Education as a Performance Metric: A Different Approach to Environmental Management

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Introduction

Implementing an environmental management system in a service-based industry such as an architecture or engineering practice is notoriously difficult. As a result, many firms simply seek ISO14001 certification for their office management procedures rather than their actual design practice. The key to ISO14001 certification is completing the feedback loop - ensuring that there is proper performance monitoring, measurement and review - and that corrective action is taken when and where required. If the 'product' is taken to be a firm's design process, then defining performance presents some very real challenges.

New software has recently been developed to attack this very problem. Based on the certification experiences of a major London design firm, it provides a range of standard features for the management of project information, documentation and progress reporting. However it also introduces two quite unique features, the basis of which form the subject of this article.

Environmental Management Systems

The United Nation's historic Conference on Environment and Development in Rio de Janeiro in 1992 (http://en.wikipedia.org/wiki/Earth_Summit) sparked a series of initiatives around the world to develop viable approaches to sustainable development. One of these efforts involved forming a technical team within the International Organization for Standardization (ISO) to develop voluntary environmental management standards.

The most important product of this work has been the ISO14001 standard for Environmental Management Systems (EMS). This is just one part of the ISO14000 family of environmental standards. However, like ISO9001 detailing quality management systems, it is the only one against which individual companies and organisations can gain certification.

ISO International Organization for Standardization

Standard	Title / Description
14000	Guide to Environmental Management Principles, Systems and Supporting Techniques
14001	Environmental Management Systems - Specification with Guidance for Use
14010	Guidelines for Environmental Auditing - General Principles of Environmental Auditing
14011	Guidelines for Environmental Auditing - Audit Procedures-Part 1: Auditing of Environmental Management Systems
14012	Guidelines for Environmental Auditing - Qualification Criteria for Environmental Auditors
14013/15	Guidelines for Environmental Auditing - Audit Programmes, Reviews & Assessments
14020/23	Environmental Labeling
14024	Environmental Labeling - Practitioner Programs - Guiding Principles, Practices and Certification Procedures of Multiple Criteria Programs
14031/32	Guidelines on Environmental Performance Evaluation
14040/43	Life Cycle Assessment General Principles and Practices
14050	Glossary
14060	Guide for the Inclusion of Environmental Aspects in Product Standards

Figure 1 - The ISO14000 family of environmental standards.

The aim of certification is to establish within an organisation the commitment to a systematic approach to reducing the impact of all the environmental aspects over which it has some control. To gain certification, the organisation must convince an independent third-party registrar that it has a viable and effective environmental management system that implements, documents, and executes all the elements detailed in ISO14001, and that both management and staff are committed to a continual process of minimising its impact on the environment.

This last component is very important as the ongoing audit process usually involves questioning individual members of staff at all levels about their knowledge and experience of the organisation's EMS.

Establishing a Feedback Loop

ISO 14001 is all about establishing a continual feedback loop in which environmental impacts are identified, steps taken to reduce them and measures used to ensure a positive effect. The basic Plan-Do-Check-Act (PDCA) cycle is the operating principle behind all ISO's management system standards.

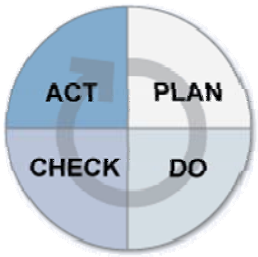

Figure 2 - The basic ISO PDCA cycle common to all ISO management systems.

- **Plan** - establish objectives and make plans (analyse the organisation's situation, establish overall objectives, set interim targets and develop plans to achieve them).
- **Do** - implement plans (do what was planned to do).
- **Check** - measure results (measure/monitor how far actual achievements have met planned objectives).
- **Act** - correct and improve plans and how to put them into practice (correct and improve plans, learning from mistakes in order to achieve better results next time).

The EMS is a formal management program so, similar to ISO 9000 & QS-9000, documents and records must be controlled, training must be conducted and recorded, responsibilities must be clearly defined, measurements must be taken and corrective actions must be implemented.

Additionally, ongoing audits are a major requirement. This essentially means the ability to track back through process documentation and clearly identify the basis on which all major design decisions effecting environmental performance were made.

Application to a Design Practice

In the context of a design practice, these requirements raise some fundamental issues:

- *What are the potential environmental impacts of the building design process?*
  Obviously there are the physical resources used by staff such as paper, electricity and fuel for travelling to meetings and site visits. However, these are absolutely trivial compared to the *potential environmental impact* of the *resulting building*, taken over its entire lifespan.
- *How do you measure the environmental performance of a design team?*
  It is possible to objectively measure both the physical resources used in a project and the potential/actual environmental performance of the resulting building – so the ideal result would obviously be the maximum building performance for the minimum input resources. Does this mean reducing design activity to some function of building performance versus time and resources expended? Also, as design is often the art of discovering the 'least-worst' compromise between a myriad of competing requirements, how would selectively measuring only a small number of performance criteria affect the process as a whole?
- *How important is the as-built environmental performance of the final building?*
  Whilst the design team is not in sole control of the entire building process, obviously the ultimate aim is to minimise as many environmental impacts as possible – and the building itself represents by far the largest component. Thus, what is the real use of a design-time EMS if the final results of the process are never truly known?
- *Is it practical or even possible to fully document each major design decision?*
  Implementing an EMS would require a design team to record and document the basis on which all major decisions effecting environmental performance are made. This must be done to a level sufficient for an independent third-party auditor to understand and accept the logic applied in each case.

Whilst contentious, these are very real issues faced by design firms in practice around the world – many of whom require ISO14001 certification before they can work for/with some government organisations.

It is important to note that EVAtool does not profess to offer a neat solution to all of these problems. It's aim is to provide firms that need it with a viable and effective means of approaching and dealing with the environmental impacts of their design projects. As such, it offers an infrastructure that helps designers better arrange and understand the different environmental design issues, and provides the tools for measuring and feeding back just how well their design ideas have addressed each problem.

The History of EVAtool

EVAtool evolved from the ISO14001 certification processes undertaken by Grimshaw Architects in London during the design of the Eden Project in 1998-99. They developed their own in-house proof of concept system which they termed Environmentally Viable Architecture (EVA).

The major innovations at this early stage were:

- Establishing that the 'product' of the office was not actually the final building in physical form, but the design process used to generate it. The view was taken that the final as-built performance of a project was not under the sole control of the original design team and that a reliance on detailed post-occupancy measurements would introduce unacceptable delays in closing the required feedback loop. This in no way precluded the use of POE and as-built studies as a valuable long-term performance measure within the system, however feedback had to be more immediate and based on measures of the design team's own performance.
- Structuring the system around self-assessment responses to a series of questions arranged within specific environmental impact categories.
- Acceptance by the ISO registrar that an ongoing staff education programme is a viable means of demonstrating 'product' improvement.

After realising the significant investment that had been made in developing questions and implementing the EVA system, the decision was made to establish an independent group to deliver a commercial version called **EVAtool**. ENVIARCH was formed in 2003 to manage this collaboration as well as deliver product development, content, sales and support.

Some of the principals behind the original EVA system have since left Grimshaw and formed KIRKLAND, FRASER, MOORE Architects, taking on the responsibility of pushing EVAtool forward.

SQUARE **ONE** *research* was approached in late 2005 to undertake technical development and it is now at pre-release stage and being trialled by a number of international architectural practices.

Environmental Management Structure

Questions within EVAtool are structured around twelve (12) main impact categories. These contain 96 sub-impacts that get down into some real detail in each area. Each question is assigned to one of four different stages in the design process. This produces a large matrix of available questions, presented to the user by stage as either a spider-gram or a large grid.

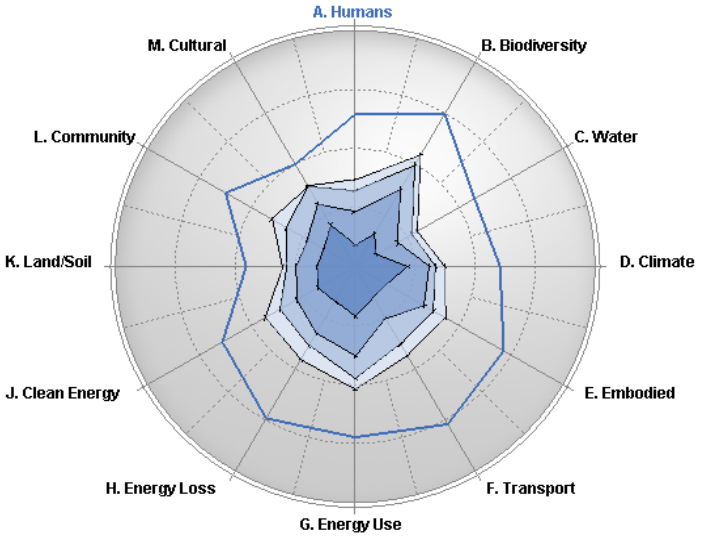

Figure 3 – The twelve main impact categories within EVAtool.

Responses to each question can include:

- A textual **explanation** of the current status to be included in reports and summaries,
- A **progress** value given as a percentage complete,
- A **quality** value given as the percentage of the design aims within the question achieved, and
- A **time** value given as the number of hours spent working on the question.

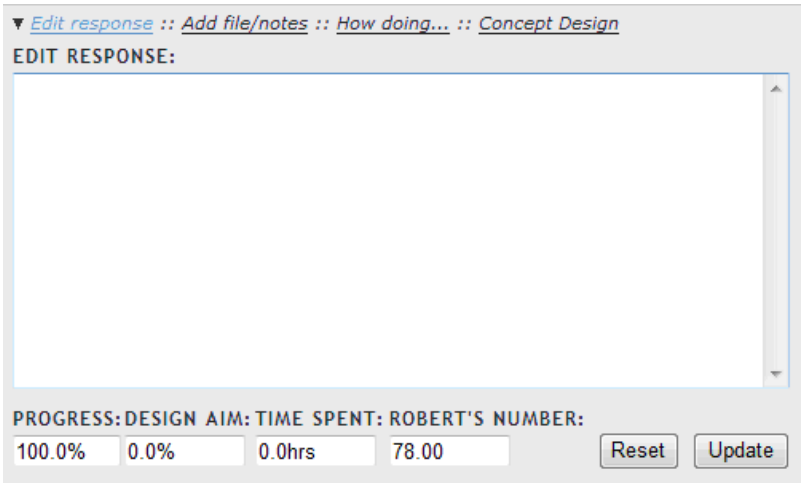

Figure 4 – An example of the question response area to be completed by team members, showing optional entries such as design aims met, time spent and a customised project metric value.

In addition, a chronological/hierarchical set of comments and notes can be added to each question that can also include attached files and useful references. The system records a complete history of all updates and changes as well as allowing specific questions to be brought to the attention of other users and their priorities set based on the current level of urgency.

All the values entered in response to each question are based on self-assessment. A single member of the design team takes or is assigned responsibility for each individual question and makes a professional judgement as to the completeness and quality of their response. The requirement for ongoing auditing within the EMS ensures that there is a second check on all questions in each project.

Measuring Environmental Performance

As each question represents a specific aspect of the environmental performance of the project, the more questions that are dealt with, the wider and deeper the consideration of environmental effects. Thus, the aim for any design team is ideally to:

- Deal with as many aspects of environmental performance as practicable;
- Achieve or exceed the performance goals and/or targets set; and
- Do so within a reasonable time frame.

The information for each of these aspects can be represented diagrammatically on the spider-gram. Progress, quality and time can be shown as polygons on the chart where the radius along each category axis represents its relative value. A separate polygon is displayed for each design stage of the project, showing cumulative progress and achievement.

Design targets for each impact category are shown as a solid line and are set by selecting the design stages in which each impact category is to be addressed and the relative importance of each to the client and the project. Obviously a television studio will not have a large daylighting component in its design considerations so this can be accommodated very early, for example. If each axis represents the total number of questions in each impact category, given as a percentage, then these spider-grams provide an objective means of monitoring each project and comparing it with any other.

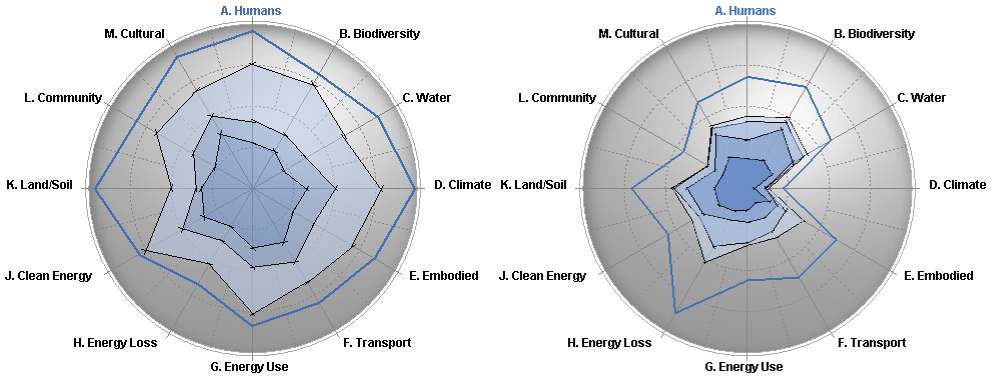

Figure 5 – The immediate visual difference between an environmentally comprehensive design project (left) and one with very limited scope (right).

In addition, it is also possible to generate overall project metrics. Based on the ideal aims of a design team, this becomes simply:

$$Overall\_Project\_Score = \frac{(Questions\_Complete * Aims\_Achieved)}{Time\_Spent}$$

Question Development

EVAtool has been designed to be very flexible in terms of the number, range and types of questions that can be included. The primary aim is to provide a comprehensive library of well considered questions that, when dealt with effectively by a design team, will actually result in more efficient, comfortable and lower-impact building stock. However, the system is also fully customisable and able to adapt to pretty well any question set that will fit within its impact category concept.

The EVAneers Website

To assist in the development and refinement of this central library of questions, an **EVAneers** website has been established and a number of educators, practitioners and theorists invited to assist. On this site, questions can be added, edited and commented upon, as well as voted for and against.

With the EVAneers site, EVAtool is effectively split into two components:

- The open-source questions (*evatool.org*) laid out as WEB 2.0 social networking content with creative and discussion forums; and
- The commercial tool (*evatool.com*) which acts as a catalyst between the open-source material (generated by real-world feedback loop) and the architectural companies deploying them.

The EVAneers site aims to harness the power of WEB 2.0 to create a "Globally Integrated Knowledge Ecosystem" for green building design and leverage concepts such as Wikinomics (*Wikinomics: How Mass Collaboration Changes Everything, a book by Don Tapscott and Anthony D. Williams, published in December 2006 (www.wikinomics.com)*) to serve not only the EVAtool project, but building designers at large.

The EVAneers group is currently chaired by Andrew Whalley, a partner at Grimshaw, and includes Prof. Vivian Loftness from Carnegie Mellon University and recently appointed to the World Business Council for Sustainable Development, Prof. Sue Roaf, Professor of Architectural Engineering at Heriot Watt University and author of the 'EcoHouse' series of books, with assistance from Huston Eubank, recently from the Rocky Mountain Institute and former director of the World Greenbuilding Council.

Additional Features

Whilst this article won't go into it into too much detail, the EVAtool system also includes:

- Detailed document management in which any number of files can be attached to individual questions or the project itself, complete with version tracking.
- Fully auditable version tracking – able to track every change in the system, who made it, when and what it was.
- Customisable knowledge base – any team member can add new references, resources or tools to the system. Other team members can then vote on those they found most useful so

that they rise to the top of the reference list. Items can then be uploaded / downloaded from a central library available to all EVAtool users.

- An in-built wiki – allowing users to document specific workflows, explain definitions and associate items with relevant questions.
- An in-built frequently asked question (FAQ) database – again linked to a central library available to all EVAtool users.
- Custom project metrics – able to set up and display design metrics such as LEED, BREEAM, and star ratings relevant to different projects and locations, associating them with one or more questions in each project.

These features allow for the generation of a 'corporate memory', where methods and ways of doing things no longer reside solely within the experience of those particular members of staff who do them every day. Documented workflows and methodologies become open for scrutiny by other team members and can be more quickly developed and refined.

Demonstrating Improvement

Demonstrating ongoing improvement within an EMS is very difficult for a design practice as performance measures will vary with the type and size of projects currently being undertaken. There are only two real changes that a firm can implement within the feedback loop:

- Refine and improve the workflows undertaken by staff, and
- Educate and train them to make them more effective.

Education and training of the workforce is a major element of ISO14001 goals. If the EMS includes an ongoing training programme and can both measure and demonstrate an increase in the skills and experience of its staff, then ISO14001 registrars have been willing to accept and certify this. Also, by aiming to get all team members to interact on a daily basis with environmental design issues (not just a single green guru), EVAtool is able to greatly empower and increase the knowledge assets of an entire firm (and by implication the general profession) for climate change mitigation.

Tools for Actually Doing the Work

Whilst EVAtool manages the overall design process, tools such as ECOTECT and other SQUARE **ONE** software facilitate the detailed simulation and analysis that underpins the range of different performance measures and design decisions-making tasks required. Education and training at this very detailed and applied level is just as important as any other. Whilst enthusiasm for environmental design is laudable, the knowledge, skill and capacity to actually see it through is critical.

To support designers in this endeavour, the SQUARE **ONE** Training Programme has been developed, delineating the diverse range of concepts and practical skills required for effective environmental design and analysis into a series of discrete topic areas. The system also sets out five accredited achievement levels within each topic area that building designers can progress through.

Achievement levels

Achievement levels are designed to give structure to the process of learning each aspect of building performance and analysis, helping designers understand the steps they need to take to progress their development and what each step will enable them to do. Table 1 shows a summary of the different levels within the programme. For a more detailed description of the aims, titles and capabilities at each level, see the SQUARE **ONE** wiki (*http://squ1.org/wiki/Training/Programme*).

LEVEL	ACHIEVEMENT	TITLE	CONTRIBUTION
1	Understanding	Novice	View
2	Capability	Capable	Assist
3	Proficiency	Proficient	Produce
4	Expertise	Expert	Manage
5	Innovation	Eminent	Innovate

*Table 1 – The five achievement levels within the SQUARE **ONE** Training System.*

This system of accredited achievement levels has three major advantages:

1. It allows both new and experienced team members to quickly assess their overall levels of skill and understanding in each area and provides a clear path for improving both their awareness and effectiveness in design projects requiring performance analysis support.

2. It breaks up the required knowledge base into a series of discrete and achievable chunks, linked together by a clear logic so as not to be overwhelming.
3. It provides an effective means by which design firms can objectively rate, deploy and manage the range of capabilities of different team members within each project.

The last of these points is by far the most important. The structure of the industry is such that the design of large buildings is predominantly a team effort, often carried out by large design firms. No matter how great the enthusiasm or brilliance of individual team members, if the process as a whole does not work effectively, chances are neither will the building.

For a design project to be effective, it needs team members with a diverse range of skills and contributions to make in many different areas. Not everyone can be a manager. Similarly, not everyone can be a novice. This system offers firms an infrastructure, in a manner similar to EVAtool, by which they can understand the skill levels available within their staff, identify areas needing improvement and actually measure and verify their progress. This represents a major step towards closing the feedback loop required by ISO14001.

Conclusion

As a simple conclusion to this presentation, I refer to a quote about EvaTool from Amory Lovins, founder of the Rocky Mountain Institute in Colorado:

"The concept of EVATool is very powerful in terms of really changing designer's mindset. If you integrate green design directly into the process and even the software that people use to design buildings, then thousands of designers will automatically do it right. In many ways, this approach is far more powerful and direct than writing a book, hoping people read it and are then willing and able to wrestle with bad software and other processes to implement it."

Amory Lovins, Rocky Mountain Institute, Colorado