) and intermediate term (50 years) implementation of sustainability in pragmatic terms. Strong sustainability remains a principled long-term objective (spanning hundreds of years) (AIJ, 1997: p.5). The AIJ believes that an important way towards realizing sustainability is through a continuous process of environmental management (AIJ, 1997: p.5).

In a proposal for realising sustainable building, the Architectural Institute of Japan defines sustainable building as

"A building that can moderately maintain or improve the quality of life and harmonise with the climate, tradition, culture and the environment in the region, while conserving energy and resources, recycling materials and reducing hazardous substances within the range of the capacity of the local and global ecosystems throughout the building lifecycle" (AIJ, 1997: p.5).

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<sup>1</sup> *Kangkyōsei*: Japanese word meaning living in harmony with the environment. The concept is an Asian / Japanese / Eastern understanding and equivalent to the Western concept of sustainability. Prof. Iwamura used this word in interview discussions; refer to Appendix 1.

The Japanese perspective of sustainable building implementation of "eco-efficient design and construction" strives towards minimising energy consumption when maintaining the indoor environment, prolonging buildings' use life, using environmentally safe building materials with life-cycle based thinking and improving the quality of the urban environment (Ikaga, *et al.*, 2000).

Discussing a framework for conceptualising architecture of the future, Nagashima (1999: p. 8) puts forward the idea of "global universality" and "local particularity". The GLOBAL vision pertains to the effects of architecture on energy and natural resources, the economy and the environment. Architecture should be compatible with the LOCAL characteristics of the building site as well as the human and socio-cultural environment. Integration of the two possibly opposing concepts may be termed a GLOCAL approach (Iwamura, 2000a).

The combination of global and local forces resulting in the 'Glocal' approach to architecture is seen as a way forward towards architecture of the future. The Glocal approach is an important concept in current Japanese architectural thinking. This paradigm can be related to the understanding of Japanese priorities when discussing the use of the GBTool in Japan. The testing and use of the 'international' GBTool and consequent development of a Japanese 'local' tool, has resulted in what could be described as a 'Glocal' building environmental assessment tool.

### **2.1.2 Environmental policy and management in Japan**

Japan has adopted strict environmental standards and has used the best available technology to preserve the environment. Nationwide standards are often supplemented by stricter ordinances and guidelines by local governments as well as by voluntary agreements that help to adapt national efforts to local conditions (Inui & Kato, 2002).

Local governments are authorised, under the Constitution, to enact ordinances as long as they are not in conflict with national laws. Those ordinances can be more stringent than nation-wide standards (Inui & Kato, 2002).

The role of public opinion and social consensus in Japan is a very strong force, even more so than in most countries. The consensual nature of Japanese society also means that if something becomes a social, or legal norm, it is strongly adhered to. The role of government in environmental management is therefore significant in this regard. Local governments are strongly behind the implementation of environmental regulations.

"Under the Japanese approach, local governments undertake the implementation and enforcement of the framework through ordinance and other measures such as onsite inspections. Environmental issues are resolved through cooperation between local governments, industry and citizens. Implementation of Japanese environmental policy owes its success to the usually excellent training of local civil servants and their strong desire to serve the public good" (Inui & Kato, 2002: p. 38).

The adoption of international benchmarks has played a large role in this process.

"Recently, new environmental criteria in the market such as International Standards Organization's ISO 14001 standards have helped establish and maintain environment-friendly management systems" (Inui & Kato, 2002: p. 40).

Initiatives of this nature have not been limited to the public sector, and the corporate sector has taken parallel initiatives – often leading the way.

"Japanese companies are very sensitive to the risk to their reputations, and they want to make sure that there are no boycotts or bad publicity regarding their products or practices. Therefore a steady commitment to pollution control and dialogue about the environment with the local community help maintain an enterprise's good public image" (Inui & Kato, 2002: p. 41).

Japanese society is characterised by a large degree of inter-sectoral co-operation, and this process has been central to the implementation of environmental management processes.

"Often committees consisting of representatives from national and local governments, the private sector, academia and civil activists are set up to coordinate the stakeholders' interests in the formation of environmental measures

as well as the mid- and long-term national visions of economic development and environmental policy. Such an approach often results in the formation of new joint research initiatives by government, business and universities" (Inui & Kato, 2002: p. 43).

This is the manner in which the Green Building Challenge has been managed in Japan.

## **2.2 BUILDING PERFORMANCE ASSESSMENT CRITERIA**

Building performance assessment criteria are the principles and standards by which building environmental performance may be judged or decided. In order to understand the use of the GBTool in Japan, the critical environmental issues that have been identified by Japanese research are discussed. Japanese research has identified the environmental consequences of construction industry activities. These consequences include the environmental impact of energy use in summer time, resource use, the magnitude of construction waste, the limited capacity of space, the global supply chain of materials and the short life of buildings (Yashiro, 1999).

### **2.2.1 Energy**

Japan is a wholesale importer of energy. After the 1970s international oil supply crisis, Japan realised how much energy was consumed and the consequent economic and environmental burden. The economic depression of the 1980s and the collapse of the Asian economy in the 1990s followed mass consumerism and spending without regard for the future. There was little understanding of the impact that the construction industry and energy consumption were having on the national and international environment.

Efforts to increase energy efficiency began after the 1970s oil supply crisis. The construction and building sectors were particularly affected because of the large amount of energy the building and construction industries consumed (Ando, 2000: p.4). Energy efficient design and management are essential for the construction and building industry.

"The building sector is one of the largest energy consumers. The residential and tertiary sectors are responsible for over one-third of the total energy consumption in OECD countries. Three quarters of energy use and carbon dioxide emissions from this sector originate from the operating phase. Heating accounts for the largest share in the building sector" (Ando, 1999: pp.14-15).

In Japan, carbon dioxide emissions are greatest in summertime because of the humidity and intense heat and the necessity to cool the internal environment of buildings.

"Energy efficient design and management, green house gas emissions reduction and the use of renewable energy are essential factors" (Ando, 1999: pp.14-15). It is clear from these statements, that buildings are being designed that are energy inefficient and inadequately insulated. Increasing their efficiency, using a building environmental assessment tool before the operational phase is desirable.

Energy production and consumption accounts for approximately ninety percent of all greenhouse gas emissions in OECD countries (Ando, 1999: p.15). Between 1980 and 1990, carbon dioxide emissions increased considerably within the transport, residential, commercial and service sectors while emissions from industry proportionally decreased (Ando, 1999: p.15).

Japanese total carbon dioxide emissions increased by nine percent between 1990 and 1996 (<http://www.env.go.jp/en/pol/jde.html>). On-site construction work is responsible for 1,3 percent of national carbon dioxide emissions, construction materials production 12,8 percent, construction-related transportation emissions 3,4 percent and the operation of buildings 16,5 percent. This makes the building and construction industry responsible for 34 percent of the national carbon dioxide emissions (Yashiro, 1999).

"The amount of energy used is a key element of the sustainability of buildings, so it is essential to develop an energy efficiency policy for this sector" (Ando, 1999: p.16).

Energy conservation codes are one of the key instruments in the building sector, to control energy efficiency (Ando, 1999). Consumers can exert strong pressure on builders

to improve energy efficiency to reduce household expenditure on fuels and electricity (Ando, 1999).

Japan introduced regulations to cope with the increase in carbon dioxide emissions in the 'Law Concerning the Promotion of Measures to Cope with Global Warming' that was established in 1998. This law stipulates that national government, local authorities, business and citizens are all responsible for reducing energy consumption, carbon dioxide and other greenhouse gas emissions (Ando, 1999). Since Japan ratified the Kyoto Protocol in June 2002, Japan will now have to reduce carbon dioxide emissions by six percent from its 1990 levels, by 2012 (Harano, 2002).

Japan is making a conscientious effort to increase energy efficiency in the industrial, residential, commercial and the transportation sectors (Izumi, 2000). The Japanese Ministry of Land, Infrastructure and Transport enacted the regulatory 'Law Concerning The Rational Use Of Energy' in 1979, revised in 1993 and again in 1999, with the expectation that this would reduce energy consumption in houses and buildings by twenty percent (Izumi, 2000: p. 14). Guidelines based on this act, the 'Energy Saving Guideline for Housing' and the 'Energy Saving Guideline for Buildings', were also enacted in 1979, with the intention of reducing energy consumption in houses and buildings (Ando, 1999: p. 15). After the Kyoto Third Conference of Parties (COP3), reducing greenhouse gas emissions from building operation became more important than before because emission quantities by 2010 needed to be reduced by six percent, from the 1990 level (Yashiro, 1999).

The 'Law Concerning The Rational Use Of Energy' includes standards that the Minister is able to determine and make public for judgement regarding the rational use of energy (Chapter 2, Article 4: <http://www.eccj.or.jp/law/e-law.html#3>). Building and house owners are obliged by the 'Law Concerning The Rational Use Of Energy' to conserve energy by standards. These standards include: rationalization of fuel combustion; rationalization of heating, cooling and heat transfer; prevention of heat loss by radiation, conduction; recovery of waste heat; rationalization of heat conversion into power;

prevention of electricity loss by resistance, and rationalization of conversion of electricity into power or heat (Chapter 2, Article 4: <http://www.eccj.or.jp/law/e-law.html#3>). Japan's policy for sustainable building in relation to climate change aims to promote energy conservation, use of natural energy and unused energy sources. The Japanese government ratified the Kyoto Protocol in June 2002, showing Japan's "determination to fulfil its global obligation to fight global warming" (Harano, 2002: p.16).

This energy conservation would also have economic implications, because importing energy is costly and a burden to Japan particularly when experiencing environmental pressures and a slowing economy (Izumi, 2000).

Energy use in Japan is at its peak during summer time as Japan is within the monsoon belt of Asia, where temperatures and humidity during summer time are high (Yashiro, 1999). Architects and engineers in Japan put effort into summer time cooling of buildings using air conditioning devices. This results in a summer time energy demand, which is higher than energy demands in wintertime when snow falls in Japan. Thirty percent of carbon dioxide emissions in Japan result from some part of buildings' life cycles (Yashiro, 2000c).

### **2.2.2 Resources: land, materials, waste and the global environment**

As a result of the limited available land in Japan, the combination of demography and geography places pressure on the environment. The total land area of Japan is 379 000 square kilometre with 126 000 square kilometre of that land being habitable by people (Magnier, 2001). Japan's population is approximately 126 million people (Magnier, 2001). The gross, national population density is 329 people per square kilometre, but in habitable areas the figure is 988 people per square kilometre. Usable and habitable land area is relatively scarce. The relationship between population density and habitable land area indicates how important the limitation of land area is, making it a critical building environmental issue for Japan (Yashiro, 1999).

"Appropriate material selection, waste minimisation, recycling of building materials and efficient use of water, are essential factors to curtail depletion of natural resources. These factors also promote increased durability of buildings and allow for cyclical utilisation of materials" (OECD, 1999: p.10).

The OECD (1999) suggests that the selection of appropriate building materials and the use of durable materials could extend building life. In addition, embodied energy in buildings and their ease of recycling are believed to be important indicators that could help in the selection of materials that would have fewer impacts on the global environment (OECD, 1999: p.12).

Construction and demolition waste accounts for the most significant part of the total waste often containing a mixture of resources as well as superannuated materials; that is, materials too old or outdated to be useful. The approach used for building design and construction, such as prefabricated components will provide one of the solutions to minimise construction waste (OECD, 1999: p.12).

The quantity of waste is an issue of concern to government and society because of space as well as resource constraints in Japan (Yashiro, 2000c). The magnitude of construction waste can be linked to the issue of short life of buildings, coupled with high population density (Yashiro, 1999). Additionally, the limited available habitable land area makes it critical for Japan to reduce the amount of waste produced and to increase the quantity recycled. Of the 76 million tons of construction waste produced during 1990; which constitutes 21 percent of total industrial waste produced; 42 percent was recycled (Yashiro, 1999). The use of hybrid building materials makes recycling more difficult (Yashiro, 1999). Hybrid building materials result when recycling or material reconstitution to create new materials to be used in new building components has occurred, which makes the recycling of those materials difficult.

Fifty percent of the total national resource consumption is construction related (Yashiro, 1999). In an interview conducted on the 19th of April 2001(Appendix 1), Mr. Izumi, the

Director of Housing Construction at the MLIT, predicted that the available space to dump waste including construction waste would be full to capacity by 2003. Economist and noted waste expert, Prof. Hosoda, predicts that Japanese landfills are at the end of their lives (Magnier, 2001). However, new laws took effect in 2002, requiring that building industry waste be recycled which was hoped would improve the situation (Magnier, 2001).

Total material flow in Japan in 1997 was approximately 2,16 billion tons. Managing stocked material therefore in the form of buildings is critical to improve the current construction waste situation in Japanese cities (Yashiro, 2000c: p.4). Construction waste from building operations is twenty percent of the total Japanese waste from all industries and forty percent of the final disposed amount (Ando, 2000).

Stocked material	56 %	1,2 billion tons
Disposed as waste	14 %	0,3 billion tons
Vaporized material	3 %	0,07 billion tons
Exported material	5 %	0,101 billion tons
Recycled material	10 %	0,21 billion tons
Stocked material in building form (Osaka)	50 %	-
Illegally disposed waste	90%	Construction waste

shorter user life of buildings (Yashiro, 2000b).

The construction waste situation in Japan is pressing compared to other OECD member countries in relation to the quantity and potential impacts of the waste on the global and local environments (Yashiro, 2000b). Reasons for this include the high population density, demand for new buildings and the noticeably

Japan has historically had to acquire many resources from other countries to sustain its industry. Consequently there has long been the need to import resources for production and development. In recent years, a high proportion of resources in Japan are used by the construction industry because the number of construction projects is high. The Japanese building industry uses 50 percent of the total Japanese use of resources (Ando, 2000).

The Japanese construction industry is impacting not only on its own natural environment, but the international environment too. Examples of this are the use of aluminium and hard woods. Aluminium used in Japan is imported from Australia, the USA and Indonesia. This accounts for 99 percent of aluminium used in Japan (Yashiro, 1999). Scarce and non-renewable resources such as tropical timber have been used by Japan to make plywood. For many years, this was then used for shutter boarding of concrete (Yashiro, 1999).

Japan imports most of its resources for industrial production, and the construction industry depends on the global supply chain of resources from other countries (Yashiro, 2000c). The use of resources such as rain forest timber or aluminium has an impact on other country's natural environments.

Being a consumer society and the second largest economy in the world, Japan substantially affects the international global supply chain and impacts on the global environment (Yashiro, 1999). For example, carbon dioxide emissions produced by the Japanese construction industry are estimated to be a third of the total emissions in Japan, being a substantial portion of global emissions (Nakamura, 1997).

The construction industry is making efforts to reduce impacts on the global environment. Policy initiatives were established by Japan after the UNFCCC-COP3 Conference (Nakamura, 1997) to reduce greenhouse gas emissions from building operations. The initiatives were established by the MLIT and aimed at upgrading insulation levels, registration of qualified insulation technicians, encouragement of 'Environmental Symbiosis' housing and urban development projects as well as supplying low interest loans to facilitate 'Eco-care' pilot building projects (Ando, 1999). The fact that Japan ratified the Kyoto Protocol in 2002 puts pressure on all sectors of society, industry, business and government to reduce carbon dioxide emissions.

### 2.2.3 Building life cycle

Buildings in the last 40 to 60 years in Japan, after the Second World War, have been built with a short life expectancy (20 to 40 years) and poor building quality (Yashiro, 2000). Japan's high population density and demand for new buildings places loads on Japanese and international natural environments (Yashiro, 2000). After the Kobe earthquake in 1995, buildings constructed in the last 20 years collapsed revealing inferior workmanship while many older buildings remained intact (Magnier, 2002).

Buildings in Japan have a comparatively short life, for example, when compared to North America or European countries. Buildings in the United States and Europe have a life of approximately 80 to 100 years (Yashiro, 1999). Office buildings in Japan with a reinforced concrete structure are replaced after approximately 40 years and buildings with a steel structure are demolished after 30 years (Yashiro, 1999).

The reasons for buildings in Japan being demolished after 30 or 40 years can be related to historical, physical, economic and government policy reasons (Yashiro, 2000b). During the period of recovery from the Second World War with rapid economic growth, buildings were constructed and demolished quickly creating a short building life cycle (Yashiro, 2000c).

Economic reasons for the building cycle of 'short life - demolish - new build' can be linked to the Japanese tax regulations, where it is advantageous to demolish and build rather than to refurbish an old building (Yashiro, 2000b). Further, current government policy encourages investment in construction, particularly new houses, as a way to keep the slumping economy buoyant (Yashiro, 2000b). Some parties in industry encourage and promote demolition in order to improve and secure construction job opportunities, further exacerbating the problem (Yashiro, 2000c).

An increased motivation for demolition was the lack of physical integrity of many buildings (Yashiro, 2000b). With new building owners or tenants, came changing user requirements. Buildings were unable to accommodate new user needs because of the way

they were serviced and constructed. Buildings are also difficult to maintain, being a further motivation for demolition (Yashiro, 2000b).

There are currently 120 000 condominiums that are over 30 years old but it is expected that in 10 years this will increase to over 1 million condominium buildings. Old buildings face two options, large-scale renovations or being rebuilt. Condominiums are a major form of urban housing in Japan accommodating nearly 4 million households at present. The Ministries of Construction and Transport will soon compile a set of guidelines for condominium residents. The Ministry is also discussing how to extend support for renovation or reconstruction (Harano, 2001).

#### **2.2.4 Building environmental quality**

The Housing Quality Assurance Act covers residential buildings in Japan. The purpose of the Act is for the assurance, protection and resolution of housing quality issues or problems in Japan. Measures to conserve energy for heating and cooling by means of insulation guarantee the thermal environment is comfortable (MLIT, 2000). The quality of the indoor environment of a building during the occupancy phase of the building life cycle is important for the health and comfort of building uses. Indoor environmental quality is assessed according to the quality of the air, acoustic, thermal, and visual environments inside a building (Iwamura, 2002).

Many houses in Japan are finished with prefabricated or synthetic or treated timber interior finishes. The indoor air quality is measured against formaldehyde emissions and air quality. Lighting, acoustic and consideration for the elderly are some of the other factors covered by the act (MLIT, 2000). These houses are often built to fixed standard designs, which prospective owners can order from catalogues.

The local environment surrounding a building, including the natural and social context of a site needs to be taken into account when undertaking building environmental assessments in Japan. The impact of a building on the surrounding environment, both on- and off-site is also important (Iwamura, 2002).

### **2.2.5 Conclusion**

In this section building environmental factors in Japan and building environmental assessment priorities were discussed, followed by discussion on establishing the performance requirements for building environmental assessment tools in Japan. Particularly important to Japan are energy conservation, increasing the life cycle of buildings, reducing the quantity of construction waste, conserving space and Japan's impact on the global environment through resource consumption. These issues can be addressed by building environmental assessment tools. However, the ease of use of an assessment tool and its suitability to the local, national, socio-economic systems and government policies are questionable. The reality of a building environmental assessment tool being adequately used in Japan depends on the assessment tool's performance requirements.

## **2.3 ASSESSMENT TOOL PERFORMANCE REQUIREMENTS**

There were no comprehensive Japanese building assessment methods or development in this sector before 2001 (Oka & Yokoo, 2000). A survey was conducted in Japan in 2000, to determine Japanese building engineers' prioritisation of assessment criteria in three existing building environmental assessment tools. Three existing building environmental assessment tools were used for the survey. These consisted of the established British system, the Building Research Establishment Environmental Assessment Method (BREEAM); an established Canadian tool, the Building Environmental Performance Assessment Criteria (BEPAC); and the Japanese customisation of the Green Building Tool (GBTTool).

The results reflected the adjusted building environmental assessment criteria weightings as rated by Japanese building engineers, construction companies and utility companies (Oka & Yokoo, 2000). The conclusion was that global issues, environmental impact, environmental loadings, carbon dioxide emissions, ozone depletion were highly weighted, implying that the construction industry believed these factors to be important.

However, 'site/transportation' and 'longevity/process' criteria were perceived to be less important as they were rated lower than the former criterion (Oka & Yokoo, 2000). The finding that the construction industry perceives global issues to be more important than these local issues indicates that it will be difficult for Japanese to address local building environmental issues (Oka & Yokoo, 2000).

These weightings may also be taken to indicate that the Japanese construction industry may be hesitant to embrace assessment criteria, which reflect negatively on some of their own entrenched interests – such as site-based environmental matters, the shortening of rebuilding rates, and the changing of existing building methods.

Factors rated highly may be seen to be generic, affecting the industry as a whole, and less likely to involve direct, individual accountability. Factors given low ratings may possibly be understood as those related to less generic questions which involve a case-by-case assumption of individual accountability by individual players in industry.

Given the many pressing building environmental issues in Japan, a building assessment tools needs to demonstrate that it can assess energy efficiency, resource efficiency and environmental loadings caused by construction, life cycle of buildings and their performance. It must also address capacity of space, building lifespan and the building industry's international environmental impact (Yashiro, 1999). Yashiro (2001) notes that environmental priorities identified by the Japanese construction industry are similar to those identified by the European construction industry.

In a detailed examination of existing assessment systems, four assessment aspects of importance were identified. These included energy consumption, cyclical use of resources, local environment and indoor environment (Iwamura, 2002).

An assessment system that can be used to assess the extent of energy savings during the building operation phase, in relation to the Japanese national energy saving standard

would help monitor and improve Japanese building energy consumption (Iwamura, 2002).

Assessment tools in Japan need to be able to assess the extent of resource saving, the quantity of resources that are reused and recycled, i.e. the cyclical use of resources (Iwamura, 2002). Reducing the quantity and type of building materials used is also seen as necessary because most building materials need to be imported and Japan also needs to reduce its global impact on foreign environments. The spatial constraints Japan faces with waste disposal, particularly building material waste, is also likely to encourage a move in this direction. Therefore an assessment tool that promotes resource saving is seen as desirable.

Assessment tools that address natural and social contexts and assess building impacts both on- and off-site are important (Iwamura, 2002). Assessment of indoor environmental conditions is critical. The indoor air quality, acoustics, thermal comfort and visual quality of the building must be of an acceptable standard, all achievable if addressed during the design and construction phase of building (Iwamura, 2002).

A building environmental assessment tool that is of use in Japan therefore needs to address these global and national building environmental priorities. Assessment tools must be able to address these global building environmental issues while meeting national and local Japanese building environmental demands. If a tool cannot achieve these goals, it needs to be modified to do so.

In addition to the environmental performance criteria of an assessment tool, discussed above, an assessment tool must fulfil other requirements in order to be of use and applicable to the Japanese construction industry. Design factors that need to go into a building environmental assessment tool in order for the tool to be applicable to Japan include economic, political, social, cultural, use and user performance requirements (Iwamura, 2002).

An assessment tool's economic performance requirements for example, are whether or not the use of the tool slows down the building process by being uneconomically viable in relation to time to building completion. An assessment tool's political performance for example, is that it should be able to dovetail with existing legislation and complement national standards. User requirements are for example that the assessment tool does not significantly complicate or interfere with the design, construction or renovation phases of a building. Some criteria that affect an assessment tool's performance when in use in the market place are now discussed.

### **2.3.1 Economics**

Economically related factors can limit the use of building environmental performance assessment tools in Japan. In an e-mail questionnaire conducted with representatives of the Ministry of Land, Infrastructure and Transport (MLIT) on the 15th of May 2001 (Appendix 2, Q 15), respondents said that assessments are voluntary and if the possibility of design and construction work being delayed as a result of the assessment process, the use of assessments is limited or neglected because of pressure by clients to complete building projects.

The implications of this are that assessment tools, which are complex to operate, understand and complete are unlikely to be commonly used. The Japanese market requires an assessment tool that is simple and quick to use and easy to understand. Additionally the tool should not interfere with the completion of buildings for occupation.

The use of building environmental assessments is seen by some clients and builders as an environmental status symbol and therefore increases the marketability of buildings. This could then encourage the use of environmental assessments in design and renovation or alteration of buildings. It can be concluded from this that if the assessment process does not interfere with the economics of the building process, assessment tools are more likely to be used during the design process as well as later in the building life cycle.

In an e-mail questionnaire conducted with representatives of the MLIT, on the 15th of May 2001 (Appendix 2, Q 15), the respondents said that building owners and users do not insist on building assessments being undertaken, because in many cases the assessment does not result in a higher rent or lower building cost for the owner.

In the case of commercial buildings, owners often want to secure rapid repayment and only require a building with a short life span. Commercial building owners also require that the building is cost effective with easily changeable facilities able to suit varying customer preferences.

In an e-mail questionnaire conducted with representatives of the MLIT on the 15th of May 2001 (Appendix 2, Q 10), the respondents suggested that there are some important design factors that need to go into a building assessment tool in order to make building environmental assessment tools applicable in Japan. A building environmental assessment tool must be able to assess a building in particular, the economic factors, including life cycle costing of a building. Owners and users also regard the reduction of energy used and waste produced as important. This may be in order to reduce the running cost of buildings, however it is also environmentally efficient.

One may conclude from these client preferences, that if building environmental assessment tools were cost effective in relation of the time taken to do assessments, then clients would understand building environmental assessment from an economic point of view linking their economic priorities to building environmental improvement.

Additionally, if the assessment process were marketed to clients by developers and building professionals as contributing towards increasing the marketability of property by creating greener buildings, this would further increase the assessment tool's attractiveness. Meeting economic demands are important criteria an assessment tool should meet in order to be used and effective in the Japanese market.

In an OECD / IEA joint workshop held in 2001, on the design of sustainable building policies, one of the main conclusions was that "Governments need to place more emphasis on economic instruments and information tools to improve energy efficiency" (Hasegawa, 2001: p.16). As awareness of environmental performance of buildings increases in the market, and becomes an economic lever as described, so will the demand for these criteria in buildings to be of a certain standard.

In an e-mail questionnaire conducted on the 25th of April 2002 (Appendix 3, Q 7), Dr Ando of the MLIT suggested that as environmental awareness increases, and environmental issues set standards that need to be met in order for buildings to be desirable to clients and tenants, assessment tools will need to address these environmental performance requirements to be of use in the construction industry in Japan.

### **2.3.2 Politics**

Further important criteria for building environmental assessment tools in Japan are that they are appropriate to the social context that the building industry operates in, meeting political requirements as well as meeting market needs (Iwamura, 2002). Additionally, social and cultural performance requirements need to be considered. These are diverse requirements.

In Japan, there are strong connections between the different functional layers of society, from corporations, academia, government and society. Business success for example, is strongly linked to a company's public profile. In Japan, there is a strong ethic of responsibility and accountability between companies who often have had long business relations with each other. Stemming from these relationships are links to government and society that need to be maintained.

The Japanese construction industry and government are closely aligned, with the government investing strongly in construction projects (Magnier, 2002). This has been a method used by the government to boost the slump in the Japanese economy that

occurred after the collapse of the Asian Bubble Economy in the 1980's (Hijino & Pilling, 2000).

During the early to mid-1990s, the Japanese construction industry, with its ties to the government construction ministry (MLIT) was being put under pressure by industry and business that were already environmentally sensitive. The pressure was aimed at improving the building industry's service and product with respect to the environment and the building industry realised the economic necessity of being environmentally sensitive and accountable (Yashiro, 2000d). This was at the same time as the Japanese became involved with the International Green Building Challenge.

In an e-mail questionnaire conducted with the MLIT on the 25th of April 2002 (Appendix 3, Q 6), Dr Ando was asked what the political or policy requirements for a building environmental assessment tool in Japan were. Dr Ando responded that building environmental assessment tools in Japan must be in agreement with or above the standards set by Japanese laws and national regulatory requirements. The Japanese government is currently in the process of revising the "Energy Conservation Law" of 1978. In addition to the Energy Conservation Law revision, a new "Law on Recycling of Construction Waste" and the "Housing Quality Assurance Act" came into effect in 2000 (Appendix 2, Q 4).

At a joint OECD / IEA workshop on the design of sustainable building policies, one of the main conclusions was that: "Governments need to monitor the actual performance of buildings so that they can understand the precise effect of policy instruments and receive guidance for future improvements" (Hasegawa, 2001: p.16). The Japanese government in conjunction with Japanese academia has recently established a building environmental assessment system that is to be standardised throughout Japan (Iwamura, 2002).

Therefore the government will be able to monitor building performance, make informed decisions and improve policy making decisions for the future as advised by the OECD

workshop. Japanese decision-making depends strongly on a team and consensus approach.

The use of a building environmental assessment tool in Japan can be optimised if the tool is linked to existing Japanese systems, regulations and procedures (Appendix 2, Q 16). Important systems in place that would need to be linked into are the Performance Indication System and the Government Housing Loan Corporation (GHLC). The GHLC regulates the quality of housing based on the Building Standards Law of Japan, which is Japan's national building code. The purpose of the Building Standards Law is to:

"Safeguard the life, health and property of people by stipulating minimum standards concerning the site, structure, equipment, and use of buildings, thereby to contribute to the furtherance of the public welfare" (GHLC, 2000: p. 1).

Technical standards for standard interest rate housing include energy efficiency to meet the government energy-saving standards established by government in 1992 and a barrier-free house interior, aimed at increasing ease-of-living for aged and handicapped people. Houses also must meet with durability requirements linked to the structure of the house (GHLC, 2002).

In the case of large buildings, building regulations may be efficient in monitoring their building environmental quality. There are no special quality checking systems in place for large buildings, as with residential buildings therefore it is important that building environmental assessment tool are linked to existing Japanese systems, regulations and procedures (Appendix 2, Q 16).

### **2.3.3 Society, culture, users and uses of building environmental assessment tools**

It is appropriate that Japanese building environmental assessment tools should be suited to the Japanese culture of working in teams. A set of tools is most suitable, where a sub-tool can be used to assess a specific stage in a building life cycle by a part of the assessment team. The assessment results may also be used together by a larger assessment team to understand various stages of a building's environmental impacts.

Different types of assessment tools are necessary for the various stages and their applications in buildings' life cycles. Examples of the various stages are: the building design phase, building execution phase, building operation phase or the renovation phase. Apart from needing to be able to assess different stages in a building's life cycle, a building environmental assessment tool needs to be able to assess different building types (Iwamura, 2002). Examples of building types are: multi-unit residential, office buildings, industrial or school buildings.

In an e-mail questionnaire conducted with representatives of the MLIT on the 15th of May 2001 (Appendix 2, Q 16), the respondents suggested that the Japanese construction industry used building environmental assessment tools in various ways and that they have different roles. They are used as planning documents for energy conservation, based on the Energy Conservation Law, for housing performance indication, based on the Housing Performance Indication Standard, and as a design check that buildings have for example, sufficient sunlight.

Assessment tools are also used as environmental management systems according to the ISO 14001 and for model projects by local governments, national corporations and the private sector (MLIT, 2001: Appendix 2, Q13). The GBTool would be expected to be able to be modified to meet national laws, regulations and international standards that the Japanese government had adopted. Is the GBTool able to meet these requirements?

In an e-mail questionnaire conducted with representatives of the MLIT on the 15th of May 2001 (Appendix 2, Q 16), the respondents said that industry and consumer environmental education and information provision would encourage the use of assessment tools in Japan because the tool and its standards would be more easily accepted by industry and the public. Can the GBTool link into existing systems in Japan and would environmental awareness and education make it more acceptable to users?

The main users of building assessment tools in Japan are *Kenchikushi* (a Japanese licensed architect and building engineer). Mechanical and electrical engineers who design

building facilities also use building environmental assessment tools (MLIT, 2001: Appendix 2 Q14). Environmental assessment tools must be practical, simple and flexible in their structure. Additionally, the tools must be simple to understand and adaptable to various types of computer aided design programmes (MLIT, 2001: Appendix 2, Q 8).

"A key issue is the interpretation placed on the final environmental profile or label by the current marketplace, and its significance alongside other performance requirements. Perhaps more importantly, the adoption and promotion of such assessment tools by organisations that are in the public eye, is critical in contributing to the process of shifting public awareness and perceptions of what constitutes building quality" (Cole, 2001a: p. 27).

In an e-mail questionnaire conducted with Dr Ando of the MLIT on the 25th of April 2002 (Appendix 3, Q 7), Dr Ando explained that as the general awareness of the International Organisation for Standardisation's ISO 14 000 environmental standards has increased amongst building owners, construction companies, builders and engineers, therefore environmental performance issues are becoming more desirable in satisfying economic performance requirements in buildings. For example, energy efficiency and air quality inside buildings is of particular concern in relation to market requirements because responsible clients are demanding these qualities in buildings. The quality of the indoor environment including natural lighting is also highly regarded by owners and users and, in some cases, owners consider the building exterior and facade to be important.

This therefore almost guarantees that the construction industry will make sure these criteria are satisfied, encouraging the use of building environmental assessment tools in the design and production of green buildings.

### 2.3.4 Summary of performance requirements for building environmental assessment tools in Japan

Table 2.2 summarises the issues discussed in section 2.3 of this chapter. These are requirements that are necessary for the tool to be acceptable for Japanese application in the market place.

<b>Table 2.2 Assessment tool performance requirements</b>	
<b>Economics</b>	Should not delay construction process Simple to use and interpret Cost effective in relation to time taken to do assessment Economic lever in relation to green building standards
<b>Political</b>	Appropriate to the social context in which the building industry operates Concur with Japanese law, regulations and link into existing systems and procedures Used by government to monitor building performance to inform policy making
<b>Socio-cultural</b>	Good public profile making use desirable by the public sector Use appropriate to working in teams and simple to understand Tools should be practical, simple and flexible in their structure Adaptable to various types of computer aided design programs
<b>Use</b>	Set of tools suitable for different building life-cycle stages For use as planning documents, housing performance indication, design standards check Environmental management system For model projects by local governments
<b>Main tool users</b>	<i>Kenchikushi</i> (Japanese licensed architect and building engineer) Mechanical and electrical engineers, Builders and Clients

## 2.4 CONCLUSIONS

One of the leading attitudes towards realizing sustainable building is held by the Architectural Institute of Japan who believe it is achievable through a continuous process of environmental management. This is significant because their attitude makes the idea of national implementation of a building environmental assessment tool or system viable. Furthermore, the fact that the role of government is seen as important for environmental

management and that Japan is a consensus based society with co-operation between different sectors makes the national implementation of an environmental management system more feasible.

This chapter highlights two main issues of importance for establishing performance criteria for building environmental assessment tools in Japan. The first being the actual tool's building performance assessment criteria and the second being the assessment tool's performance requirements or ability, i.e. the structure of the tool and how user friendly it is. The building environmental performance criteria are similar to other industrialised countries, Japan's critical issues being building life cycle, spatial constraints, energy and resource consumption and efficiency. Related to the success of the implementation of a building environmental assessment tool in Japan, are the tool's performance requirements, i.e. how suitable the tool is to the political economic, social, use and user needs and contexts.

Table 2.2 summarised the performance requirements outlined in this chapter that building environmental assessment tools need to fulfil in order to be suitable for Japanese application. The most important criteria that a tool must fulfil are in relation to economic factors and user requirements. The use of an assessment tool during the building process, should not delay the construction process otherwise building clients will reject their use. Therefore tools should be simple to use. The Japanese use requirements suggest small discrete tools making up a comprehensive set of assessment tools in preference to one large building environmental assessment tool as the GBTool. These tools should be suitable for ordinary building professionals, mainly *Kenchikushi* in Japan.

An international building environmental assessment tool is useful for addressing building environmental issues, such as energy and resource consumption; environmental loadings; indoor environmental quality and economics. These international issues are similar around the world. However, individual country's national issues are often more detailed and complex. Although there are commonalities between countries, there are also differences. An international assessment tool is useful for international building

assessment comparison if the assessment system allows for country-by-country comparison using weightings making assessment results comparable.

In order for international building environmental assessment tools to be applicable under national conditions, tools need to be adapted for actual building assessment in different national contexts. Additionally, every building assessment undertaken is different according to the buildings age, stage in its life cycle, type, size, construction materials, client's requirements, the purpose of the assessment, to list a few. This suggests that one single assessment tool, even if its assessment framework were flexible, could not be most suitable in all contexts. This suggests a systematic layering of tools, making up an assessment system consisting of a set of assessment tools able to be used discretely or together as a whole in contrast to one large complex building environmental assessment tool.

University of Cape Town

## ***JAPANESE APPLICATIONS OF THE GREEN BUILDING CHALLENGE***

### **3.1 INTRODUCTION**

This chapter examines Japanese involvement in the Green Building Challenge and its use of the Green Building Tool. The GBC and GBTool are discussed in relation to Japanese building environmental priorities.

The Japanese customisation of the GBTool assessment criteria and assessment framework is presented in tabular form. The use of the GBC process and the GBTool as a platform for the development of a new Japanese building environmental assessment system is also discussed.

#### **3.1.1 Initial Japanese building assessment initiatives**

The Japanese joined the Green Building Challenge (GBC) in 1996 for the GBC 1998 exploratory phase (Kimata, 1999). This was at the same time as the Japanese building industry was being put under pressure by other industries to improve their environmental performance and social responsibility (Yashiro, 2001). Industrialisation in Japan put environmentalism on industry's agenda earlier than the building industry, especially because the human cost was higher (Ikaga, et al., 2000). At this time there was also public pressure on the government to improve its environmental awareness and responsibility in public projects (Yashiro, 2001). In the last two decades, society, government and the building industry have become more aware of the impact that the building industry has on the environment and efforts to curb impacts have been undertaken (Yashiro, 2001).

By the 1990s, global environmental issues were well recognised by the Japanese building industry's engineers, researchers, professional consultants and government officers (Kimata, 1999). Many research activities, focusing on the global environmental impact of Japanese buildings and related industrial production (e.g. materials processing) of the construction industry, were being undertaken in Japan at that time (Kimata, 1999).

In efforts to improve the environmental quality of buildings, the Japanese government developed a life cycle assessment tool in 1998, known as the Life Cycle Assessment Program, to aid environmentally conscious building design (Yashiro, 1999). This system focuses mainly on carbon dioxide emissions and life cycle energy consumption and does not look at the building as a whole (Yashiro, 1999).

There was a need however for a more comprehensive building environmental assessment system that could be used in the Japanese context (Oka & Yokoo, 2001). Increasing Japanese awareness of building environmental issues coincided with the need for a building environmental assessment tool. When the Green Building Challenge opportunity arose, Japan was therefore eager to become involved in the testing of the GBTool (Kimata, 1999). Hence international cooperation around the international GBC and testing of the GBTool commenced in 1996 (Kimata, 1999). The holistic aims of the GBTool in assessing building environmental performance may have seemed more appropriate to evaluating overall building performance than the more limited Life Cycle Assessment Program method.

### **3.2 THE GBC IN JAPAN – A CONVERGENCE OF INTERESTS**

Japan eagerly participated in the GBC as its broad goals strongly overlapped with Japanese priorities at the time. During the initial GBC phase, between 1996 and 1998, the Japanese teams customised the GBTool evaluation criteria in order to suit the Japanese context.

"The Green Building Challenge aims at international collaboration, in an effort to develop a building environmental assessment tool that exposes and addresses controversial aspects of building performance and from which participating countries can selectively draw ideas to either incorporate into or modify their own tools" (Cole & Larson, 2000: p.5).

The goals and opportunity of the GBC were optimal for the Japanese building industry's situation. The building industry needed a tool but did not have one. It would be necessary to either adopt an existing tool or to design and develop a new Japanese building environmental assessment tool.

The specific objectives of the GBC 1998 included developing methods for building energy and environmental performance, testing the system on buildings in different countries and reporting the results of the process (Cole & Larson, 1999). The process of international collaboration led to a better understanding of building environmental assessment. Building energy and environmental performance issues are of interest and concern to the Japanese and so the GBC objectives were compatible with the Japanese priority to create green buildings.

Further, "the GBC allowed countries involved, access to discussion on the state of the art information on international building environmental assessment systems" (Cole & Larson, 2000: p.5). For Japan this was useful because the research community, government, professionals and construction industry had limited or no experience in the use and design of assessment tools and this would have assisted them in the process of testing and modifying the GBTool (Yashiro, 2001).

Additional aims of the Green Building Challenge 2000 were:

"To develop an internationally accepted generic framework that could be used to compare existing building environmental assessment methods and be used by others to produce regionally based industry systems" (Cole & Larson, 2000: p.19).

In order for the GBC assessment framework to be useful across a wide range of regions and building types, "national teams were able to make adaptations to suit national and regional needs while retaining the tool's overall approach and structure" (Cole & Larson, 2000: p.19). The GBC gave Japan the opportunity to either adopt the GBTool or to design a new tool based on the GBTool using the experience and lessons learned during the GBC process.

### **3.3 THE JAPANESE GREEN BUILDING CHALLENGE TEAMS**

Two national teams were organized for the Japanese GBC 1998. The teams consisted of the Building Contractors Society Team (BCS Team) and the Institute of Building Environment and Energy Conservation Team (IBEC Team). The BCS and IBEC Teams jointly made up the GBC National Team.

The Building Contractors Society is made up of a large number of building contractor corporations, 11 of whom were on the BCS Team. Many of the BCS member corporations have had significant power and influence in the Japanese building industry. The construction industry is a large national employer and major political fundraiser in Japan. Construction ministry bureaucrats are often hired after retirement and the building industry plays a significant role in writing the regulations that govern its practices (Magnier, 2000). The BCS presence in the GBC National team has impacted on the decisions made in adapting the GBTool for use in Japan.

The Institute of Building Environment and Energy Conservation (IBEC) is an independent research institution charged by the Ministry of Land Infrastructure and Transport with the control and management of energy conservation research in housing and buildings in Japan (Kimata, 1999).

The GBC teams consisted of 22 organizations, including universities, research engineering firms, energy suppliers, facility management and design firms, building contractors, and academics (Kimata, 1999). The team members who have been testing the GBTool are leaders in their fields (Kimata, 1999), able to direct the use and customization of a new building environmental assessment tool.

Key role players in the building industry attended team meetings as interested parties (Kimata, 1999). The government's construction ministry, the MLIT, showed an interest in the initial Green Building Challenge discussions during the GBC 1998 and was party to the meetings with the GBC Teams. The Sustainable Building Committee of the Architectural Institute of Japan (AIJ), which is an organization of professionals representing 40 000 architects and engineers in Japan, was involved in information exchange and discussions at an early stage (Kimata, 1999). The Sustainable Building Program of the Organization for Economic Co-operation and Development (OECD) got involved from the initial stages of the GBC in Japan (Kimata, 1999).

The early involvement of leading role-players from broadly representative sectors of the Japanese construction industry, research and business, in the testing and customisation of the Japanese GBTool is significant, considering the subsequent development of a Japanese building assessment tool for national cross sectoral implementation.

### **3.4 THE JAPANESE GBTOOL – FROM ADAPTATION TO CUSTOMIZATION**

The Japanese GBC 1998 national teams initially focused on validating the international assessment framework and its categories and criteria in relation to Japanese culture and geography (Kimata, 1999). Secondary customization followed, with the establishment of reference buildings and the determination of criteria for baseline performance, as well as production of Japanese versions of the GBC manuals (Kimata, 1999). Initial case studies

covered five buildings, including a school, office buildings and a multi-unit residential building (<http://greenbuilding.ca/gbc98cnf>).

The GBTool has a hierarchical structure where building performance is described at several levels of detail (Cole & Larson, 1999). Performance level 1 aspects of the GBTool assessment framework are known as 'Performance Issues'. These are:

- Resource consumption
- Loadings
- Indoor environmental quality
- Quality of services
- Economic performance
- Pre-operations management.

These performance areas collectively define 'green building' performance (Cole & Larsson, 1999: p.223). As it was intended that these categories would be similar in most countries around the world, the Japanese assessment framework retained them. These GBTool assessment categories address central Japanese building industry concerns, particularly resource consumption and environmental loadings.

Performance level 2 criteria of the GBTool assessment framework relate to the depletion of natural resources (Cole & Larsson, 1999: p.223). Resource consumption criteria measure the use of energy, land, water and materials, for example.

The Japanese GBTool assessment framework has retained these original level 2 criteria. However, assessment criteria were altered to suit existing Japanese standards that were somewhat higher than the GBC standards in certain cases (Kimata, 1999). For example, the 1973 oil crisis had such a significant effect on Japan that efforts to develop technological methods to address energy consumption had been developed to a high level.

Consequently Japanese standards are higher than international standards. Prof. Kimata explained at an interview on the 27th of March 2001 (Appendix 1, Kimata) that the Japanese GBTool was therefore adjusted to suit these Japanese standards. Prof. Kimata explained that the basic framework of the Japanese GBTool did not change between the 1998 and 2000 versions, but that some new assessment criteria were added.

Prof. Kimata said that these included energy consumption, new environmental performance criteria such as air quality and total investments, and addressing societies needs. Prof Kimata said that this was because the teams believed that, in order to realize a sustainable Japanese society from a holistic perspective, an assessment tool including society and building life cycles was important.

In the interview, Prof. Kimata further explained that Japan did not have scientific information on certain particulate and gas emissions and therefore these assessment criteria were omitted for the GBC '98 assessment. Although the information on particulate emissions was still unavailable for GBC 2000, Japan applied the criteria using internationally acceptable standards for these emissions (Hanzawa, 2000).

There was strong debate amongst team members during discussions about the focus and role of the Japan GBC framework (Kimata, 1999). One preference was to develop an overall assessment methodology for buildings and the other was to develop an assessment methodology on green performance (Kimata, 1999). An overall assessment methodology would encompass all areas of building services at a national level. An approach focusing on green performance would for example, focus on improving energy and resource consumption in buildings.

This difference in opinions was as a result of the difficulty in achieving consensus on the required criteria for an overall assessment methodology (Kimata, 1999). This was because of how the categories relevant to regional and national conditions related to

present conditions in Japan (Kimata, 1999). Eventually it was decided that the GBTool assessment framework should focus on methodology for green performance.

The Japanese team's decision to focus on green performance in the assessment framework implies the acceptance of the international consensus understanding of green performance. That also impacted on the later development of a Japanese assessment system which uses includes core green assessment criteria similar to the GBTool, but in less detail. This new system is however closer to the idea of an overall methodology, which encompasses all areas of building services at a national level.

The generic issues in the GBTool system are the testing, verification and development phase. However, there has been no international consensus on what constitutes excellence in building environmental performance (Cole & Larsson, 1999). Core fixed 'green' environmental assessment agendas are: resource use, ecological loadings, and indoor environmental quality. These criteria are relative as opposed to environmental sustainability criteria, which are absolute (Cole, 1999: p.245).

These core green building environmental assessment agendas of resource use, ecological loadings, indoors environmental loadings are issues of concern in the Japanese building industry (AIJ, 1999).

The initial Japanese discussions revolved around four questions. Which categories and criteria needed modification to suit the Japanese social, professional and regulatory systems? Which criteria could not be applied in Japan because of insufficient information? Which indicators of criteria and sub-criteria did the team consider unreasonable or unacceptable? Finally, what modifications or customizations of criteria were necessary to make them appropriate to Japan (Kimata, 1999)?

As Cole (1999: p. 205) notes, "a central issue in the development of the GBTool, was that a common set of performance criteria underlies all existing methods and that these core

criteria could be structured to form the basis of all future methods". Japanese thinking has remained in line with this perspective. Even though some of the GBTool criteria were unsuitable for the Japanese GBTool, the core criteria remained applicable to the development of the Japanese GBTool.

### 3.4.1 Japanese customization of the Green Building Tool

Customizations the Japanese teams decided to make (Kimata, 1999) are shown in the following table.

<b>Table 3.1 Customization of the Japanese GBTool</b>	
<b>Customized GBTool criteria *</b>	<b>Explanation for Japanese customization</b>
<b>Categories and criteria, which needed modification to suit Japanese social, professional and regulatory systems:</b>	
<i>Provision of automobile parking</i>	The Japanese Government enacted regulations to ensure safe and smooth traffic flow on roads. Under this regulation, every building is required to provide enough space for car parking. The Japanese Government has also recently encouraged bicycle use. The GBTool tends to limit automobile use. The Japanese GBC team raised the GBTool standards to correlate with higher limitations specified in the national and local regulations.
<i>Nuclear waste hazard</i>	The Japanese Government is still promoting nuclear power. While the GBTool criteria on nuclear power usage are unclear, the Japanese GBC team accepts the status quo in relation to nuclear power.
<p>Comment: As the Japanese government regulations adequately address automobile parking, the GBC team modified the GBTool criterion to suit existing regulations. The GBTool standard was raised to meet the government standard, to encourage continual improvements in standards and best practice, i.e. to provide adequate parking, but to discourage car use</p> <p>Fifteen percent of Japanese power is nuclear (<a href="http://www.eia.doe.gov/emeu/cabs/japan.html">http://www.eia.doe.gov/emeu/cabs/japan.html</a>). Nuclear waste is significant issue for Japan. This criterion standard was made to agree with current Japanese government regulations. Modifying criteria to agree with country standards and regulations is positive. However, the GBTool should be used to improve building environmental standards in a country. Therefore, if a countries standards are low and the GBTool criteria are lowered or changed to meet and agree with these standards, this could be counter productive to improving building environmental performance.</p>	

<b>Criteria that could not be applied in Japan because of insufficient information:</b>	
<i>Insufficient information</i>	Particulate emissions Methane emissions Radon control measures Nuclear emissions Hydro reservoirs emissions Geothermal emissions Biomass emissions
<p>Comment: The Japanese did not have sufficient information for these criteria and so they were omitted for the GBC 1998 testing. For the GBC 2000, although still lacking the information, the teams decided to include these criteria in the assessments, using airborne emissions factors that corresponded to acceptable international standards (Hanzawa, 2000). In reference to the above comment, this is a good alternative to changing or omitting criteria.</p>	
<b>Modifications or customization to criteria to suit Japan:</b>	
<i>Energy consumption</i>	The Japanese building industry achieved a high level of efficiency and the teams therefore believed that there was little room for improvement. The default performance level of each criterion was changed to suit higher Japanese standards.
<i>Maintenance of acceptable relative humidity</i>	The proposed default performance level was not adequate for the Japanese climate and culture; therefore amendments were made to suit.
<i>Dedicated recycling storage and handling areas and systems</i>	The proposed default performance level was not adequate for Japanese climate; therefore amendments were made to suit. What influence does climate have on recycling?
<p>Comment: Although Japanese energy consumption and efficiency standards are high in comparison to international standards, Japan consumes the greatest proportion of total annual energy consumed during summertime. This is because of high temperatures and humidity. Therefore, amendments were made to the relative humidity performance level and increased use of energy. The flexibility of the GBTool to be adjusted to meet different countries needs, while retaining the core criteria, makes it a useful tool. However, in order for there to be country-by-country comparisons, the tool is not useful after countries have adjusted the criteria. This means that there needs to be some further weighting method or system to keep different country's GBTool's comparable and internationally applicable.</p>	

<b>Indicators of criteria and sub-criteria which the team felt were unreasonable or unacceptable:</b>	
<i>Solid waste in future decommissioning</i>	The economic cost to society of recycled materials has not yet been established; therefore the indicator of this criterion was made qualitative.
<i>Sanitary waste flows to municipal systems</i>	Japan has already obtained enough statistical information for assessment; therefore the indicator of this criterion was made more stringent.
<i>Interference to access of Winter sun to adjacent properties</i>	This indicator was changed to suit the Japanese Building Basic Act, which addresses this criterion.
<i>Transmission of building noise to work place</i>	Modified to suit the guidelines already in place, by the Architectural Institute of Japan.
<i>Specification of construction and demolition waste strategy</i>	The Building Contractor's Society research information on waste discharged by the construction industry was applied to this indicator.
<i>Appropriate illumination levels in the work place</i>	Japanese guidelines that have previously been developed for efficiency of lighting control system and efficiency of lighting fixture set this standard. "Efficiency" was added to the criterion.
<i>Minimum use of scarce resource materials</i>	There was insufficient information, therefore this indicator was provisionally changed to "rate of conservation of tropical lumber used for concrete form" but the teams acknowledged that this was not sufficient to sufficiently assess the criterion.
<i>Retention of existing building for new uses</i>	Insufficient information, therefore this indicator was changed from quantitative to qualitative.
<i>Efficient use of finishing materials</i>	Insufficient information, therefore this indicator was changed from quantitative to qualitative.
<i>Use of salvaged materials and components</i>	Insufficient information, therefore this indicator was changed from quantitative to qualitative.
<i>Use of materials with high post-consumer recycled contents</i>	Insufficient information, therefore this indicator was changed from quantitative to qualitative.
<i>Capability for future change of energy supply</i>	Insufficient information, therefore this indicator was changed from quantitative to qualitative.
<p>Comment: Where there was a lack of scientific information, indicators were changed from quantitative to qualitative as the solution to the lack of information. However it is hoped that this will encourage research so that these criteria may soon be assessed quantitatively, so as to improve standards. Certain criteria indicators were made more stringent or added because of Japanese research and local information, indicating that there is a trend towards improving standards. The team's acknowledgement that the 'minimum use of scarce resources' criteria was not adequately address hopefully implies that research will be encouraged to find out information and that this criterion will be adjusted back to reduce the quantity of scarce resource use in Japan.</p>	

\* Customization information obtained from Kimata (1999).

A total of 38 items out of 126 were modified (Kimata, 1999). The Japanese GBC teams felt that it was important for international green building standards to have flexibility to suit any cultural or regional characteristics with a fair, clear and rational framework, which could provide a positive and visible impact on the global environment (Kimata, 1999).

The Japanese teams also noted the flexibility of the GBTool assessment system to adapt to different regional natural features, cultures, social systems and economic conditions (Kimata, 1999). However the tool was complicated and needed a lot of information in order to do an assessment (Curwell, *et al.*, 1999). The Japanese answer to this problem was the later development of a set of tools making a building environmental assessment system rather than one assessment tool. This assessment system is discussed in chapter four.

After the initial GBC process between 1996 and 1998, the Japanese GBC 2000 teams decided between 1998 to 2000 on some general principles relating to the case studies and assessments being conducted using the GBTool (Hanzawa, 2000). The teams decided that there must be consistency with existing Japanese laws and building regulations. This particularly referred to the laws and regulations promoting the use of recycled materials and the reduction of construction waste. A further example relates to indoor environments, which are regulated by the Sanitation Act (1970) that specifies acceptable levels for room temperatures, relative humidity, mean air velocity, carbon dioxide and airborne particles.

The Japanese GBC 2000 teams also agreed that there must be correspondence between the international framework of global environmental issues and the GBTool. Where there was a lack of Japanese information for particulate emissions from for example building interior finishes of walls, floors or ceilings, international standards were adopted by the Japanese (Hanzawa, 2000).

Climatic conditions in Japan needed to be taken into account when modifying the assessment system because of differences between Asian and North American or European climatic conditions where temperatures and humidity differ. Japanese summers are hot and very humid and therefore most buildings do have air-conditioners, resulting in differential seasonal energy demands (Hanzawa, 2000). The basic stance of the Japanese Team was that Japan should adopt the global environmental framework (Hanzawa, 2000).

In the initial Japanese customization of the GBTool for GBC 1998, the Japanese team initially modified assessment criteria with regard to local conditions in relation to government regulations, local policies, or matters of culture and climate. Where there was limited information for certain assessment criteria, the teams stated quantitative criteria in qualitative terms so that the criteria could still be included in the assessment. This indicated a desire to include as many generic assessment criteria in the GBTool as possible, even when statistical information was lacking.

In the later development phase of the Japanese GBTool process there was a movement from straightforward testing to the incorporation of broader international and local environmental concerns. The self-evident international environmental impact of the Japanese building industry may have encouraged the adoption of broader international environmental parameters as assessment criteria in the Japanese GBTool.

### **3.5 FURTHER DEVELOPMENT OF THE JAPANESE GBTOOL – ADDRESSING SUSTAINABILITY CONCERNS**

As the GBC process unfolded in Japan it became clear that broader sustainability criteria should play a large role in determining GBTool criteria – as already outlined in the debate around assessment methodology. It had been decided then that green performance criteria would be adopted (Kimata, 1999). This concern with sustainability in Japan dovetailed with broader GBC concerns.

One of the intended goals of the Green Building Challenge is to "maintain a watching brief on sustainability issues, to ascertain their relevance to 'green' building in general and to the content and structuring of building environmental assessment methods in particular" (Cole & Larson, 2000: p.5).

The GBC 2000 Assessment Manual describes the Assessment Framework as providing measures for both "sustainable" and "green" performance. Environmental sustainability performance is included as "absolute performance in a selected set of performance criteria to contrast with other buildings in different regions" (Cole & Larson, 2000: p.12).

Environmental Sustainability Indicators (ESI) are defined in the GBC 2000 Assessment Manual as "a limited set of performance measures that characterize sustainable building practices and that would facilitate international comparability" (Cole & Larson, 2000: p.12).

The requirements of ESI are that they "represent a fundamental performance requirement for all buildings in a sustainable society. For example, they must relate to issues of non-renewable resource consumption, environmental loadings and human health concerns" (Cole & Larson, 2000: p.12). ESI are further described as being "capable of being defined, derived and expressed unambiguously in quantitative terms" (Cole & Larson, 2000: p.12).

There is a definite convergence between the GBC parameters and built environment sustainability initiatives in Japan. A leading and influential Japanese perspective on sustainability in the built environment, is that of the Architectural Institute of Japan, which notes that:

"Sustainable building is building that can moderately maintain or improve the quality of life and harmonize with the climate, tradition, culture and the environment in the region, while conserving energy and resources, recycling materials and reducing hazardous substances within the range of capacity of the local and global ecosystems throughout the building lifecycle" (Appendix 3, Q 1).

The GBTool contains four Environmental Sustainability Indicators, which are: "annual consumption of delivered primary energy, net area of land consumed for building and related works, net annual consumption of water from building operations, and annual GHG emissions from building operations" (Cole & Larson, 2000: p.12). Cole and Larson (2000: p.12) comment that the limited set of ESI are as a result of the "practicalities of time, cost and data available".

In an e-mail questionnaire conducted on the 15th of May 2001 (Appendix 2, Q 1), the MLIT said that the Japanese Government's policies related to sustainable construction include energy conservation, recycling of construction materials, control of indoor air pollution and preservation of the natural environment. These factors indicate the building environmental agenda that the government feels is important and is practically achievable.

These perspectives on sustainability in the built environment held by leading role-players in Japan and the building industry are similar to the GBTool Environmental Sustainability Indicators. The Japanese team in the GBC 2000 assessment used the ESI without changes. No extra optional criteria that could have been added at the team's discretion were added. This seems to indicate that the Japanese teams were in agreement with the GBC assessment framework and what was feasible to implement in relation to

sustainable building. The GBTool covers Japan's main building environmental issues and is concurrent with predominant Japanese government and AIJ thinking.

The Japanese sustainability concerns are similar to the GBTool Environmental Sustainability Indicators. The Japanese priority to conserve energy is similar to ESI-1: annual consumption of delivered primary energy. Preservation of the natural environment, also a Japanese priority and concern to be addressed in the building industry, is covered by ESI-2: net area of land consumed for building and related works. The Japanese issue of control of indoor air pollution, for example the use of air-conditioners, is covered by ESI-4: annual GHG emissions from building operations. The GBTool covered the Japanese assessment needs, but the GBTool was not as suitable for Japanese application and a Japanese assessment system was developed.

The Japanese had to manage two duel agendas. One being Western pressure to raise building industry standards, improve resource efficiency and energy consumption, the second being Japanese requirements, related to government policy, economic necessity, as well as socio-cultural norms and user requirements. At this point the nature and processes involving the GBTool became significantly Japanese.

The development of a uniquely Japanese building environmental assessment system became a priority, rather than remaining with a modified assessment tool of western origin. The development of this system - CASBEE - is discussed further in Chapter 4.

A Japanese building assessment tool specifically applicable to Japan's needs was being developed during the GBC process (From an e-mail interview with Dr Ando of the MLIT conducted on the 25 April 2002, see Appendix 3). During the GBC 2002 test phase the Japanese team were assessing case study buildings using both the GBTool and the Japanese tool. This allowed the Japanese to compare the new tool to the already tested GBTool (Oka & Yokoo, 2001). The GBC process and GBTool were therefore used by the

Japanese as a model for research and development of a set of building environmental assessment tools.

### **3.6 JAPANESE USES OF THE GBC**

The Green Building Challenge was a research and development opportunity for the Japanese construction industry, role-players and researchers to become familiar with building environmental assessment tools. This involved the GBTool function, priorities, structure, ease of use and compatibility with national regulations and laws. Through the process the teams were able to gather ideas, experience and information about building environmental assessment tool design and use (Iwamura, 2002).

The initial GBC process was used as a learning experience for the Japanese. An e-mail questionnaire conducted with the Ministry of Land, Infrastructure and Transport in on the 15th of May 2001 (Appendix 2, Q 22) revealed that the GBC process allowed Japan to use and test the GBTool in the Japanese context and to modify the GBTool to suit national and local building environmental priorities. Further, the use of the GBTool gave Japan the opportunity to become familiar with a building environmental assessment tool, specifically the GBTool.

The teams customised the GBTool to suit the Japanese context and checked the assessment framework, categories and criteria in relation to the Japanese social, professional, regulatory systems, economic and environmental contexts and customised criteria where applicable (Kimata, 1999).

An e-mail questionnaire conducted with the MLIT on the 15th of May 2001 (Appendix 2, Q 20) showed that the Japanese used their experience with of the GBTool for local and national government policy examples of building environmental performance assessment and for architectural best practice.

In an interview conducted on the 27th of March 2001 (Appendix 2), Prof. Kimata said that the GBC process was used by Japan as a means of maintaining international communication in order to keep in touch with the state of the art information on building environmental assessment tool methodology. The questionnaire with the MLIT on the 15th of May 2001 (Appendix 2, Q 23) concurred with this by saying that through the GBC process Japan is interested in sharing information on building environmental performance assessment method with other countries through research exchange programmes with other country's universities or research institutes.

Additionally, the MLIT said that Japan could assist developing countries through the Official Development Aid Programme, with research and technological assistance for building environmental performance assessment methods and tools. In the 15th of May interview, the MLIT said that this would involve pre-fabricated housing and low-cost residential buildings as well as earthquake engineering and cooling for buildings (Appendix 2, Q 25).

The GBC process and conferences allowed for an international sharing of knowledge in building environmental performance assessment (Kimata, 1999). There was exchange of information at the GBC international conferences where there was the opportunity to discuss the latest information on building assessment with other teams and specialists (Kimata, 1999). The Japanese GBC team found this knowledge sharing important and useful.

To give one example, comparisons with other countries revealed Japanese buildings to have an unusually short life expectancy. This indicated that too much investment goes into buildings that are demolished and therefore wasted. For example, Japan consumes more building materials than Britain, France, Germany or the United States of America (Kimata, 1999). From an international environmental perspective, it is critical that the life expectancy of buildings in Japan is increased (Yashiro, 1999). Therefore the GBC

process and experience gained through interactions with other countries emphasised the importance of Japan increasing the life expectancy of buildings (Kimata, 1999).

Japan is interested in sharing up to date information on her own work on building environmental performance assessment tools and guidelines (Kimata, 1999). In the e-mail questionnaire conducted with the MLIT on the 15th of May 2001 (Appendix 2, Q 22), the MLIT indicated that Japanese resources such as the Performance Indication System, technology standards and policies developed for sustainable building and housing, such as regulations, taxes and information tools, may also be of interest to other countries developing building assessment systems.

In an e-mail questionnaire with the MLIT on the 15th of May 2001 (Appendix 2, Q 2), the Ministry of Land, Infrastructure and Transport indicated that they thought that the GBTool could be useful for the creation of an international building environmental performance assessment tool as opposed to a national or local assessment tool.

### **3.7 OVERVIEW ON THE GBTOOL IN JAPAN**

The GBTool assessment framework adequately addresses global and national building environmental issues such as energy consumption, limited land area, the short life of buildings, construction waste and the global environmental impact of the construction industry.

The Japanese GBC team was able to customise assessment criteria where necessary in order to satisfy political performance requirements such as Japanese Laws, Regulations, Acts, Guidelines and Standards. However, without some simplifications to make the GBTool user-friendlier, it would not be entirely suitable for the market.

As the GBTool requires a large amount of data input in order to assess a buildings environmental performance, it is possible that an assessment using the GBTool is likely to delay the construction work and the completion of the design or building phase (Kohler, 1999).

The large quantity of data necessary to describe a building in its specific performance, using the GBTool was noted as problematic (Kohler, 1999). Japanese commercial building clients expect rapid completion of buildings in order to secure income from the rent or sale of the building. Therefore the GBTool's use would be avoided in fast track building projects.

In order for assessment tools to be more acceptable in Japan they need to be able to be used in mini assessments on discrete parts or phases of the building. These assessments would be performed at specific times in the building's life cycle and for specific purposes.

It was found by the Japanese GBC teams that the GBTool was not quick and easy to become familiar with, use, or to achieve assessment results (Kimata, 1999). The quick use of the GBTool at different phases of a buildings life cycle, such as the design, building or renovation phases would not be feasible because of the structure of the GBTool and the amount of data required for an assessment (Kimata, 1999).

It was suggested that the GBTool be simplified for use in design, post-design certification and post occupancy phases. Japan recommended that future tools be simplified but was very positive about the possibilities for an international environmental building assessment tool (Kimata, 1999).

The use of an environmental assessment tool as a method to rate the building environmental efficiency after completion is a desirable function of assessment tools in Japan (Iwamura, 2002). Life-cycle cost assessments are of interest to the Japanese

construction industry because of the impact and burden the construction industry has placed on the local and international environments. The Japanese require a tool that can be used for the design phase, for environmental rating for marketability and for environmental management at any time during the post-design building phase (Iwamura, 2002).

### 3.8 CONCLUSIONS

The Green Building Tool was originally designed with core performance criteria that are common to all existing building environmental performance assessment methods. The Japanese teams customized the GBTool between 1996 and 2002. During this time, customization changed from a response mode related to international building environmental pressures on Japan, to a more complex phase – rooting the tool in Japanese government laws, standards, and norms of environmental and social responsibility.

The debate amongst the Japanese GBC team about the focus and role of the GBC framework in Japan indicates that there was a divide in opinions of the role-players about the form and role building environmental assessment tools should take. The one opinion being that an overall building assessment methodology would be appropriate for Japanese application and the other that a tool specifically targeting green building performance would be appropriate. (The significance of this divide is discussed in Chapter Four, when the CASBEE system is discussed.)

Initial Japanese discussion over the GBTool focused on criteria suitability and how to customize the GBTool for it to be applicable to Japan. During the customization and testing of the GBTool to make it most applicable to Japan the team was asking questions about how to make the GBTool suitable for implementation in Japan. One can conclude from this that there was an effort to make the tool suitable for actual application in Japan.

The inclusion of criteria using qualitative data when quantitative data was unavailable indicates the team's desire to include the maximum number of generic green performance criteria as possible.

After customization and testing of the GBTool, the team concluded that the GBTool was flexible in its application related to context, but that it was complicated to use, needing a lot of data to do an assessment. The significance of this to later developments is that the GBC team agreed that the GBTool was useful for building environmental assessment, but that a solution to the problem of the difficulty in its use needed to be found.

The combination of Western pressure on Japan to improve environmental performance in general and in the building industry in particular, combined with national pressure on government and industry to become environmentally accountable to society, was a turning point in the GBC process. The Japanese team attitude shifted away from international influence and focused on the development of a building environmental assessment tool applicable to national contextual requirements and user needs. The result was the new Japanese building assessment system called CASBEE.

The GBTool's limited potential for Japanese use lies in the tool's assessment framework and structure that make it user-unfriendly. The limitations of the GBTool in relation to the Japanese context did not lie with its assessment criteria. On the contrary, the Japanese GBTool had adequately customized generic GBTool assessment criteria. In addition, the new Japanese system's assessment criteria are closely comparable to that of the GBTool.

A large and complex assessment tool, such as the GBTool, though comprehensive, cannot meet Japanese needs. If an assessment tool is to be used in the implementation of building environmental management, rather than only for comparative research in an international context, it has to be less cumbersome, and more practically useful.

## ***DEVELOPMENT OF A JAPANESE ALTERNATIVE TO THE GBTOOL***

### **4.1 INTRODUCTION**

This chapter discusses the development of CASBEE - a customised building environmental assessment system developed as a consequence of Japanese experience with the Green Building Tool (GBTool). Reasons why the Japanese decided not to develop the GBTool for national implementation are also discussed.

### **4.2 ADVANCING THE GBC PROCESS: DEVELOPMENT OF A JAPANESE BUILDING ENVIRONMENTAL ASSESSMENT SYSTEM – CASBEE**

In March 2001, Japanese GBC team representatives attended the Green Building Challenge 2002 meeting in Santiago. The draft notes stated that Japan was developing their own assessment tools and would test these in parallel with the GBTool (2001 anonymous, draft notes: GBC-IFC meetings, Santiago, Chile, 19-23 March). In early 2001, the Japanese GBC team then announced that both the GBTool and the new Japanese national assessment tool would be used for the case study building assessment for Green Building Challenge 2002 (Yokoo & Oka, 2001).

In a meeting held on the 19th of April 2001 (Appendix 1, Izumi), at the Ministry of Land, Infrastructure and Transport, Mr. Izumi indicated that a shift in the Japanese GBC leadership was imminent, moving from academia allied with construction corporations to the Japanese government. The impact, influence and control governments can exert in

encouraging moves towards developing sustainable buildings were noted at an OECD/IEA joint workshop on design of Sustainable Building Policies (Hasegawa, 2001).

The Japanese government may have seen the advantage of having a building assessment tool and the additional advantage of having some control of building environmental assessment in Japan. This would also ensure that the assessment criteria were in agreement with national legislation and standards. The GBTool or a Japanese building environmental assessment tool was possibly a way for the government to control or manage the building environmental performance of the construction industry as well as improve its public image in relation to the built environment.

As a consequence of the GBTool testing using Japanese case study buildings, between 1996 and 2000, the teams become familiar with the use of the tool. The experience and knowledge derived in the GBTool adaptation process substantially contributed towards the design of the Japanese set of tools suited to Japanese political and market requirements (Iwamura, 2002).

The recent development of the Japanese building environmental assessment tool CASBEE has been an undertaking of the Japanese government, in collaboration with academia, industry and public sectors (Iwamura, 2002). This assessment and design tool was developed by GBC Japan, supported by the Ministry of Land, Infrastructure and Transport.

A Japanese building environmental performance requirement (discussed in Chapter 2) is that assessment tools should be suited to the Japanese culture of working in teams, as well as being designed by teams that are representative of all sectors of society. This would make the final standardization of the tool acceptable to all role players because they would have been involved in the development of the tool at the different developmental stages. The tool (CASBEE) is said to meet both political requirements

and market needs and moves towards realizing a sustainable society throughout the building lifecycle (Iwamura, 2002).

The GBTool was used in research and development towards a Japanese building environmental assessment system. The international GBTool was adapted via Japanese processes in a Japanese way to suit Japanese criteria. This resulted in a system of tools, rather than one assessment tool such as the GBTool. The result is that the Japanese have developed a building environmental assessment system containing quick and simple-to-use tools for different stages in a building's life cycle.

In the development of the first Japanese building environmental assessment system detailed examination and testing of existing assessment systems led to the development of three assessment tools (Iwamura, 2002). The new system of a suite of tools, underscores the Japanese preference for more user-friendly assessment tools that allow for specific assessment at different phases of a building life cycle as opposed to a single, large system, such as the GBTool.

Continued participation in the GBC process allows Japan to keep in touch with the latest information on building environmental assessment, using this information to improve the Japanese tool, and continue its participation in international forums.

#### **4.3 A SET OF TOOLS: A COMPREHENSIVE ASSESSMENT SYSTEM**

The Japanese building environmental assessment system, called the Comprehensive Assessment System of Building Environmental Efficiency (CASBEE) was developed by the GBC Japan as a joint project by academia and government (Oka & Yokoo, 2001). The team was supported by the Ministry of Land Infrastructure and Transportation (MLIT).

At an OECD workshop on sustainable building policies, it was noted that, "governments need to monitor the actual performance of buildings so that they can understand the precise effect of policy instruments and receive guidance for future improvements" (Hasegawa, 2001: p.16). Additionally "governments need to understand that no single instrument can solve the problems and that they need to take a holistic approach by integrating various instruments to create an effective policy package" (Hasegawa, 2001: p.16).

CASBEE is more a system or set of assessment tools for different stages of assessment rather than one large assessment tool (Iwamura, 2001). The aim of the system is to address political requirements as well as market needs (Iwamura, 2001). This is consistent with the ultimate goal of achieving a sustainable relationship between society and the national building stock (Ikaga, 2000).

CASBEE consists of a set of four kinds of tools with particular purposes and for different phases of the building life cycle for different uses and users (Ikaga, 2002). The different applications of the system are for the design phase, the building phase and the renovation phase of buildings (Ikaga, 2002). The system consists of the Pre-design Assessment Tool, Design for Environment Tool, the Eco-labelling Tool and the Sustainable Operation and Renovation Tool (Ikaga, 2002). The Pre-design Assessment Tool design is incomplete and will be implemented at a future date (Japan Sustainable Building Consortium).

The Design for Environment Tool (DfE Tool) is an environmental management tool for use by architects or designers of new buildings at the design phase. It acts as a simple self-evaluation check for designers or engineers wanting to improve building environmental efficiency (Iwamura, 2002). The main users would be clients, along with the building designer. Assessment would be done with the cooperation of the builder.

The assessment issues that the tool focuses on at this stage are energy consumption, resource circulation, local environment and indoor environment (Ikaga, 2002). These key

assessment issues were identified by the development team, after detailed examination of existing assessment systems including the GBTool. The format of the DfE Tool is remarkably similar to the GBTool. However the DfE Tool is small in comparison. Financially affordable assessment results would therefore become available quickly.

The Eco-labelling Tool aims at rating a building's environmental efficiency after completion. It could contribute to rating a building's basic property value (Iwamura, 2002). Information on the operation of an existing building would be necessary for this assessment. The client, designer and builder use the tool. The client would entrust the designer with the assessment (Ikaga, 2002). The builder would judge the quality of the assessment (Ikaga, 2002). At the building execution stage, the Eco-labelling Tool can be used as a provisional assessment and labelling tool to facilitate design with environmental care in mind (Ikaga, 2002). The tool is also used for assessment of existing (used) buildings (Ikaga, 2002).

The Sustainable Operation and Renovation Tool would assist building owners and managers with upgrading the building environmental efficiency of their property when improving or renovating existing buildings (Iwamura, 2002). The tool's assessment framework is integrated with the Design for Environment Tool for new buildings. Assessment of the timing of renovation would be considered in relation to the design and detail design steps of facilities (Ikaga, 2002).

In the development of the Japanese set of assessment tools, Japan considered the many existing assessment and evaluation systems, such as LEED, BREEAM and the GBTool, already developed by other countries. Instead of adopting an existing system, the Japanese academy and government tried to develop a system most suitable for the Japanese social, economic and natural environmental contexts.

In an e-mail interview conducted on the 25th of April 2002 (Appendix 3, Q 2), Dr. Ando from the Ministry of Land, Infrastructure and Transport said that one of the main reasons why Japan did not adopt one of these developed systems was that the systems do not

evaluate positive factors such as serviceability, amenities and comfort for owners and users of buildings.

The Japanese system has included these factors under building environmental quality and performance: a factor used to calculate the 'Building Environmental Efficiency' rating (BEE), which is then used to calculate the relative sustainability of the building being assessed (Bogaki, et al., 2002).

Dr Ando also said that the GBTool is at present not practical for use as a design tool by engineers and architects or as a building environmental management tool by building owners. Dr. Ando went on to say that the GBTool and other assessment tools identify and eliminate negative environmental factors. The main advantage of the CASBEE system is however, that it can be used to minimize environmental impacts while also helping to create greener buildings (Appendix 3, Q 3).

Dr. Ando from the MLIT continued by saying that the CASBEE scoring system is similar to the one used for the GBTool. However, the developers of the CASBEE system have used a BEE factor, as a comprehensive indicator of sustainability of building performance (Appendix 3, Q 4).

In understanding the advantages of the CASBEE system over the GBTool for Japanese national use, it is useful to compare the two assessment tools in relation to each other, considering Japanese needs for, and applications of such a tool, as discussed in chapter two.

#### **4.4 A COMPARISON OF THE GBTOOL AND THE JAPANESE SYSTEM**

The GBTool and the CASBEE are compared in Table 4.1 using criteria that are important in the make-up of a building environmental assessment tool. Some of the main differences between the tools are shown. This is in order to understand why the GBTool was used for research and development of a new Japanese tool as opposed to being implemented for actual use, when the assessment criteria were satisfactorily customized to suite the Japanese context. An attempt is made to identify those factors inherent in the GBTool that made it unsuitable for Japanese use.

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**Table 4.1**  
**A comparison of the GBTool and CASBEE system**

Green Building Tool*	Comprehensive Assessment System for Building Environmental Efficiency **
DESIGN GOALS (INTENTION, PURPOSE, USE)	
<ul style="list-style-type: none"> <li>• To develop and test a system that could be modified to suite variations in national, regional and building type characteristics.</li> <li>• Focus on relativistic assessments, by relating assessments to benchmarks that are based on applicable regulations or industry norms in each of the participating regions.</li> <li>• Establish a structure that can be used at various levels of detail.</li> <li>• Ensure consistency between levels of assessment, from criteria to sub-criteria.</li> <li>• Ensure consistency in terminology.</li> <li>• Establish a scoring system that is suitable for quantitative and qualitative data.</li> <li>• Include a weighting system that is user modifiable.</li> <li>• Implement in a software system that will make regional modifications possible and will also simplify the data input and assessment processes.</li> </ul> <p>The GBTool is a building environmental assessment tool for use at international, national and local levels. It is aimed specifically at assessing green building performance. The GBC and GBTool are also a platform for international debate and exchange of information about building assessment tools.</p>	<ul style="list-style-type: none"> <li>• To develop a building environmental assessment system that could be implemented nationally and that could meet political requirements and market needs.</li> <li>• Japanese user friendly: for use by <i>Kenchikushi</i>, architects, mechanical and electrical engineers, clients.</li> <li>• Environmental management at the design phase of a project (Design for Environment Tool).</li> </ul>
<p>Design goals comparison:</p> <p>The GBTool is part of an international effort for countries to develop useful versions of a comprehensive building environmental assessment tool for green building assessment. A purpose of the GBC and GBTool was for countries to customize the GBTool so that it was suitable for use in their country or to further develop a suitable tool for their context and needs. The CASBEE is an example of how a country used the GBC and GBTool to create an assessment system suitable for Japan's economic, social, environmental and political needs.</p> <p>The CASBEE's intention and purpose differ from the GBTool in that it is specifically for commercial building environmental assessment to be used across the building industry in Japan where high building environmental performance is becoming standard. Therefore the CASBEE is specifically intended for commercial use, while the GBTool is intended for use, but also for research and development of building environmental assessment tools for different countries across the world.</p>	

## DESIGN FEATURES

The **GBTool** is a single building environmental assessment tool, consisting of two software modules: The Green Building Input (GBI) and the Green Building Assessment (GBA)

- The **Green Building Tool**: evaluates the environmental performance of buildings. The framework is structured hierarchically in four levels, with higher levels logically derived from weighted aggregation of the lower ones.

**CASBEE-J** consists of four tools making up a set of tools or an assessment system:

- **Tool-0: Pre-design Assessment Tool**: enables building owners and planners to identify the basic context of the project and assists in the selection of an appropriate building site, showing basic impacts of the project. The design of this tool is incomplete and will be implemented in the future.
- **Tool-1: Design for Environment Tool (DfE)**: environmental management at the design phase which is carried out as a self-evaluation check for designers and engineers to improve building environmental efficiency (BEE) during the design phase of a building. This assessment focuses on energy consumption, resource circulation, the local and the indoor environments.
- **Tool-2: Eco-labeling Tool**: buildings are rated after completion, in terms of their BEE.
- **Tool-3: Sustainable Operation and Renovation Tool**: provides building owners and managers with information on how to improve the BEE of their building during the post-design phase.

Design features comparison:

The GBTool can be used at any stage of a building's lifecycle, however is a single tool and needs to be used as a whole to achieve an assessment result. The GBTool has many assessment criteria therefore the time taken to achieve an assessment result in relation to the financial cost would be unrealistic for most clients. Additionally, the tool has a large and complex assessment framework, which would be a deterrent to its common usage in the average commercial office environment.

The CASBEE is specifically divided into four separate tools each with different purpose and aimed at different users for each progressive stage in a building's life cycle. Each tool is comprehensive and can be used alone or in combination with the other tool's results making a larger assessment at a later phase of the building process. The CASBEE is a manageable and useful system in the average working environment.

ASSESSMENT ASPECTS COVERED	
<p>The GBC assessment framework provides a measure of both:</p> <ul style="list-style-type: none"> <li>- the environmental performance of buildings relative to typical practice ('green' performance); and</li> <li>- absolute performance in a selected set of performance criteria, which are the Environmental sustainability indicators (ESI).</li> </ul> <p>The following performance areas collectively define 'green building'. They are core assessment criteria that can be used internationally or locally:</p> <ul style="list-style-type: none"> <li>• Resource consumption</li> <li>• Environmental loadings</li> <li>• Indoor environment</li> <li>• Longevity</li> <li>• Process</li> <li>• Contextual factors</li> </ul> <ul style="list-style-type: none"> <li>• Environmental sustainability indicators (ESI)</li> </ul> <p>The ESI are defined as a limited set of performance measures that characterize sustainable building practices that would facilitate international comparability. The ESI indicators cover primary energy consumption, land area consumed for building, water consumption, and GHG emissions for building operations.</p>	<p>The CASBEE set of tools assesses buildings in terms of 'green' performance, specifically dealing with criteria of energy and resource use and indoor environments.</p> <ul style="list-style-type: none"> <li>• Energy consumption</li> <li>• Cyclical use of resources</li> <li>• Local environment</li> <li>• Indoor environment</li> </ul> <p>These are performance areas that the Japanese government believes and research findings show are necessary and adequate for building environmental assessment in the Japanese context.</p> <ul style="list-style-type: none"> <li>• Building environmental efficiency (BEE)</li> </ul> <p>BEE is an indicator calculated using an equation where,</p> $BEE = \frac{\text{Building environmental quality and performance}}{\text{Building environmental loading}}$ <p>This is a visual representation of the environmental sustainability of the assessed building.</p>
<p>Comparison of assessment aspects covered:</p> <p>The GBTool covers most assessment criteria necessary to check for 'green' building performance. The tool does not however include 'social' assessment criteria. The GBTool's attempts to measure a limited number of quantifiable criteria that are described as environmental sustainability indicators (ESI). The CASBEE system includes the main green performance criteria specifically ones that effect Japan government internationally and nationally, such as energy use, resource use and indoor building environmental quality which effects building users.</p>	

**TOOL ASSESSMENT FRAMEWORK components (STRUCTURE)**

The GBTool assessment framework consists of five hierarchical levels of assessment, becoming successively more detailed.

**Level 1: Performance Issues**

(e.g., *Resource consumption*)

- Generic and broadly applicable.
- Divided into six distinct performance areas.
- Collectively define 'green building' performance
- RESOURCE CONSUMPTION (R): Performance issues, which relate to natural resource depletion.
- LOADINGS (D): Performance issues that relate to outputs from building construction, operation and demolition which place stresses on natural systems.
- INDOOR ENVIRONMENTAL QUALITY (Q): Performance issues, affecting building occupants health, comfort and control of environmental systems.
- QUALITY OF SERVICE (S): Design features having an effect on the building's environmental performance.
- ECONOMIC PERFORMANCE (E): Measure of cost and value issues of green building design.
- PRE-OPERATIONS MANAGEMENT (M): Performance issues related to planning for effective building operation.

**Level 2: Performance Categories**

(E.g., *Energy*)

- Principal performance characteristics that define the overall characteristics of a building.
- Most direct means of communicating the results of an assessment.

**Level 3: Performance Criteria**

(E.g., *Peak demand*)

- Derived through the aggregation of several performance sub-criteria.
- Represent distinct areas of building performance and specific in contrast to the generic and broadly applicable nature of the performance categories.
- Building and region specific.

**Level 4: Performance Sub-criteria**

(E.g., *Peak electrical demand*)

- Represent the basic building blocks of the overall assessment framework.
- Criteria and sub-criteria may be quantitative or qualitative in value.

**Level 5: Default scoring scales**

The most detailed level where default scoring scales are shown.

The CASBEE is consists of four separate tools. The DfE Tool can be compared to the GBTool. The DfE Tool consists of three hierarchical levels of assessment, becoming successively more specific.

**Level 1: Performance Issues (of the DfE Tool)**

(E.g., *Building environmental loading*)

- BUILDING ENVIRONMENTAL QUALITY AND PERFORMANCE (Q): Performance issues also known as issues categories, which relate to the comfort of the building's environment and the quality of services.
- BUILDING ENVIRONMENTAL LOADINGS (L) Issues categories, which relate to depletion of natural resources and the consequential impacts the building will have on the surrounding environment.

These two main issues categories of the DfE Tool, being Q and L respectively, are used in the BEE equation to calculate the environmental sustainability of the assessed building.

$$BEE = Q/L$$

**Level 2: Criteria**

(E.g., *Energy conservation: Heating and cooling load*)

**Level 3: Sub-criteria**

(E.g., *Site plan*)

**Comparison of tool assessment framework:**

The tools are similar in that they are both structured hierarchically with levels of assessment becoming successively more detailed. The GBTool is detailed in the amount of assessment criteria that can be included in an assessment, while the CASBEE system has fewer assessment criteria and is more 'broad-brush' in its approach. This 'broad-brush' approach makes the CASBEE system quick and simple for professionals to use and achieve results, also making it economically competitive in the market place. Although the GBTool is thorough in what is included in an assessment, this thoroughness requires a large amount of data often taking time for assessors to acquire and complex to use, making it less attractive for common professional use in a competitive market place.

ASSESSMENT SCALE / SCORING METHOD	
<p>The assessment scale consists of a scoring system that ranges from (-2) to (+5). All performances are assessed relative to a datum condition or benchmark, being zero (0) on the performance scale. The datum is intended to reflect current standard or typical practice for the particular building type and region. The 'demanding performance' condition (+5) indicates performance that is considerably in advance of current practice. A score of (-2) indicates performance that is inferior to acceptable industry standards.</p> <p>-2 -1 (0) 1 2 3 4 5</p> <p><b>Score sheet</b></p> <ul style="list-style-type: none"> <li>• Summary presentation sheet outlining results.</li> <li>• Detailed performance assessment results sheets with figures given.</li> </ul> <p><b>Assessment results</b></p> <ul style="list-style-type: none"> <li>• Series of detailed bar charts.</li> </ul>	<p>Scores are given based on the scoring criteria for each assessment item. The criteria applied to the assessments are determined taking into consideration the level of technical and social standards at the time of the assessment. A five level scoring system is used, where three (3) indicates the average.</p> <p>1 2 (3) 4 5</p> <p><b>Score sheet</b></p> <ul style="list-style-type: none"> <li>• Assessment categories are Q and LR.</li> <li>• Scores are given based on scoring criteria for each assessment item.</li> <li>• Weighting is used for certain criteria.</li> </ul> <p><b>Assessment results</b></p> <ul style="list-style-type: none"> <li>• Project outline</li> <li>• Results of CASBEE by category, BEE and optional assessment items.</li> </ul>
<p>Comment on the Assessment scale / Scoring method:</p> <p>The GBTool scoring method influenced the CASBEE system's method although CASBEE's is smaller and possibly therefore less accurate. The CASBEE system's scale from (1) to (5) with (3) as the average appears biased towards buildings being rated positively in terms of environmental performance. This is in contrast to the GBTool's scale of (-2) to (+5) where (0) represents industry norms. The CASBEE system seems to lack scores to indicate optimal performance moving towards sustainable building performance. This possibly implies that the Japanese are regarding the CASBEE system as an indicator of performance in a static way rather than aiming for greater building environmental performance.</p>	
WEIGHTING	
<p>Appropriate weighting is important because it affects the overall building performance profile and score.</p> <p>Weighting of qualitatively different sub-criteria is judgemental. Decisions should be made by experts who are familiar with environmental issues in the region.</p> <p>Weightings should be customized for each region using a common starting point.</p>	<p>Each item (e.g. Q-1: Indoor environment or Q-2: Quality of service) is weighted so that all the weighting coefficients within the assessment category Q add up to 1.0. The scores for each assessment item are multiplied by the weighting coefficient and aggregated into scores for Q and LR.</p>

OUTPUT PROFILE / ASSESSMENT RESULTS SHEET	
<p>The output of the assessment is shown on the Results Sheet of the GBTool.</p> <p>The GBTool uses a series of nested bar diagrams, each capable of showing successive levels of detailed performance. This method allows the performance profiles at various levels to be shown collectively or individually and providing the means of identifying sub-criteria that are inapplicable, and their subsequent impact on higher levels of performance evaluation.</p> <p>Green performance scores are shown in the form of bar-chart profiles, set on the -2 to +5 scale.</p>	<p>The output profile consists of a:</p> <ul style="list-style-type: none"> <li>• Project outline</li> <li>• Result of CASBEE</li> <li>• Results by category: summarized in the form of a radial chart, bar graphs and numerical values.</li> <li>• Building Environmental Efficiency (BEE): information for the BEE is calculated by the results Q (Building environmental quality and performance) and L (Building environmental loading). The CASBEE assessment scale for Q and LR (Reduction of building environmental loadings) range from 1 to 5. The gradient of a graph showing Q against L represents the BEE. This is a visual representation of the environmental sustainability of the assessed building.</li> <li>• Optional assessment item.</li> </ul>
<p>Output profile comparison:</p> <p>The GBTool output profile is large, consisting of bar charts, each showing successive levels of detail. The CASBEE system's output is made up of a number of scores shown on bar charts and radial charts. The presentation is simple and easily interpretable for assessors, informed clients and the interested public.</p>	
FLEXIBILITY / EASE OF USE	
<p>The size of the GBTool assessment framework and the amount of necessary performance criteria that need to be quantified makes the GBTool complex to use by users.</p>	<p>The purpose of the CASBEE system is for commercial use and therefore has been made user friendly and attractive because it will be implemented across Japan and become a part of common practice in the building process.</p>
<p>Flexibility and ease of use comparison:</p> <p>The GBTool is comprehensive but complex to use while the CASBEE system is user-friendly it contains far fewer performance criteria than the GBTool.</p>	

TOOL USERS	
<p>Research and development phase:</p> <ul style="list-style-type: none"> <li>• Research</li> <li>• National GBTool research teams</li> </ul> <p>Commercial use phase:</p> <ul style="list-style-type: none"> <li>• Architects</li> <li>• Engineers</li> <li>• Building environmental performance assessors</li> </ul>	<p>Pre-design assessment tool</p> <ul style="list-style-type: none"> <li>• Building owners</li> <li>• Planners</li> </ul> <p>The Design for Environment Tool</p> <ul style="list-style-type: none"> <li>• Client</li> <li>• Designer</li> </ul> <p>The Eco-labeling Tool</p> <ul style="list-style-type: none"> <li>• Client</li> <li>• Designer</li> </ul> <p>The Sustainable Operation and Renovation Tool</p> <ul style="list-style-type: none"> <li>• Client</li> <li>• Designer</li> </ul>
<p>Tool users comparison:</p> <p>The GBTool is technician in orientation, aimed at professionals interested in building environmental assessment and building research scientists with intended use by building professionals. The CASBEE management system is in contrast intended for national implementation across Japan and it therefore simple for use by architects, designers, engineers and clients.</p>	
TOOL USES / APPLICATION	
<p>“... development of a comprehensive, generic assessment framework and not necessarily in the development of a commercially viable version of the GBTool” (Cole &amp; Larson: 2000, p. 5).</p> <p>The GBC process is also intended as a forum for discussion of existing building environmental performance assessment methods and research and development into how to improve these methods.</p> <p>Eventual commercial implementation of the GBC assessment framework and GBTool.</p> <p>International partnerships between countries involved in the GBC.</p>	<p>For commercial building environmental assessment of buildings across Japan.</p> <p><b>Pre-design assessment tool:</b> The client and planners will be able to analyze the basic context of a project, which will assist in the selection of an appropriate building site, showing basic impacts of the project. The design of this tool is incomplete and will be implemented in the future.</p> <p><b>The DfE Tool:</b> The client and designer use this tool at the building design stage with the cooperation of the builder to assess energy consumption, resource circulation, local environment and indoor environment. This tool is also used at the building execution phase, where design changes are possible before being built.</p> <p><b>The Eco-labeling Tool:</b> The client, designer and builder use this tool at the building execution phase, where the client entrusts the designer with self-assessment. The tool is used to indicate or label ‘design with environmental care’. Assessment and labeling of the building after one year or more in operation can be done with this tool to give the building an environmental rating.</p> <p><b>The Sustainable Operation and Renovation Tool:</b> The client and designer use this tool to assess and label an operational building or a building to be renovated. New buildings can be assessed using this tool in combination with the DfE Tool.</p>

Tool uses / application comparison:

Although the final intention of the GBC is to develop the GBTool or versions of it for commercial use, the reality is that it still remains more in the realm of research and development. The CASBEE system appears to be a Japanese version of the GBTool, which is one of the main intentions of the GBC. The CASBEE system contrasts with the GBTool in that it is specifically for commercial use by building professionals for use in the Japanese context.

\* GBTool information obtained from Cole & Larson (1999) and (2000).

\*\* CASBEE information obtained from Bogaki *et al.* (2002) and Japan Sustainable Building Corporation (2002).

In Table 4.1 the GBTool and the CASBEE system have been compared. This has been done in relation to their design goals, design features, assessment aspects covered, assessment frameworks, assessment scales, weighting, output profiles, flexibility, ease of use, tool users and tool uses.

The main differences that have been found between the GBTool and the CASBEE system relate to their design goals, the detail of assessment criteria, the assessment frameworks and ease of use.

The main design goals differ because of the original intention of the two systems. The GBTool is an international effort for countries to develop useful versions of a comprehensive building environmental assessment tool for green building assessment comparison. The CASBEE system has been specifically developed as a Japanese system for national commercial use in part as a consequence of their experience with the GBTool.

Comparing the assessment aspects or criteria covered by the tools, the CASBEE system's Design for Environment score sheet contains far fewer criteria than that of the GBTool, while still touching on what the Japanese developers believe are the most important issues. The CASBEE's main 'Issue Categories' are comparable with the GBTool's 'Performance Level 1 Issues' that remain similarly important in most countries. Under each 'Issue Category', the CASBEE system has six assessment criteria, with sub criteria. These are comparable to the GBTool's 'Performance levels 2 and 3'.

The CASBEE Design for Environment (DfE) assessment tool can be summed up in one sheet with an additional score sheet. The assessment consists of a Project Outline, Assessment Results of Issues Categories, a Building Environmental Efficiency (BEE) rating, an optional Environmental Loadings Index that is similar to the GBTool Sustainability Index and a Design Process Assessment.

The CASBEE system is comprehensive in its performance assessment criteria in relation to what it sets out to do, as is the GBTool. However, because of the tool structure (assessment framework), quick assessments can be done at different building design phases. These focus on design, building environmental efficiency or renovation. The CASBEE system is a Japonisation of the GBTool and other assessment tools, specifically suited to the Japanese context, users, political requirements and market needs.

Since Japan has designed a building environmental assessment tool, the GBTool may not be used after GBC 2002. However, the GBC conferences are a platform for exchange of information with European, North and South American countries, African, Australian and Asian countries. In an e-mail interview conducted on the 25th of April 2002 (Appendix 3, Q 5), Dr. Ando from the MLIT said that the GBTool is useful in order to compare Japanese building performance with other countries in efforts to improve assessment tools. Additionally, the evaluation process provided Japan with information and different international perspectives on sustainability in the built environment.

Dr. Ando from the MLIT responded (Appendix 3, Q 6) that the CASBEE system's political requirements are that the tool is concurrent with Japanese laws. The revised energy conservation and construction material recycling laws are for example, minimum requirements for the assessment levels of the tool.

In discussing the market requirements of the CASBEE system, Dr. Ando from the MLIT noted (Appendix 3, Q 7), that building owners, builders and engineers were becoming more aware of the ISO 14000 standards and the importance of energy efficiency and

indoor air quality. Dr Ando added that as environmental awareness increases in the market improving building environmental performance will become an economic, not only an environmental issue.

Dr. Ando said that in order for the CASBEE system to meet both political and market requirements, the Japanese government would try to improve the building performance indication system and housing performance indication system created in 2000 (Appendix 3, Q 8). Dr Ando added that it would be possible that the CASBEE system could be used as to provide the criteria for the improved or new performance indication systems in Japan.

#### **4.4.1 A Comparative assessment of the GBTool and CASBEE system**

In understanding why the Japanese opted to develop the CASBEE system in favor of the comprehensive and well tested GBTool assessment method it is interesting to comparatively assess the two tools. This has been done using criteria that have been essential to the making of all assessment tools, sourced from Table 4.1. In addition, criteria for Japanese assessment tool performance requirements from Table 2.2, that are necessary for commercial use of a tool by building professionals are used.

In Table 4.2, criteria for the use of the GBTool or the use of the CASBEE system for Japanese application are rated. A scale of: Not applicable (N/A), Low (L), Medium (M) and High (H) is used. N/A means that the criterion is not applicable to be rated for that tool, a Low score indicates that the tool is poor in performance for that criterion, Medium indicates fair performance and a High score indicates that the tool rates well for that criterion. The scale is not linked to good or bad qualities of the tools; merely high or low performance rating, meaning the tool performs well or poorly in these criteria.

Rating scale: Not applicable (N/A) / Low (L) / Medium (M) / High (H) performance		GBTool	CASBEE
Design goals	Research and development of assessment tools	H	L
	Commercial building environmental assessment	L	H
Assessment aspects covered	Green building performance assessment	H	H
	Environmental sustainability indicators	M	L
Assessment framework	Framework is structured hierarchically	H	H
	Singular assessment tool	H	N/A
	Set of assessment tools	N/A	H
Assessment scale	Numerical scales	H	H
Ease of use	Large tool, complex to use	H	L
	Small sets of tools, simple to use	N/A	H
	User-friendly	L	H
Main tool users	Building environmental researchers	H	L
	<i>Kenchikushi</i>	H	H
	Mechanical and electrical engineers	H	H
	Builders	L	H
	Building owners, Clients	L	H
	Planners	M	H
Tool uses, applications	Research of building environmental assessment	H	L
	Set of tools suitable for different building life-cycle stages	L	H
	Planning documents, design standards check	L	H
	Environmental management system	M	H
	For model projects by local governments	H	H
	Current tool version, commercial use viability	L	H
	Japanese applicable tool version, commercial use viability	L	H
Economics	Delay in construction process	H	L
	Simple to use and interpret	L	H
	Cost effective in relation to time taken to do assessment	L	H
	Economic lever in relation to green building standards	H	H
Political	Appropriate to the social context of the building industry	L	H
	Concur with Japanese law and regulations	H	H
	Link into existing systems and procedures	L	H
	Gov. building performance monitor, inform policy making	H	H
Socio-cultural	Positive public profile encouraging use and demand	L	H
	Appropriate for team use, simple to understand	L	H
	Tools structure: practical, simple and flexible	L	H
	Adaptable to computer aided design programs	H	H

When comparatively assessing the tools in this way, it is possible to conclude that the CASBEE system rates well for Japanese common building environmental assessment in

the commercial environment while the GBTool rates highly for research and development of assessment tools. From the comparative assessment in Table 4.2, it can be seen that where the GBTool performance is rated with a high score, the CASBEE system predominantly has a low rating and visa versa. The GBTool high scores indicate that the tool is more suited to research and development of building assessment tools and not common use by professionals in the building environment. This is contrasted with the CASBEE system that performance indicates it is more suitable for commercial use, where a less comprehensive, simple, user-friendly tool is necessary to meet variable user needs and time constraints for assessments set by the market.

#### **4.5 CONCLUSIONS**

After Japan's customisation and testing of the GBTool between 1996 and 2002, the idea of implementing the tool as a national building environmental performance assessment system was rejected in favour of a condensed Japanese version of the tool with a re-conceptualised assessment framework suited to Japanese users, market requirements and national regulations. The Comprehensive Assessment System of Building Environmental Efficiency was designed with Japanese requirements being met where the GBTool was unsuitable because of its limitations for common practice use.

The Japanese assessment tool, CASBEE, appears not to have improved on the GBTool and GBC in terms of environmental assessment criteria, impact and protection. The CASBEE set of tools has been pragmatically focussed by the market and political considerations, and less idealistic than the GBTool. However the GBTool is closer to a building environmental assessment that comprehensively assess building environmental performance with the 'sustainable future' paradigm considered. The GBTool has been used for research and development of a commercial Japanese tool that is applicable for Japanese use.

An original intention of the GBC was that countries used the process and experience of their GBTool use to help them develop country appropriate tools. Japan achieved this by developing the CASBEE building environmental management system. In relation to the initial goals set out by the GBC process, the Japanese GBC process has been a success in Japan.

In terms of design features, the single GBTool assessment framework was limited for Japanese market requirements where little time is available for building environmental assessments because of clients demanding rapid completion of the building process. The CASBEE system is more viable under these competitive conditions, being made up of four condensed tools with targeted functions in the building process.

The assessment aspects included in the GBTool are comprehensive. In contrast, the Japanese chose to design the CASBEE system with far fewer assessment criteria. The Japanese system is therefore less detailed in what is included in assessments. The system does have core assessment criteria that check green building performance. As building environmental performance improves in Japan, so it is hoped will the standards set by the CASBEE system.

The significant difference between the GBTool and CASBEE is found in their assessment frameworks. The desire to assess buildings at different stages in building life cycles, by many different interested parties with different needs at market related prices is more compatible with a simple set of tools making up a building environmental assessment system.

The GBTool's single assessment framework was superseded by a set of tools for Japanese use that can be used together or individually. This suits the Japanese way of working in teams and the time constraints placed on assessors by the market pressures.

The GBTool assessment scale strongly influenced the Japanese scale, although the CASBEE is smaller and therefore leaving less room for scoring accuracy because the average score is in the centre of the scale, not the lower third as the GBTool.

The Japanese government and building industry wanted a building environmental assessment tool, but the practicalities of implementing the GBTool across Japan were seen as unrealistic because of its complexity and above all, the assessment framework's complexity and size for users to become familiar with. The greater the number of people using a system or tool seems to indicate that the simpler, more user-friendly and acceptable it needs to be. Therefore conceptually restructuring the GBTool assessment framework and designing simple condensed tools suitable for Japanese use was an answer to the desire and need for national building environmental assessment. One can conclude that flexibility and ease of use of a building assessment system to be implemented nationally for common usage is determinate in the system being effective and the GBTool did not meet these criteria for Japanese use.

A last conclusion related to the Japanese application of the Green Building Challenge is to note how powerful the Japanese consensus approach to decision-making is in bringing about successful implementation of an environmental management plan in a country of 126 million people. Team-based and consensus decision-making representing all affected sectors results in a plan that can enjoy wide support.

## ***CONCLUSIONS***

### **5.1 REQUIREMENTS FOR JAPANESE BUILDING ENVIRONMENTAL ASSESSMENT TOOLS**

The central problem in this research project was to study whether the GBTool is sufficiently flexible to be implemented as the preferred building environmental assessment method for Japan.

The GBTool has been seen to be relevant for Japanese implementation. Japan remains a member of the GBC International Framework Committee, which is central to decisions involved in the development and direction the GBTool takes. This therefore increases the relevance of the GBTool for Japanese use.

The GBTool was piloted between 1996 and 2002. Since 2000, there has been a significant change in the Japanese GBC leadership, with the increasing role of government in effective environmental management being seen as important. This indicates a significant national commitment to taking the GBC process beyond testing of the GBTool into the implementation stage.

During this phase the CASBEE system has been developed and tested in parallel with the GBTool. Although the CASBEE system is conceptually different in structure, it could be seen as an offshoot of the GBTool. The rapid development of this local tool has been facilitated by Japanese application of the GBTool. The success of the CASBEE process rests on the Japanese exposure to the GBC.

The GBTool has been customized to meet Japanese building environmental performance requirements. Since the GBTool's initial customisation and use, the teams have concluded that the GBTool is flexible and have modified it to suit the Japanese environment. They also noted that the tool is complex to use and needs a lot of data to produce assessment results. This research concludes that GBTool flexibility has been linked to the customisation of the GBTool assessment criteria. The difficulty the teams found in using the GBTool is related to the GBTool performance ability. The size of the tool impedes its extensive use in practice and therefore decreases its applicability.

The process of customisation during the six-year process moved from basic modification to suit Japanese environmental conditions to a more complex customisation linked to an acceptance of broader GBC goals. The customisation process became concerned with national laws and standards. An acceptance of international environmental standards indicates an acceptance of environmental responsibility within an international context. The Japanese GBC team also wanted to optimise assessment accuracy and include as much information in relation to assessment criteria in efforts to improve the environmental efficiency of buildings.

An early divide in the GBC team's attitude about the role of the GBTool in Japan emphasises the different attitudes towards building environmental assessment in Japan. Green building performance at national level became the focus, rather than only general building assessment.

In terms of the expectations of other countries, a tool focusing on green building performance, which addresses Japan's international responsibilities may seem adequate. However, detailed national or local building environmental responsibilities are variable. Designing or adapting a tool that can address these responsibilities is somewhat more complex.

The GBTool continues to be used in Japan. Although the GBTool is not going to be used commercially, it is central to the research, development and improvement of Japanese

building environmental assessment in general. The GBC gives researchers access to state of the art information and a platform for discussion and information sharing about building environmental assessment. National and local responsibilities could be dealt with at a local level of detail in more specific ways. This is the paradigm in which the CASBEE has been development, tested and is being implemented.

The follow up conference to the Sustainable Building 2002 Conference held in Oslo, Norway is to be held in Tokyo, Japan in 2005. The state of the Japanese built environment will be of interest to other countries, particularly since the Japanese government has put the CASBEE system in place for common use as part of the building process. This commitment to sustainable building research and to the development of practical and commercially viable building assessment tools makes the Japanese building industry one of interest, to be noted by other countries.

Returning to the central problem of this research, it can therefore be concluded that the GBTool is flexible enough to be used in Japan. For this reason the problem statement can be verified. However, although the GBTool may be preferable in terms of the comprehensiveness of its assessment criteria, it is not the preferred building assessment tool of choice and is not being commercially implemented for national use. The GBC process has led to the GBTool being superseded by the CASBEE system. The GBTool was superseded by the CASBEE system because the GBTool's adaptability was limited. The GBTool assessment criteria could be adapted to Japan but could not meet Japanese tool performance requirements.

The GBTool could not meet the Japanese need for a suite of tools, which need to be user friendly and able to be used broadly within industry. Therefore the limited flexibility of the GBTool in relation tool performance criteria means that the hypothesis can only partly be verified.

## **5.2 THE GBTOOL IN JAPAN – ITS USES AND LIMITATIONS**

The aim of this project has been to examine the process and use of the GBTool in Japan. The degree of its usefulness as a viable building environmental assessment tool for Japanese application has been the focus of the study. Further examination as to why a new assessment system has been nationally implemented rather than the GBTool has been undertaken.

The GBC process in Japan has moved environmentalism and building environmental management from the research stage to the applied field of the building industry. The application of the GBTool in a research context has led to the development and implementation of the CASBEE system, which is a direct offshoot of the GBTool.

As Japan is a consensus-based society, realizing sustainable construction through a continuous process of environmental management is becoming a reality. The use of building environmental assessment tools is central to the environmental management process within the building sector. Building environmental assessment is becoming standard practice in a country with a far-reaching environmental profile.

### **5.2.1 Project objectives revisited**

Several objectives were linked to the project's overall aim. Central building environmental issues such as energy and resource consumption that would need to be addressed by a building environmental assessment tool in the Japanese building industry have been identified. One can conclude that the GBTool as adapted by the Japanese GBC team adequately addresses these central environmental issues.

When establishing performance criteria for building environmental assessment tools in Japan, the research distinguished between two groups of criteria requirements. This distinction is central in understanding why the use of the GBTool has been limited to research in Japan and not commercial implementation.

The applicability of the GBTool has been determined by analysing the GBTool building performance criteria in conjunction with the GBTool's performance ability. This analysis has been done in relation to Japanese tool performance criteria determined during this research. In relation to problem issues in the built environment, that need to be dealt with during assessment, the GBTool is comprehensive and adequate.

However, in terms of the context in which assessment tools are actually used, in relation to its actual use by professionals in the competitive, fast track building process, the GBTool appears unsuitable. The particular nature of the Japanese building industry in terms of scale, construction turnaround time, and existing construction procedures add to this specific situation.

It can be said that commercial building environmental assessment in the Japanese building industry is expected to slot into the already established building process, systems, regulations and time constraints. The competencies of tool users, who include *Kenchikushi*, engineers, builders and clients, are varied. Therefore assessment tools should be relatively simple to use and interpret in the limited time available for assessment. The GBTool could not fulfil these criteria because of the large amount of data required for assessment and the complexity of actually using the tool. The size of the assessment framework makes it unrealistic for every day use.

The GBTool assessment framework is contained in a single tool consisting of a large and comprehensive array of assessment criteria. This is where the GBTool and the CASBEE system differ conceptually. This makes the CASBEE system the tool of choice for commercial nation wide use in Japan. As the CASBEE system is made up of a set of four tools for particular stages and specific purpose, mini- or sub-assessments can be achieved giving assessment results for different building phases. However, assessment results cannot be as comprehensive as the GBTool assessment results because fewer assessment criteria are used in the CASBEE system. Nonetheless, as core green building criteria are used, the most important green performance of buildings is assessed. This should then improve building environmental performance, fulfilling the objectives for a building

performance assessment tool. This fulfils Japan's international obligations to improve building environmental performance. The more limited CASBEE performance assessment tool evaluation process is financially viable for professionals and clients as part of the regular building process. As such it does not place an onerous burden on the building professionals who need to do the assessments.

The reduced number of assessment criteria in the CASBEE system compared to the GBTool, does mean that a less rigorous assessment result will be achieved. The benefit of the smaller system will make building assessment more viable as a part of common building practice.

Considering the number of stakeholders potentially affected by national regulatory building environmental assessment, the GBTool may have been seen as too stringent a tool to begin implementation with as opposed to the smaller tailor made CASBEE system. The CASBEE developers, including the GBC team and government, have designed the CASBEE system as an easier place to start for national building assessment.

Gaining public acceptance, the building industries acceptance and all the other stakeholders acceptance of a new assessment system may be more important to the implementation of a tougher system in the future, than starting off with difficulty, especially given political and pragmatic concerns. Therefore having the acceptance of a system may at first be more important than the degree of the tool's effectiveness. Tool effectiveness can gradually be increased as industry and stakeholders become accepting of the system and green building as standard practice.

Buildings that have assessment ratings, although in the short term more costly for clients, will be highly marketable as green buildings as opposed to non-green buildings. This would further encourage the use of assessments in common practice. It can therefore be concluded that, even though the GBTool is flexible enough to be customized to meet Japanese building performance criteria, it is at this point unsuitable for market requirements - at least in its present form because its assessment framework is somewhat

user-unfriendly. For this reason its use in Japan may be limited at present to the research environment and focused on facilitating discussions on questions of international comparability.

The use, customisation and limitations of the GBTool for Japan have been discussed. It has been shown that the GBTool was satisfactorily customized. Even so, a new Japanese assessment system has been preferred for national implementation.

Identifying similarities and differences between the GBTool and the CASBEE system added to the understanding of reasons why the GBTool is presently unsuitable for Japanese application. It also highlighted how building environmental assessment tools need to meet user requirements for implementation in a national context.

The final research question centres on whether assessment frameworks have an impact on the implementation value of building environmental assessment tools. A comparative assessment of the GBTool and CASBEE system has been undertaken. The purpose has been to compare the suitability of the tools for Japanese application, particularly in the commercial context. When analysing the assessment framework, a distinction has been made again between the assessment criteria and the tool performance ability (i.e. tool performance requirements). As already concluded, the assessment criteria of the GBTool have been adequately customized to meet Japanese context requirements. Limited tool performance ability in Japan has been a more decisive factor.

This research therefore concludes that the design of the tool's assessment framework is one of the main factors influencing the use and implementation value of an assessment tool. This holds even if the assessment criteria are applicable to the national context - as is the case with the Japanese adaptation of the GBTool. The Japanese GBTool in its present form has not adequately been able to address national priorities for an assessment tool in the implementation phase. Therefore the GBTool has been complemented by the CASBEE system developed from the GBTool.

However, one should keep in mind that the GBTool is a generic building environmental assessment tool. It is intended for international building performance comparability and national building assessment. Given this rationale, the GBC aims for the GBTool in Japan have been completely met. The GBTool has been a success in Japan in terms of its possible applications – international comparability and the development of nationally applicable assessment tool.

### **5.3 THE VALUE OF THE JAPANESE GBC PROCESS FOR OTHER COUNTRIES**

A final objective is to discuss the implications of the conclusions of this research for the further development of assessment tools in other countries. Having observed the GBC process in Japan, several conclusions have been made about the value of the local Japanese process.

The development of an assessment tool is a social process where technical development of the tool should not be the only focus of the process. Including as many parties as possible, who will be affected by the tool's implementation, at the development phase and during the decision making process increases the tool's acceptance when it is implemented at a national level. This process also brings environmentalism from the edge to the centre in public and professional perception, resulting in greater acceptance of building environmental management.

Consensus based decision-making facilitates implementation of a new assessment tool nationally, especially where the implementation process is likely to involve large groups of people. A high level of government involvement in the development process, as with the Japanese GBC facilitates successful implementation of a new national system across all sectors.

The degree to which a tool is user-friendly has a large impact on the implementation value of a tool. The size of the assessment framework has been seen to have a significant impact on this. A simple set of small assessment tools making up a comprehensive system as opposed to one large tool has been seen to be preferable to a greater variety of users in the Japanese context.

The implementation value of the tool is also affected by the degree to which a tool fits into already established building processes, laws, regulations and market requirements. The degree to which it keys into pre-existing local projects or agendas is also important. The use of a tool should not slow down the economic building process because its use in the commercial building environment will consequently be limited.

Through a strategic implementation process using a simple assessment system in the first national implementation phase, as seen in the Japanese example, could ensure political success of improving building performance. This would be through pragmatic limitations of initial goals to create and implement comprehensive green building tools and sustainable building assessment systems. The introduction of a building environmental assessment system to the building industry with a user-friendly system even though it is not comprehensive in assessment criteria, at least will ensure effective use of the new assessment system. As the market becomes accustomed to the system as a normal part of the building process, so the performance standards can be increased.

A possible shortfall of an assessment system fitting smoothly into existing economic and building processes, for example the CASBEE system, is that possible margins for improvement of building performance could be limited. The use of the CASBEE tool could raise building environmental performance. However, because one needs to do this without disrupting already established patterns of behaviour in the building industry, the tool may not be effective in substantially raising building environmental performance on a large scale.

Therefore, the advantage of the commercial CASBEE system maintaining a strong link with the GBC research is that the commercial assessment tool can be continually updated and improved. This method of having a commercially viable assessment system with a comprehensive assessment system such as the GBTool as a constant shadow, will keep commercial building environmental assessment tools close to the forefront of research through forums such as the international GBC.

The GBTool has been identified as a comprehensive green building performance assessment tool. It has been successfully customized to suite Japanese environment requirements, standards and laws. Different countries worldwide are developing ways to implement the assessment criteria for their own particular requirements. From the Japanese experience it also seems clear that countries should establish appropriate performance criteria for the use and implementation of a building performance assessment system, so as to facilitate their actual use.

Each country needs to develop its own locally applicable assessment framework that is acceptable to local users and fits into established building processes so that building assessment becomes a part of common commercial building practice at a local level.

# APPENDIX 1

## DETAILS OF CORRESPONDENCE

### Shoichi ANDO, Dr.

Director for Development Coordination, Building Land Division, General Policy Bureau, Japanese Ministry of Land, Infrastructure and Transport (MLIT).

#### 1. Key issues discussed

*Questionnaire A* (Appendix 2) - 15 / 05 / 2001

- Key issues of sustainability in Japan.
- Developing building environmental assessment tools in Japan.
- Environmental issues in Japan that building environmental assessment tools need to address.
- The use of building environmental assessment tools in Japan.
- The benefits to Japan of being involved in the GBC.
- What the international community could gain by Japan's involvement in the GBC.

*Questionnaire B* (Appendix 3) - 25 / 04 / 2002

- Comparisons between the advantages and disadvantages of GBTool and the CASBEE system in relation to use, user requirements, political, policy and market requirements in Japan.

#### 2. Details of e-mail correspondence

- 15 / 05 / 2001 - Answers to Questionnaire A.
- 19 / 04 / 2002 - Confirmation about completion of Questionnaire B, CASBEE document.
- 25 / 04 / 2002 - Answers to Questionnaire B.

### Kazuo IWAMURA, Prof.

Architect: Iwamura Atelier

President: Japan Institute of Architects

Professor: Musashi Institute of Technology, Faculty of Environmental & Information Studies

Lecturer: Chiba University & Waseda University, Japan.

#### 1. Key issues discussed

- Government Housing Loan
- Symbiotic Housing Project
- Technician nature of the Green Building Challenge and GBTool.
- Education and the gap between commercial architectural practice and green architecture.
- What the role of architects is in this context.

#### 2. Details of interview

- 18 / 04 / 2001, 11h00 – 13h00.
- Interview was held at Iwamura Atelier in Tokyo.
- Prof Iwamura offered pertinent documents on his work on Symbiotic Housing in Tokyo (which was visited) and the Architecture of the Future Conference.

**Hiroto IZUMI**

Director for Housing Development Division, Housing Bureau, Japanese Ministry of Land, Infrastructure and Transport.

**1. Key issues discussed**

- Green Building Challenge
- Japanese policies in the construction industry.
- Kyoto protocol and the Japanese governments desire to act responsibly to reduce GHG.
- Green Tax under discussion in parliament at the time of the interview.
- Japanese waste disposal area crisis and research into recycling.
- Basic Environment Plan.
- The short life span of housing in Japan compared to the USA and UK.
- The burst of the Bubble Economy and its effect on the value of property and land.
- Environmental check for houses that began in 1998.

**2. Details of interview**

- 19 / 04 / 2001, 11h00 – 12h00.
- Interview was held at the Housing Bureau, Ministry of Land, Infrastructure and Transport in Tokyo.

**3. Details of e-mail correspondence**

- 19 / 04 / 2002 Agreement to complete Questionnaire B with Dr. ANDO of the MLIT.

**Nobuyuki KIMATA**

At the time of interview, Kajima Corporation.

Currently, Professor: Faculty of Environmental Studies, Tottori University.

**1. Key issues discussed**

- Conflict of interests between the GBC '98 teams.
- Basic GBTool framework for GBC 2000 has remained unchanged since 1998.
- New assessment criteria added to the GBTool for GBC 2000.
- Customisation of the GBTool between 1996 and 2000.
- The problem of the GBTool's weighting system for international comparison.
- GBTool not able to satisfy sustainability issues, as it is an assessment system.
- Combining 'Factor 10' of the World Business Council for Sustainable Development with the GBTool to improve its ability to assess sustainability.
- GBTool as a communication tool between nations.
- The importance for the need for national consensus to define 'level 5' which is the highest rating on the GBTool (close to green and finally sustainable building), and recognize 'level 0' so that assessment results are internationally consistent.

**2. Details of interview**

- 27 / 03 / 2001, 16h00 – 17h00.
- Interview was held at the Kajima Corporation head offices in Tokyo.

**Tatsuo OKA, Dr.**

Professor: Utsonomiya University, Department of Architecture  
 Primary contact for Japan GBC team

**1. Key issues discussed**

*Questionnaire A* (Appendix 2) - ? / ? / 2001

- Key issues of sustainability in Japan.
- The Japanese GBC Team.

**2. Details of meeting**

- 20 / 04 / 2001, 11h00 – 13h00.
- Presentation meeting was held at the Institute of Building Energy and Environment Research in Tokyo.
- Presentation of a specially written paper on “*A comparison of South African and Japanese sustainability priorities in the construction industry*” to the Japan national GBC Team at the Institute of Building Energy Environmental Conservation

**3. Details of e-mail correspondence**

- June 2001 - Answers to Questionnaire A.

**Tomanari YASHIRO, Dr.Eng.**

Associate Professor: Institute of Industrial Science, University of Tokyo.

**1. Key issues discussed**

- The issue of sustainable building in Japan.
- Development of building environmental assessment tools in Japan.
- Different Green Building guidelines in Japan.
- Environmental Symbiotic Housing Forum.
- Environmental Symbiosis: *Kyankyosei*.
- Eastern equivalent to sustainability.
- Government Housing Loan Corporation.
- Environmental Management System Consortium and ISO 14001 Certification.
- No overarching group or consensus position on sustainable building in Japan.

**2. Details of interview**

- 27 / 03 / 2001, 14h00 – 15h00.
- Interview was held at Dr. Yashiro's office, Komba Research Campus, University of Tokyo.

## ***APPENDIX 2***

### **QUESTIONNAIRE A**

1. How is sustainability defined in Japan? What are the key issues?
2. How would you create a building environmental assessment tool that is applicable internationally, nationally and locally?
3. What are the key socio-political, economic and environmental issues affecting the construction industry in Japan for the 21<sup>st</sup> century?
4. What are the main initiatives towards sustainable construction and improving building performance in Japan?
5. What are the special issues in Japanese society that initiatives towards sustainable construction must address?
6. What are the special issues in Japan's building industry that initiatives towards sustainable construction must address?
7. (Error in original questionnaire, no question asked)
8. What are the special issues in Japan's building industry that a building environmental assessment tool needs to address?
9. What uniquely Japanese characteristics impact on the building industry in Japan?
10. What design factors need to go into a building environmental assessment tool to make it applicable to Japan?

11. What building environmental assessment and management methods has Japan developed?
12. What are the major environmental issues in Japan that a building environmental assessment tool needs to address?
13. How are building environmental assessment tools used in the Japanese building-industry?
14. Who uses building environmental assessment tools in the Japanese building-industry?
15. What factors limit the use of building environmental assessment tools in Japan?
16. How can the use of building environmental assessment tools be optimised in Japan?
17. What systems are in place in your field of work, which are used for environmental management and assessment?
18. Who are the major stakeholders in your field of work affecting moves towards sustainable development?
19. How could Japan benefit by being involved with an international building environmental assessment project?
20. What would Japan gain from an international project such as the Green Building Challenge?

21. What could the international building community gain by Japan's involvement in an international building environmental assessment project such as the Green Building Challenge?
22. What knowledge and environmental resources can Japan share with the international community?
23. How can Japan assist other countries with building environmental assessment methods?
24. How can Japan assist developing countries with building environmental assessment methods?
25. What Japanese environmental assessment resources could be useful to developing countries?

## ***APPENDIX 3***

### **QUESTIONNAIRE B**

1. Was it possible to modify the Green Building Tool (GBTool) to suite Japanese building environmental and cultural issues?
2. Why did Japan decide to design the Comprehensive System of Building Environmental Efficiency (CASBEE-J) instead of using the modified GBTool?
3. What are the advantages for Japan of CASBEE-J and the disadvantages of the GBTool?
4. What are the main differences between CASBEE-J and the GBTool in terms of
  - (a) assessment criteria
  - (b) tool performance requirements?
5. Is the GBC process and GBTool still useful to Japan? If so, how?
6. What are the political /policy requirements for a building environmental performance assessment tool in Japan?
7. What are the market requirements for a building environmental performance assessment tool in Japan?
8. How will CASBEE-J meet both political /policy and market requirements?
9. Why does CASBEE-J consist of three tools and not one tool, like the GBTool?

## APPENDIX 4

### QUESTIONNAIRE A: JAPANESE VERSION

ケープタウン大学  
環境地理科学学科

#### 環境アセスメントツールについてのアンケート

この研究は、日本における環境アセスメントツールを調査するもので、南アフリカ共和国における sustainable construction (環境維持建設) を研究するために、同国の建設経済経営省・環境地理科学省によって行なわれている研究プロジェクトの一部です。

このアンケートは日本の建設業界における sustainable development (環境維持発展) と日本の建築環境アセスメントツールを調べることを目的としています。

この研究は、日本がグリーン・ビルディング・チャレンジにどのように関わってきたのか、またグリーン・ビルディング・ツール (GB Tool) をどのように利用してきたかを把握することを目的としています。グリーン・ビルディング・ツール (GB Tool) を利用する際に日本が経験したことから南アフリカ共和国が学びたいと思うからです。

このレポートによって得られた情報は、ケープタウン大学によって収集されている南アフリカ共和国が応用可能な sustainable construction (環境維持建設) と建築環境アセスメント方式についての研究に使用されます。

みなさんからいただいた回答は、この研究プロジェクトのためにのみ用いられ、他で今回のコンテキスト (文脈) をつけずに引用されることはありません。もし、回答されることに不都合がある場合には、回答なさらなくとも結構です。

一般的な質問

回答日

回答者氏名

匿名でも結構です。

回答者職業

以下の質問に ( ) から詳しく教えてください。

- 1 日本において sustainable (持続可能性) はどのように定義されていますか。重要課題は何ですか。
- 2 国際的にも、国内でも、地域内でも適用できる建築環境アセスメントツールをどのようにすれば作成できるとお考えですか。
- 3 社会的、政治的な観点・経済的な観点・環境の面で、どんなことが21世紀の日本の

建設業界に影響を与える重要課題ですか。

- 4 日本国内では sustainable construction(環境維持建設)と建築パフォーマンスの改善を目指した主なプロジェクトにはどんなものがありますか。
- 5 sustainable construction(環境維持建設)を目指した主なプロジェクトが考慮にいれねばならない日本の社会特有の課題とは何ですか。
- 6 sustainable construction(環境維持建設)を目指した主なプロジェクトが考慮にいれねばならない日本の建築業界特有の課題とは何ですか。
- 7 建築環境アセスメントツールが考慮にいれねばならない日本の建築業界特有の課題とは何ですか。
- 8 日本の建築業界に影響を与えている日本の特徴とは何ですか。
- 9 建築環境アセスメントツールを日本で適用できるようにするためにデザイン面での要因で考慮に入れられねばならないことは何ですか。
- 10 日本ではどのような建築環境アセスメントと環境管理の方法が発達してきましたか  
(移り変わりやどのようなものを中心になってきたかということなど)
- 11 建築環境アセスメントツールが考慮に入れなければならない日本の主要な環境課題にはどんなものがありますか。
- 12 日本の建築業界において 建築環境アセスメントツールはどの様に使われていますか。
- 13 日本の建築業界では建築環境アセスメントツールを利用するのは誰ですか。  
設計者、土木技師、業者、業界
- 14 日本において建築環境アセスメントツールの利用を制限する要因にはどんなものがありますか。
- 15 どうすれば日本において建築環境アセスメントツールが有効につかわれますか。
- 16 あなたの仕事の分野では、環境管理と環境アセスメントを目的に使われるものとしてはどのシステムが適切ですか。  
(例：環境法、ISO14000、建築規制、優遇税制)

- 17 あなたの仕事の分野ではだれが sustainable development(環境維持発展)に移行するための有力なメンバーとしての役割を果たしていますか。
- 18 国際的な建築環境アセスメントのプロジェクトに関わることによって日本はどんな利益を得ますか。
- 19 日本は Green Building Challenge のような国際的な環境プロジェクトから何を得ますか。
- 20 日本が Green Building Challenge のような国際的な環境プロジェクトに関わることによって国際建設業界が得ることができるものは何ですか。
- 21 国際建設業界に日本が貢献できる知識や環境資源にはどんなものがありますか。
- 22 諸外国が環境アセスメントの評価方法を作る上で日本はどのように援助できますか。
- 23 発展途上国が環境アセスメントの評価方法を作るうえで日本はどのように援助することができますか。
- 24 日本がこれまで行ってきた環境アセスメントの蓄積のうちで発展途上国に有益なものにはどんなものがあるでしょうか。

私は、建設業界の sustainable development(環境維持発展) や日本の環境アセスメントツールについての出版物をぜひ手に入れたいと思っています。私の研究に関係のある皆さんの研究や、参照文献や、皆さんが見たことのある関係印刷物の手に入れ方等教えていただければ幸いです。また、日本でこの分野の研究に関わっておられる団体や個人の方との連絡を切に望んでいます。

このアンケートのためにお時間を割いていただきまして本当に有り難うございました。ご提案・コメントがおありの場合は、下記の所へお願いします。

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## ***ABBREVIATIONS AND ACRONYMS***

AIJ	Architectural Institute of Japan
BCS	Building Contractors Society (Japan)
BEE	Building Environmental Efficiency
BEPAC	Building Environmental Performance Assessment Criteria
BREEAM	Building Research Establishment Environmental Assessment Method (United Kingdom)
CANMET	Energy Technology Centre (Ottawa, Canada)
CASBEE	Comprehensive Assessment System of Building Environmental Efficiency (Japan)
COP3	Third Conference of Parties (linked to the Kyoto Protocol)
DfE	Design for Environment Tool
ESI	Environmental Sustainability Indicators
GBC	Green Building Challenge
GBTool	Green Building Tool
GHG	Green House Gas
GHLC	Government Housing Loan Corporation (Japan)
IBEC	Institute of Building Energy and Environmental Conservation (Japan)
IEA	International Energy Agency
ISO	International Organisation for Standardisation
LEED	Leadership in Energy and Environmental Design (USA)
LCA	Life Cycle Assessment
MOC	Ministry of Construction (Japan)
MLIT	Ministry of Land Infrastructure and Transport (Japan)
OECD	Organization for Economic Co-operation and Development
Q	Questionnaire
UNFCCC	United Nations Framework Convention on Climate Change (linked to the Kyoto Protocol)

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