Rapid assessment checklist for sustainable buildings

Article *in* Building Research and Information · July 2006

DOI: 10.1080/09613210600764455

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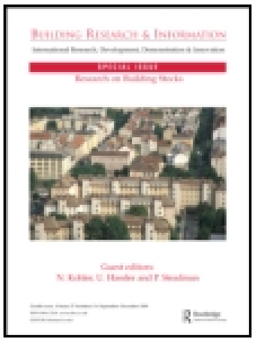

Building Research & Information

ISSN: 0961-3218 (Print) 1466-4321 (Online) Journal homepage: http://www.tandfonline.com/loi/rbri20

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To cite this article: Bill Gething & Bill Bordass (2006) Rapid assessment checklist for sustainable buildings, Building Research & Information, 34:4, 416-426, DOI: 10.1080/09613210600764455

To link to this article: https://doi.org/10.1080/09613210600764455

Published online: 03 Feb 2007.

Routledge
Taylor & Francis Group

Rapid assessment checklist for sustainable buildings

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The development of a checklist used for judging the 2005 Royal Institute of British Architects (RIBA) Sustainability Award is described. A quick, simple, robust and fair approach was required. The checklist drew upon an existing practice-based method that had been developed to assist a dialogue between design team members and their clients – first setting priorities and targets for sustainability and then assisting later reviews and progress reports. The topics covered were extended by the findings of a review of available sustainability assessment methods, and organized broadly in accordance with the sequence of work in an architectural project – from site selection to building in use. Although not objectively calibrated, the checklist allows levels of aspiration and achievement to be identified, reports quickly and concisely, and permits comparisons between buildings of very different types. The checklist not only helped with judging the award, but also attracted favourable comments from users and others. The approach may therefore have wider applications in providing a simple introduction to sustainability assessment, which can then lead into more precise quantification if and where required.

Keywords: assessment, awards, checklist, grading, priorities, sustainability, targets

Cet article décrit l'élaboration d'une liste de contrôle utilisée pour évaluer le Sustainability Award 2005 accordé par le Royal Institute of British Architects (RIBA) de 2005 et qui récompense les travaux les plus écologiques. Il fallait, à cet effet, avoir recours à une méthode rapide, simple, fiable et équitable. Cette liste s'appuie sur une méthode existante basée sur la pratique, qui a été mise au point pour faciliter le dialogue entre les membres d'une équipe de conception et leur client en définissant, tout d'abord, les priorités et les cibles relatives à la durabilité puis en contribuant, plus tard, à la rédaction des revues et des rapports d'avancement. Les sujets couverts ont été élargis en prenant en compte les résultats d'une revue des méthodes d'évaluation de la durabilité actuellement disponibles et ont été organisés, en grande partie, selon la séquence de déroulement d'un projet d'architecture, depuis le choix du site jusqu'à la mise en service opérationnelle du bâtiment. Cette liste de contrôle, bien qu'elle ne soit pas étalonnée du point de vue objectif, permet de recenser des niveaux d'attente et de réalisation, d'élaborer rapidement des rapports concis et de comparer des bâtiments de types très différents. Cette liste a non seulement aidé à évaluer la Sustainability Award mais a également suscité des commentaires favorables de la part des utilisateurs et d'autres. Cette méthode peut donc trouver des applications plus larges en proposant une simple introduction à l'évaluation de la durabilité, ce qui peut ensuite conduire à une quantification plus précise lorsqu'elle nécessaire.

Mots clés: évaluation, récompenses (awards), liste de contrôle, classement, priorités, durabilité, objectifs.

Introduction

In December 2003, the Edge,[1] a UK multi-professional group concerned with the built environment, held a debate entitled 'The Tipping Point' to explore how to accelerate interest in and uptake of more sustainable buildings with lower carbon dioxide (CO_2) emissions.

Building Research & Information ISSN 0961-3218 print/ISSN 1466-4321 online
http://www.tandf.co.uk/journals
DOI: 10.1080/09613210600764455

At the debate, concern was expressed that one barrier to uptake by clients was the lack of credibility of many 'green' claims, as discussed for energy by the New Buildings Institute (2003) and by Bordass *et al.* (2004). A need was identified for simple, clear, quick and, if possible, consistent indication of sustainability and energy performance in publications and competitions. In 2004, this was discussed with editors and competition organizers, who were supportive but requested a method they could use. Funding was then obtained from the Carbon Trust for a scoping study into one aspect – a standard approach to a Voluntary Energy and CO_2 Declaration (VECD) on operational energy performance, which might also assist the UK's implementation of the European Parliament's (2003) Energy Performance of Buildings Directive.

Following the scoping study, individual Edge members contributed towards taking things forward, developing a prototype VECD and testing it on candidates for a design competition. The Royal Institute of British Architects (RIBA) was approached regarding the RIBA Sustainability Award 2005, and kindly accepted. In the event, the Awards process also became an opportunity to develop and test the proposed sustainability indicator. The judging panel, which included the authors, was faced with a longlist of diverse projects, including a new public library, new and refurbished individual private houses, school buildings, an adventure playground, and an agricultural building adapted into an office and meeting rooms. The schemes had been selected from those that had already reached the shortlist for regional and national RIBA awards on the basis of their architectural quality. However, they had not been subject to any consistent sustainability assessment; and the information that accompanied the competition entries was very variable in its coverage. It was immediately clear that the emphasis on different aspects of sustainability differed widely across the projects; and there was no out-and-out winner that pushed the boundaries of sustainability in all respects.

How could the projects be assessed systematically, yet relatively quickly and cheaply? As the definitions of sustainability widen, the assessment of buildings has tended to become increasingly complicated and detailed. The methodologies often used to assess architectural projects (e.g. BREEAM, LEED, SPEAR, and GBTool) all aim to be robust, quality-assured systems that attempt to quantify the often unquantifiable. Consequently, they all require significant amounts of information in order to arrive at an assessment. Many are also commercial products in that they need paying for. Most also tend to be designed and calibrated to suit specific sectors, making comparisons between a diverse range of buildings difficult; and rendering the benefits of detailed analysis somewhat questionable.

In any event, there was not enough time to require all the projects to be assessed formally, the RIBA had no budget for it, and entrants would have been likely to balk at the associated costs – not just the fees for assessment, but the time it would take the design and building teams to assemble the information required. The judges therefore decided to develop a rapid but structured approach to compare the merits of the projects across an agreed set of topics and obtain a picture of their relative levels of achievement. This would also be a possible prototype of the sustainability indicator that had been advocated at the Edge debate.

The approach made use of previous experience of the firm of one of the authors (W. G.) in developing a sustainability matrix to assist in the management of their architectural projects, and of the other (W. B.) in working on Green Building Challenge (GBC) (Curwell *et al.*, 1999) and in comparing a variety of sustainability assessment systems for a client.

The sustainability matrix

On their National Trust headquarters project (which was nearing completion at the time), Feilden Clegg Bradley Architects (with Max Fordham and Partners, Adams Kara Taylor, Grant Associates and Davis Langdon) had developed a sustainability 'Matrix' that seemed a useful starting point. While this building had been procured under a develop and leaseback arrangement, and constructed to strict institutional and financial constraints, sustainability was a fundamental element of The National Trust's brief, with requirements for 'an environmentally benign and financially efficient building' that was 'frugal, appropriate and inspiring'.

The National Trust project did in fact have a formal BREEAM[2] assessment and achieved an Excellent rating. However, the Matrix proved extremely useful in the early stages of the project to focus the discussion of sustainability related topics with the client and to tie down a manageable agenda with agreed levels of aspiration. As the design developed – both before and after the BREEAM assessment – the Matrix became a valuable management tool: focusing team discussions, recording progress and structuring reports to the client on progress with the sustainability aspects of the project.

Not surprisingly, the topics covered in the Matrix drew heavily on the standard BREEAM criteria, which were to be used in the formal assessment. However, because the site had already been selected, the Matrix used in The National Trust project concentrated on design and management issues, and simplified the full list of BREEAM criteria into those that the design team and the client still had control over, in particular the following:

- operational energy consumption and CO_2 emissions
- materials used in the construction process
- water and waste systems
- landscape and biodiversity
- transportation
- management and monitoring

Each section was further broken down into items for which specific targets were developed against four levels of aspiration: Good Practice, Best Practice, Innovative and Pioneering. For each item, Good Practice targets could often be selected from the literature or agreed using past experience, whilst setting stretching but not impossible Pioneering levels established the range of what might be possible. The intermediate targets could then be set relatively simply. For example, Figure 1 shows the section of the Matrix that dealt with energy and CO_2. Here the Good Practice target for CO_2 emissions (using UK standard factors) was set at 40 kg CO_2/m^2 per annum (Action Energy, 2003), the Pioneering target at zero carbon, with intermediate targets for the Best Practice and Innovative levels.

For client and team reporting, cells of the Matrix were coloured in (shown lightly shaded in Figure 1) to confirm that the measures required to achieve the specific targets were already included in the design and cost plan at the time. This provided an easily assimilable, graphic representation of the level of achievement being aimed for under each heading. Items not yet included in the design but which the client and the team felt might merit an innovative or even a pioneering approach were highlighted in red (shown with a heavy boundary in Figure 1). Before deciding whether and at what level they might be adopted, these red elements were investigated in more detail in terms of practicality, financial and carbon payback, and the availability of grant aid. The technique ensured that all the bases were being covered evenly, on this project mostly to a Best Practice level. It highlighted the options for innovation, while at the same time making sure that the pursuit of opportunities in one area did not unreasonably disturb the balance across the whole range of other issues.

	1. GOOD PRACTICE	2. BEST PRACTICE	3. INNOVATIVE	4. PIONEERING	NOTES
1. CO_2 Emission Target	40kgCO₂/m²/yr	30kgCO₂/m²/yr	15kgCO₂/m²/yr	"Carbon neutral" 0kgCO₂/m²	Industry standard EEO targets
2. Heating Load Target	79kWh/m²/yr	47kWh/m²/yr	30kWh/m²/yr	20kWh/m²/yr	Industry standard EEO targets
3. Electrical Load Target	54kWh/m²/yr	43kWh/m²/yr	35kWh/m²/yr	25kWh/m²/yr	Industry standard EEO targets
4. U Values: Wall Average Window Roof Ground Floor	0.35 2.2 0.2 0.25	0.25 1.8 0.18 0.22	0.2 1.4 0.15 0.2	0.1 0.9 0.1 0.1	good practice=current building regulations pioneering=Bedzed values
5. Airtightness	<10m³/hr/m²	<8m³/hr/m²	<5m³/hr/m²	<3m³/hr/m²	All measures require careful attention to details and monitoring construction.
6. Ventilation	Natural ventilation where possible. Mechanical ventilation where not.	Designed natural ventilation with automatic openers, mechanical ventilation to WCs etc.	Mechanical ventilation with heat reclaim in winter and BMS controlled natural ventilation in summer.		BMS with manual overrides preferable on all windows.
7. On Site Energy Generation		Solar domestic water heating to WCs.	Solar domestic water heating to WC cores. Cost effective PV installation using PVs to shade rooflights. Gas fired CHP installation.	Solar water heating to kitchens. Maximum PV installation using most efficient PVs. Wood/waste fired CHP.	Potential 50% grant available from DTI for solar water heating, up to 65% for PV installation.
8. Daylighting	"Reasonable" to BS8206 part 2. A2% daylight factor.	80% office space daylit to meet criteria of BS8206: part 2.	100% of office space daylit to BS8206 part 2		Ensure prevention of solar heat gain/glare by building form/shading systems
9. Artificial Lighting Controls	PIR detectors in WCs etc. Low energy fittings throughout.	Luminance and presence detectors throughout building. No dimming.	Luminance and presence detection at all fittings with dimming to zero and BMS override.		Personalised controls strongly recommended by the client
10. Cooling Systems/Sources	Zero ozone depletion refrigerants in high efficiency comfort cooling/air conditioning systems.	Night time structural cooling with automatic window vents.	Evaporative cooling to rooms with high internal heat gains.	Borehole/ground water cooling to rooms with high internal heat gains.	Need to provide for areas where cooling is required and provide upgrade path for entire building.
11. Embodied Energy in Structural Materials	Steel and concrete frame engineered to minimise mass of materials.	Use of cement replacements e.g. GGBFS in concrete. Use recycled steel.	Timber structure in lieu of steel or concrete but retaining concrete floors. Use of recycled aggregates in structural concrete.	All timber structure with thermal mass provided using minimum amount of concrete.	NB. Client is particularly keen on use of timber for low embodied energy

Figure 1 Section of the sustainability Matrix for the National Trust building devoted to energy and CO_2

Adapting the sustainability matrix for the award

To help with judging the candidates for the Award, the Matrix was adapted in three main ways:

- The number of topics was increased (there are currently 53) to take account of the results of the comparative analysis of other sustainability assessment systems. However, the topics on the Award Checklist were usually more general in nature than the items in the Matrix. For example, the Matrix for The National Trust included 11 items on building energy use and CO_2 emissions (Figure 1), while the Checklist had only three.

- The topics were collected into nine main groups of between four and nine items each (Figure 2). To suit the purposes of the RIBA Sustainability Award (which is given to architects of recently completed buildings), the grouping chosen was not so much the normal one of technical issues (ecology, energy, water, materials, transport, pollution, etc.) as used in the Matrix, but more related to the order of decision-making in an architectural project: starting with strategic aspects of the site, then how the land was used, what the building was like, of what it was made, how it was likely to work, its likely impact on its occupants and the environment, how it was actually built, and how it was performing in use – in as far as this could be discerned during a building's first few months in operation.

- The levels of performance were extended downwards to include 'Below standard' and 'Standard' (e.g. UK Building Regulations 2002) in addition to 'Good Practice' (e.g. BREEAM Very Good), 'Best Practice' (e.g. BREEAM Excellent), 'Innovative' (Rare) and 'Pioneering' (Exceptional). This recognized that not all buildings could excel in all respects. For example, the selection and location of the site might be questionable, but an inevitable part of the client requirements and often outside the control of the architect anyway. In addition, for many reasons the actual outcomes may not always live up to the design aspirations.

Surprisingly, perhaps, architectural design quality was not one of the criteria. This was because all buildings reaching the longlist for the Sustainability Award had already been assessed by other judges for their architectural merits.

CONTEXT

1	**Choice of site**
1.1	Refurbishment, brownfield, greenfield
1.2	Proximity to public facilities and services
1.3	Transport policy, proximity to public transport
1.4	Proximity to housing and/or employment
1.5	Robustness against impacts of change (e.g. flooding)

DESIGN CHOICES

2	**Use of site**
2.1	Ecological quality of site
2.2	Use of land
2.3	Biodiversity
2.4	Community integration
2.5	Infrastructure enhancement
3	**Building form**
3.1	Location of building on site
3.2	Re-use of existing buildings
3.3	External environmental impact (visual, noise, microclimate)
3.4	Adaptability potential
4	**Use of materials**
4.1	Selection for low environmental impact
4.2	Potential for re-use and recycling
4.3	Good thermal performance
4.4	Low embodied energy and pollution
4.5	Low toxicity

OUTCOMES *(design predictions, replace by actual when in use)*

5	**Functionality**
5.1	Controls, controllability and manageability
5.2	Provision for maintenance
5.3	Provision for waste management
5.4	Resistance to climate change impacts
5.5	Durability
6	**Indoor environment**
6.1	Acoustic
6.2	Air quality
6.3	Lighting
6.4	Thermal
6.5	Spatial
7	**Energy, CO_2 & utilities**
7.1	Energy efficiency
7.2	On-site CHP and renewable energy
7.3	**Emissions to atmosphere (principally CO_2)**
7.4	Water
7.5	Liquid wastes: avoidance, drainage systems, water treatment
7.6	Solid wastes, waste management

DESIGN AND CONSTRUCTION PROCESS

8	**Construction & handover**
8.1	Briefing and design reviews
8.2	Considerate constructor
8.3	Environmental impact of operations on site
8.4	Environmental impact of transport to site
8.5	Sourcing of materials, components and labour
8.6	Waste minimisation during construction
8.7	Fitout
8.8	Commissioning, handover, training, soft landings
8.9	Incorporating post-occupancy evaluation and feedback

ACHIEVED PERFORMANCE *(if information is available)*

9	**Performance in use**
9.1	Impact on local environment community, townscape, transport etc.)
9.2	Fitness for purpose
9.3	Appropriateness of space
9.4	Appropriateness of fitout
9.5	Usability and manageabiilty *(update Section 5)*
9.6	Indoor environmental quality *(update Section 6)*
9.7	Occupant satisfaction
9.8	Use of energy and utilities *(update Section 7)*
9.9	Quality of building and facilities management

Figure 2 The nine main groupings and the individual topics within them

Piloting the assessment Checklist

Prototype versions of the Checklist were tested by the authors and colleagues on buildings known to them, on the longlisted buildings, and finally in discussion with the architect of one of the shortlisted buildings. This led to minor modifications in topics and wording, and a rather surprising change to the grading system. In practice, people found it difficult to assign a topic unambiguously to one the six grades (from 'Below standard' to 'Pioneering'), and wanted to tick the borderline between the two. The authors, therefore, introduced formal 'borderline' categories between each grade (see Figure 3, the top left part of the Checklist form). This made total of 11 separate levels of performance, which might well be thought to be an unreasonable and unnecessary increase in the complexity of the grading of what was supposed to be a simple system. In fact, the alteration helped hugely: people could fill in the forms much more quickly by not having to agonize about on which side of a grade boundary each aspect of their building fell. The finer level of resolution also helped in practical terms when scoring projects.

Judging process

The judging process was composed of six main steps:

- Judges assessed each project on the longlist independently using the information submitted and a preliminary version of the Checklist.

- The assessments were then compared and a shortlist of the four most promising buildings was drawn up. Further information was also sought from the designers of two other buildings, about which less data had been submitted initially.

- The shortlisted design teams were approached for further information, particularly on energy and CO_2 targets and performance in use, as discussed further below. The design teams were also sent a blank copy of the Checklist, making clear that it was a prototype in the process of development and that they should not only use it to score their buildings. They were also invited to comment on the Checklist itself.

- Design team self-assessments were compared with the judges' assessments. For most items it was surprising the degree to which the two corresponded; although the more experienced teams tended to be harder on themselves than teams with a shorter track record in sustainable projects. For a few topics, however, the ratings could sometimes be very different. Discussions revealed that items the architect judged to be much better were usually related to things that had happened during the design and construction process but which were not visible in the completed building and had not been pointed out in the submissions. Example included the sourcing of materials; lengthy battles with the authorities to achieve some sustainability objective; or the research undertaken behind a feature which looked obvious in hindsight. The occasional low judgement by the architects also revealed areas of disappointment, for example a construction process that had not been as thoughtful as had been anticipated.

- Following visits to the most promising buildings, the checklists were reviewed project by project.

- A final moderation was carried out using a summary spreadsheet that set the scores (-1 for Substandard, 0 for Standard, through to 4 for Pioneering) for each topic for each shortlisted building side by side. Where in the individual Checklists the judges had awarded a different score to two buildings but in the moderation exercise they proved unable to justify the difference, the scores were made equal.

Graphic presentation

A competition might want to reward the best all-rounder. Alternatively, it might wish to celebrate excellence in one particular area, in spite perhaps of some under-performance elsewhere. To make this distinction visible, a Microsoft Excel workbook used

How would you rate your building and site? *Please put a tick or a comment in one box in each row. If there is independent verification, please put a tick in the boxes to the right, or enter the source (e.g. BREEAM). Please add comments or append material if you want to.*	Below standard	Borderline	Standard	Borderline	Good practice	Borderline	Best practice	Borderline	Innovative	Borderline	Pioneering
Name *Building name goes here*	*e.g. Poor location*		*e.g. Building Regs 2002*		*e.g. BREEAM very good*		*e.g. BREEAM excellent*		*Rare*		*Exceptional*

CONTEXT

1	**Choice of site**	*please put a tick (or a 1 if using Excel) in only one box in each row below*										
1.1	Refurbishment, brownfield, greenfield											
1.2	Proximity to public facilities and services											
1.3	Transport policy, proximity to public transport											

Figure 3 Extract from the checklist showing the 11-point scale

to collect and summarize the data (which could also be hand-written on a printout) produced a simple summary graphic automatically, which in each of the nine categories showed both the average score for the category (the black parts of bars in a histogram) and the highest score for any topic (the grey parts). Figure 4 is an example of the designer's post-completion assessment for The National Trust headquarters building using the Checklist. Assessed performance is generally around Best Practice, but with highlights on the materials side including low embodied energy, and potential for reuse (e.g. lime mortar, bolted steel connections); and for operational energy (passive design, good daylight and natural ventilation, and a large photovoltaic array). However, this low-energy approach produced a single-storey building with a mezzanine; a large footprint that scored somewhat lower in some aspects related to building form; and the use of the site. Performance in use has not yet been fully verified for this new building, but anecdotal reports from the occupants are good. When reliable in-use data are available (e.g. from occupant and energy surveys), the score could eventually rise.

The 2005 Awards process produced a winner, both all-round and for innovation in two specific aspects (materials and construction process). Another building was fairly close, so the technical recommendations were queried by the wider judging panel. A series of sensitivity tests was therefore carried out. In the event, these continued to support the original selection. Without the structure provided by the Checklist, making a clear choice would have been much more difficult.

Energy performance assessment

It is over 30 years since the 1973 energy crisis and 15 years since we became aware of the magnitude of man-made climate change, but we are still not good at producing low-energy buildings routinely or reporting their performance accurately. There are often major credibility gaps between expectations and outcomes (e.g. Bordass *et al.*, 2004), to which low-energy buildings are particularly sensitive because the margins for error are smaller. Important reasons for the continuing discrepancies include the lack of a consistent approach to building energy assessment and reporting; and poor feedback from performance in use into briefing, design and construction. Design and building teams are normally commissioned to get buildings made or changed, and not to stay around after the building has been handed over to find out how it really works (Way and Bordass, 2005).

The judging process included a more detailed assessment of the energy performance and associated CO_2 emissions of the four shortlisted buildings. This was part of the development trials for the proposed VECD to help determine what design data were available, for what it had been calculated (e.g. for all energy uses in the building or for building services only – typically heating, ventilation, cooling, lighting and hot water), under what assumptions, and how it might usefully be summarized.

Three buildings had design data available: one from SAP (the UK's Standard Assessment Procedure for houses) with some extra data from the building services engineer; one a bespoke calculation by the services engineer; and one using more elaborate computer

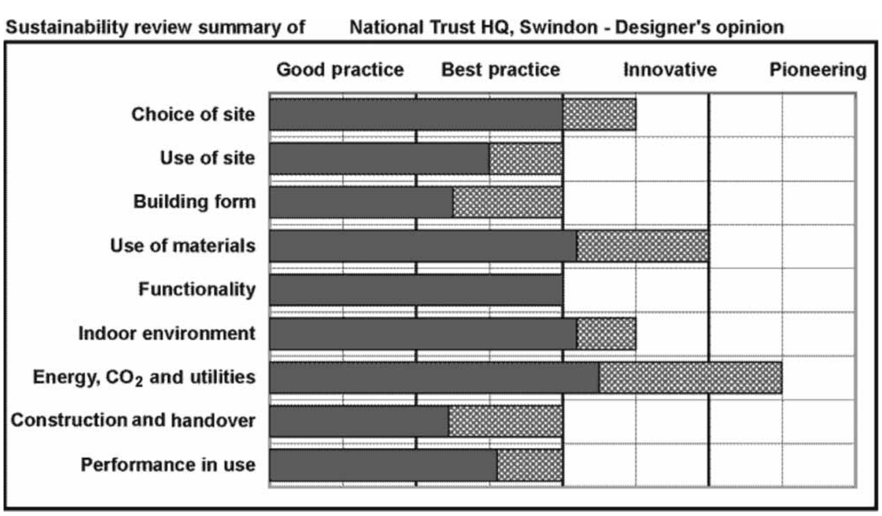

Figure 4 Example of a summary histogram

modelling and summarized in the building's log book – a recent regulatory requirement for non-domestic buildings in the UK (Office of the Deputy Prime Minister (ODPM), 2001).

It had been intended to review design data only, but since one of the buildings had been in use for 6 months, two of the buildings for a year, and one for longer, records of actual fuel consumption were also requested. Although the information initially provided was patchy, we were eventually able to put together a picture for the three buildings for which design data were also available. In the fourth, the electricity use was disappointingly high (partly, it was claimed, due to wasteful practices by the occupier); and an inconsistent pattern of gas consumption was traced to a faulty meter – an indication of how low energy is still on people's priorities, even for projects that aim to be sustainable.

For the small office building, the correspondence between the relatively simple design estimates and consumption in use was quite close. For the house, the SAP calculation of requirements for heating and hot water was higher than the actual consumption, as the thermal performance of the building was in advance of the best option provided by the procedure at the time. For the larger and more complex building, however, with the more elaborate calculations, in-use consumption was very much greater than the design estimates – though still reasonable in relation to most comparable buildings. Some of the discrepancy was traced to an error in reporting (with annual heating energy consumption recorded in kg/m^2 of CO_2 emissions was mistakenly referred to as kWh/m^2 of gas – suggesting a result five times lower than had actually been calculated), some to the initial warming-up and drying-out of the building, some to things in the building (e.g. computer and supporting equipment and the air-conditioned archive store) which had not been included within the calculations, and some to control and management systems not yet being fully operational. At the time of the survey, work was already in progress to fine-tune control systems and to make a few alterations. Energy management was also being taken seriously. This should all reduce the energy consumption substantially. It was therefore hoped to review and report the situation at a later date.

Comparison with the Design Quality Indicators (DQIs)

Commentators have asked how the Checklist developed differs from the DQIs, which were reviewed in a special issue of this journal (Gann and Whyte, 2003). The major difference is, of course, that all the shortlisted entries coming forward for the Sustainability Award had already been assessed by the judges of the RIBA Awards for design quality; so the emphasis of the secondary judging and its Checklist was specifically on sustainability. However, as sustainability today is concerned with far more than environmental performance, and with design quality reaching far beyond aesthetics, it is instructive to compare the two.

Both the Checklist and the DQIs use questions with tick-box alternatives, both originally with six choices for each question (though the Checklist increased to 11 when it added the borderline category). However, the style of the questions is different. Although not quantified at the start, the Checklist is aimed at professionals and seeks to calibrate its questions objectively by reference to Standard, Good practice, Best practice, and so on, and it aims by a process of review to converge to an assessment of where on the scale an aspect of the building's performance lies. The DQI questions are designed to be answered by anyone and are therefore more subjective, with a statement, e.g. 'the building is structurally efficient' and six choices from 'strongly agree' to 'strongly disagree'. The DQI is therefore aimed more at facilitating discussion and reaching a compromise than in presenting a single view. Indeed, the use of the DQI has shown that the opinions of different constituencies (e.g. designers, occupiers, visitors and facilities managers) on some issues can differ greatly.

The DQI is more concerned with the impression a building makes. Its questions are focused particularly on the qualities of the building – from a design intention to a completed artefact – in three main categories: Functionality, Build quality, and Impact – similar to the definitions of Commodity, Firmness and Delight in Vitruvius' *De architectura libri decem* (first century BC). The Checklist covers these topics too, but it is more concerned with how the building came to be, and with its hidden as well as its visible impacts.

In order to provide a more systematic comparison of the two methods, all the DQI questions were listed alongside those in the Checklist, and an attempt was made to bring the two sets into alignment (Figure 5). Apart from the DQI having nearly twice as many questions, major differences revealed by the analysis included the following:

- The time sequence in the Checklist, also related to the 'ownership' of different activities, from site selection through design and construction to fitout and building management. The DQIs do not have this as they aim to be a snapshot that can be taken at any time.

No.	SUSTAINABILITY CHECKLIST TOPICS	DQI	DESIGN QUALITY INDICATOR (DQI) TOPICS *In different columns for Functionality (FU, Build Quality (BQ) and Impact (IM)*
	CONTEXT		*FU / BQ / IM*
1	**Choice of site**		**Location and Siting**
1.1	Refurbishment, brownfield, greenfield		
1.2	Proximity to public facilities and services	FU1	Location relates to local facilities.
1.3	Transport policy, proximity to public transport	FU5	Public transport is convenient.
1.4	Proximity to housing and/or employment		
1.5	Robustness against impacts of change (e.g. flooding)		
	DESIGN CHOICES		
2	**Use of site**		
2.1	Ecological quality of site		
2.2	Use of land	FU2	The site responds to its urban or landscape context.
2.3	Biodiversity		
2.4	Community integration	IM1	Landscaping around the building contributes to the community.
2.5	Infrastructure enhancement		
3	**Building form**		
3.1	Location of building on site	FU3	Design takes advantage of the orientation.
3.2	Re-use of existing buildings		
3.3	External environmental impact (visual, noise, microclimate)	FU4	Design enhances the site microclimate.
3.4	Adaptability potential	FU28	Different user requirements are easily accommodated.
4	**Use of materials**		
4.1	Selection for low environmental impact	BQ3	Consideration is given to construction methods and materials.
4.2	Potential for re-use and recycling	BQ2	Consideration is given to demolition and recyclability.
4.3	Good thermal performance		
4.4	Low embodied energy and pollution		
4.5	Low toxicity		
	OUTCOMES (predictions for design, please replace by actual when in use)		
5	**Functionality**		
5.1	Controls, controllability and manageability	BQ7	The mechanical, electrical and water systems are easy to operate.
		BQ6	There is a clear fire safety plan.
		IM24	The level of personal control of the internal environment is excellent.
5.2	Provision for maintenance		
5.3	Provision for waste management		
5.4	Resistance to climate change impacts		
5.5	Durability	BQ17	Construction is well detailed.
		BQ18	Construction is durable.
		BQ19	Wear and tear does not show.
		BQ20	Components in the building can be replaced when necessary.
			Access
		FU6	Layout and landscape around the building help access.
		FU7	Directions and signposts are clear.
		FU8	Safe and secure access is provided for people.
		FU9	Safe and secure access is provided for goods.
		FU10	The building provides access for all.
		FU11	The building caters for people with impaired sight.
		FU12	The building caters for people with impaired hearing.
		FU13	The building caters for people with learning difficulties.
		FU14	The building is accessible to wheelchair users.
6	**Indoor environment**		**Engineering Systems**
6.1	Acoustic	BQ5	The acoustic environment is excellent.
		BQ25	Acoustics are supportive.
6.2	Air quality	BQ30	The air-quality is excellent.
6.3	Lighting	BQ9	Natural lighting is optimised through building design.
		BQ10	Lighting is flexible and easily adaptable for different user requirements.
		BQ27	Artificial and day light qualities sparkle.
6.4	Thermal	BQ31	The indoor climate is cool.
6.5	Spatial		
7	**Energy, CO_2 & utilities**		
7.1	Energy efficiency	BQ15	The building is energy efficient.
		BQ12	The building minimises the use of heating.
		BQ13	The building minimises the use of cooling.
7.2	On-site CHP and renewable energy		
7.3	**Emissions to atmosphere (principally CO_2)**		
7.4	Water		
7.5	Liquid wastes: avoidance, drainage systems, water treatment		
7.6	Solid wastes, waste management		
	DESIGN AND CONSTRUCTION PROCESS		
8	**Construction & handover**		**Construction**
8.1	Briefing and design reviews		
8.2	Considerate constructor	BQ1	The design can be constructed safely.
8.3	Environmental impact of operations on site		
8.4	Environmental impact of transport to site		
8.5	Sourcing of materials, components and labour	BQ4	Sustainable resources are maximized.
8.6	Waste minimisation during construction		
8.7	Fitout		
8.8	Commissioning, handover, training, soft landings		
8.9	Incorporating post-occupancy evaluation and feedback		

Figure 5 Comparison of topics in the sustainability checklist and the Design Quality Indicator

SUSTAINABILITY CHECKLIST TOPICS		DESIGN QUALITY INDICATOR (DQI) TOPICS			
			In different columns for Functionality (FU, Build Quality (BQ) and Impact (IM)		
	ACHIEVED PERFORMANCE (if information is available)		*FU*	*BQ*	*IM*
					Identity and Character
		IM25			The building is widely acclaimed for its quality.
		IM26			The building has character.
		IM27			The building tells a story.
		IM28			The building reinforces the image of your organisation.
		IM29			The building is delightful.
		IM30			Visitors like coming here.
		IM31			Visitors want to return to the building.
					Innovation and Inspiration
		IM32			The building is inspirational.
		IM33			The building raises the spirits.
		IM34			The building makes you think.
		IM35			The building changes your view of the world.
		IM36			The building develops new knowledge.
		IM38			The building enhances your understanding of value of design.
		IM37			There is clear vision behind the building
9	**Performance in use**				
9.1	Impact on local environment community, townscape, transport etc.)	IM2			The building contributes positively to the neighbourhood.
		IM3			The building enhances the surrounding environment.
		IM5			The building encourages new business in the local area.
		IM6			The building makes a civic contribution.
		IM7			The building encourages regeneration.
		IM8			The building raises the aspirations of the community.
		IM9			Surrounding residents/passers-by like the building.
		IM15			The area immediately outside the building is pleasant.
			Use		
9.2	Fitness for purpose	FU20	The building works well.		
		FU21	The building gets used efficiently.		
		FU22	The building contributes to the efficiency of the organisation.		
		FU23	The building enhances the productivity of its regular users.		
		BQ28		The structure is coherent.	
		BQ29		The finishes work well.	
		BQ32		The building is well co-ordinated.	
		BQ33		Layout and structure are well co-ordinated.	
		BQ34		Furnishings, fittings and finishes are well co-ordinated.	
		BQ35		Mechanical, electrical and water systems are well coordinated.	
		BQ16		The building can be maintained safely.	
		BQ21		The rate of component replacement/repair is acceptable.	
		BQ22		The building meets the business case.	
		IM4			The building supports the aims of the organisation using it.
					Form and Materials
		IM13			The building is well composed.
		IM10			The form is pleasing.
		IM11			The form and materials have been well detailed.
		IM12			The materials used in the building add to its quality.
		IM14			The building's colour and texture enhance its enjoyment.
			Space		
9.3	Appropriateness of space	FU15	Size is appropriate for the function.		
		FU16	Layout and relationships between rooms are convenient.		
		FU17	There is adequate storage space.		
		FU18	The ratio of useable space to the total area is excellent.		
		FU19	The ratio of useable space to circulation space is excellent.		
9.4	Appropriateness of fitout	BQ24		Layout enables the organisation to perform well.	
		BQ36		IT and communication systems are well co-ordinated.	
		BQ8		The communications and IT systems are easy to operate.	
9.5	Usability and manageability *(update Section 5)*	FU24	Changes in use are allowed for in the layout.		
		FU25	Changes in use are allowed for in the structure.		
		FU26	Changes in use are allowed for in the mechanical, electrical and water services.		
		FU27	Changes in use are allowed for in the communications and IT services.		
		BQ23		The building is easy to operate.	
		BQ14		The building is easy to clean.	
9.6	Indoor environmental quality *(update Section 6)*	BQ11		The building is safe and healthy to use.	
		IM19			The internal environment is comfortable in summer.
		IM20			The internal environment is comfortable in winter.
		IM21			The quality of light enhances the mood of the building.
		IM22			The acoustics of the building enhance communication.
		IM23			The air quality in the building is pleasant.
9.7	Occupant satisfaction	BQ26		Fabric of the building and materials used are delightful.	
		IM16			The building is a pleasure to use.
		IM17			The building does not feel cramped or overcrowded.
9.8	Use of energy and utilities *(update Section 7)*				
9.9	Quality of building and facilities management	IM18			The building produces a low number of complaints/faults reported by users.

Figure 5 Continued

- Many questions on identity, character and inspiration in the DQIs. These were not covered in the Checklist.
- Many more questions on use, form, functionality, durability and the internal environment in the DQI.
- The DQI had several specific questions on innovation. The Checklist had an 'Innovative' performance level available for every question.
- An emphasis on access in the DQI (both generally and for the disabled). This is covered only implicitly in the Checklist.
- Some near repetition in the DQI in places, for example with 'Natural light is optimized', 'Artificial and daylight qualities sparkle', as Build Quality issues plus 'The quality of light enhances the mood of the building' under Impact.
- The DQI questions are resolutely upbeat. Possible adverse effects (such as glare from the sparkling lighting above) are not mentioned; and there is no opportunity to comment on individual questions.
- Not surprisingly, the Checklist covered more issues on the external environmental impact, e.g. biodiversity, waste and pollutant streams to air, water and land, the credentials of construction materials, and on the design and construction process.

In conclusion, the two checklists are complementary and have different purposes. However, there is potential for closer coordination between them, e.g. perhaps in the coverage of topics and the framing of questions.

Possible future developments

The designers of the buildings made positive comments about the Checklist. They found that it covered most of the issues they were concerned about, was relatively quick and easy to complete, and helped to identify the strengths and weaknesses of their projects. The present authors hope that the checklist will be used for next year's awards, and that entrants will be aware of it before they make their initial submissions.

Other people and organizations have also expressed positive interest in the questionnaire, e.g. for competitions and publications, assessments of designs and of completed buildings, and in discussions with and reporting to clients. Some have also suggested alterations, in particular the following:

- Owing to the growing strategic importance of climate change, to have a completely separate category for building energy use and carbon dioxide emissions is probably desirable.
- Adding a few new topics, in particular inclusive design (e.g. good access for the disabled – which accounts for several questions in the DQI), safety, crime prevention and economics. However, as sustainability becomes more all-embracing, it can be difficult to know where to stop. This needs discussion.
- More guidance notes to accompany the Checklist. However, it was encouraging to see how easily people were able to complete it with minimal guidance.
- Clear quantification of issues to improve replicability. However, given the diverse range of buildings and contexts to be assessed, it is unlikely to be possible, or even desirable, to provide universal scales. Instead, it is thought users will move from quick, broad, initial assessments to choosing priority areas on which to concentrate, and then go on to quantify the intended and achieved performance levels in these areas as appropriate to their specific building or project.

The main question is whether the Checklist should remain as a rapid assessment tool, to which depth can be added as required, and tailored to suit the needs of a specific project – as with the original Matrix for The National Trust. Or should it form the entry level into a more detailed general-purpose system? Or do existing systems already cover the ground just as effectively? Whatever happens, the ability to undertake a quick but powerful initial 30-minute check should not be lost.

Acknowledgements

Financial support towards the work was provided by members of the Edge (www.at-the-edge.org.uk) and the Carbon Trust. Technical support from the RIBA and from the owners, designers and managers of the buildings reviewed is also gratefully acknowledged.

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Endnotes

[1]For more details on the Edge and this debate, see http://www.at-the-edge.org.uk

[2]See http://www.breeam.org/offices.html