Sustainability:
Indefinable Success in a Defined World
(…or, Your Mileage May Vary)

Note:
This paper was originally presented at the CIBSE/ASHRAE International Conference on Building Sustainability, Value and Profit, held in Edinburgh, Scotland September 2003. It has been updated slightly since that presentation.

Frame of Reference

Dateline: 2 January 2003
Spot Market Price for Sweet Crude *$33.08* per barrel
(source - NYMEX Light Sweet Crude, Contract 1)

Dateline: September 3, 2005
Spot Market Price for Sweet Crude *$67.57* per barrel
(source - NYMEX Light Sweet Crude, Contract 1)

And so…

Sustainable\Green (S\G) Design has been almost universally accepted as a desirable methodology and a 'value-added' concept which should be included in the modern and responsible execution of today's design process. To achieve or execute S/G design requires additional time and effort and sometimes special consultants and construction techniques; thus additional expense.

The result of this expense is a value add to the contract between the client and the 'service provider', be that the designer or the contractor. An addition to the value of the contract should only be considered in conjunction with an increase in the value of the services provided or product delivered. If the final service or product 'fails to deliver' the agreed upon value, the contact value should be expected to be adjusted accordingly.

This leads to the following questions:

- If sustainable design has an added value, what are the 'units' of sustainability or 'green-ness' such that an economic value can be established, performance measured and contractual compliance determined?

- What are the interrelationships in the value chain between design, construction and operating methodology such that an accurate picture of delivered value versus promised value can be developed for the completed project?

The answer to these questions may depend upon the answer to three preceding questions which might define the framework of such an analysis.

First, what is ‘value’? In the abstract, value is something, either tangible or intangible, which one party seeks to obtain from another. One man’s meat is another man’s poison as the saying goes, or so we would think. From a legal perspective, value is defined as

> **value,** *n.* **1.** The monetary worth or price of something; the amount of goods, services or money that something will command in an exchange.[1]

The ‘something’ is most often tangible, i.e. farm products, steel, a building, but not always, i.e. market ‘good will’ and the transaction is most often monetarily, but not always, i.e. ‘advertising in exchange for service’ (common in the dot.com, internet web portal world). Thus an item only has value if there is an exchange or transaction between parties. If one party receives an item without an (agreed upon) exchange to the previous owner of the item, the item could be said to have no value. This would be the case of a demolition contractor ‘keeping’ the items removed from the site for reuse or resale with no compensation to the owner. If there were no agreement made between the parties prior to the contractor performing his or her work, the owner would not be permitted to deduct the value of the recovered items after the contractor has removed them due to a late discovery by the owner that the materials could be sold or reused in the marketplace.

Similarly, if a designer incorporated S/G design features into a project at no additional cost to the client for design fees, the owner would not be permitted to seek compensation for ‘damages’ should the S/G features not provide the level of ‘green value’ stated by the designer.

So value only exists for a thing if I ‘promise’ you something and you give me something for it and we agree on that exchange prior to doing business.

The next question is what is a contract? A contract is defined as follows:

> **Contract**, *n.* **1**. An agreement between two or more parties creating obligations that are enforceable or otherwise recognizable at law; **4.** A promise or set or promises by a party to a transaction, enforceable or otherwise recognizable at law; the writing expressing that promise or set of promises.[2]

Now comes the most difficult definition – what is sustainability? What is green design?

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[1] Black’s Law Dictionary – Abridged Seventh Edition, Bryan A. Garner, Editor in Chief, published by the West Group, St. Paul, MN, USA 2000

[2] Black’s Law Dictionary – Abridged Seventh Edition, Bryan A. Garner, Editor in Chief, published by the West Group, St. Paul, MN, USA 2000

The Brundtland Report definition of sustainable development reads "…meeting the needs of the present without compromising the ability of future generations to meet their needs…"[3]

There are many organizations and committees' working to define or prescribe what is a 'good' environment. These have been promulgated in publications by the US Green Building Council, ISO Standard 205 Committee, the Johannesburg Proceedings of Sustainable Development and the LEED's Certification and Rating System.

For the purposes of this analysis, sustainable design is defined as:

> "**Sustainable design** is the art of designing physical objects to comply with the principles of economic, social, and ecological sustainability. It ranges from the microcosm of designing small objects for everyday use, through to the macrocosm of designing buildings, cities, and the earth's physical surface."[4]

In current practice, the majority of the industry considers sustainable design as 'outside' of typical design practice. Sustainable design draws from the traditional practice of design, and by extension construction, but goes beyond those customary practices to include approaches which are not so customary. For that there (typically) is a cost premium, both in design and construction. The resulting product should be a more energy efficient building with a reduced resource demand and a healthier indoor environment.

Does this sound agreeable? Any problems here?

Yes; three words:
'more', 'reduced' and 'healthier'.

These are imprecise words and imprecision can lead to misunderstanding.

The use of the qualitative modifiers and suffixes, 'more', '-ed' and '-ier' imply that there is room for movement on either side of these modifiers and suffixes; to wit: if there is a 'more' there must be a 'most' and a 'less'.

What then is 'sustainable' enough or 'green' enough to distinguish a normal design from a green design? How do we know that we've arrived if we don't know how far we are going and what do we owe the driver for the trip?

MEASUREMENT OF SUCCESS

There are various standards for the design if energy efficient buildings; ASHRAE 90.1, IES, ISO, etc. These standards often provide prescriptive approaches to system

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[3] Reshaping the Built Environment Ecology, Ethics and Economics - Edited by Charles J. Kilbert Island Press, Washington, D. C. USA 1999
[4] From Wikipedia – The Free On-Line Encyclopedia: http://en.wikipedia.org/wiki/Sustainable_design

specification and/or design. These prescriptions can be used to set targets and the performance of a design can be measured against those targets. Thus, the use of design standards plus some mutually agreed upon ‘improvement’ beyond these baselines can be used to establish an energy budget target for the project. Thus the base contract should include as a part of it’s criteria an energy and resource budget target. These targets can be developed on a system basis, i.e. lighting system energy, HVAC system energy, potable water consumption, etc.) or it can be indicated as a ‘total building’ target. The first approach allows the owner to concentrate on specific areas or systems, but reduces the flexibility of the designer to consider the design philosophy holistically. The latter approach give the designer the latitude to look for an optimized blend of solutions, but also makes it possible to overweight the solutions in one area which may be problematic if external conditions change.

Thus there are at least two possible methods to define a sustainability goal from an energy perspective.

In addition to energy there is the larger issue of resource utilization. Within commercial projects, this issue may be very difficult for the design-construction team to influence – solid and liquid waste removal, food waste and even bio-waste in hospitals and similar facilities are largely controlled by operations. In many industrial process facilities, there are significant utility demands driven by process needs that can outweigh facility demands. Compressed air, process water, gases, steam and other utilities may add significantly to the overall site resource loads. Process chemistry choices can have an equal level of impact on liquid and gaseous emissions. Often the design firm for the facility supporting such operations is directly responsible for specifying the process equipment and very involved in refining and finalizing the process itself. In the semiconductor industry, for example, many of the process ‘tools’ include exhaust air and rinse cycles. How those tools are specified in terms of allowable power, water and air utilization can greatly reduce the process’ environmental ‘footprint’ and the utility costs, both in supply and in mitigating the impact of discharges, for the building.

Therefore it should be possible to develop resource utilization targets similar to those developed for energy for these ‘non-facility’ based utilities. The challenge is that the targets will vary across projects and processes. Developing good targets will be much more dependent upon owner input.

An early consideration in this treatise is the establishment of units by which sustainability or green-ness can be measured. Given that the goal is to reduce the utilization or discharge of certain ‘things’ it would seem only reasonable to measure performance in terms of the units those ‘things’ are typically measured in – energy, mass flow, weight, volumes. The use of monetary targets is not recommended since there may be shifts in the cost of the ‘things’ due to factors beyond the control of all parties to the contract.

THE IMPLICATIONS TO THE CONTRACT

The addition of resource utilization targets to the contract exact a more demanding level of performance from the design professional. This heightened performance requirement can be equated to a transfer of risk from the owner to the designer. The transferred risk is that associated with the on-going operating cost and performance of the building. The introduction of the targets takes that risk and moves it from the owner and places it on the designer, and to a lesser extent, the contractor. This transfer is done at a cost – in design fees due to the additional analysis and investigation required by the designer to mitigate his or her risk and in construction costs due to the use of better materials, new technologies and new techniques designed to achieve these targets.

Unlike the normal arrangement where the owner is the recipient of a design and a finished project, in the sustainable project there is the concept of meeting the overall design objective over time. Sustainability is inherently about performance over time and in this regard, the owner in some ways could be said to be the final service provider to him or herself in satisfying the contract.

YOUR MILEAGE MAY VARY
(or The Impact of the Owner on Achieving Sustainability)

Reaching the goal of 'sustainability' is not only dependent upon the quality of the design and the quality of construction, but also on the desire and commitment of the owner to operate the facility the way it was intended. The situation is analogous to that of a competitive race car; to field a winning entry requires the combined skills of the car designer\builder, the pit crew and the driver. No amount of skill or craft by the builder or pit crew can overcome the impact of the driver's technique on the outcome of the race. The last component is the condition of the track, the weather, which is beyond the control of any of the parties. The same is true in facility operation.

However, the similarities to a competitive race car team have distinct limits. In the race car scenario typically the car builder, pit crew and driver are all in the employ of the owner and no one is rewarded if the car does not win. All participants have an equal exposure to risk and reward and the team is typically an on-going concern beyond one race. In the delivery of a facility to an owner, the 'team' has a very definite life span – typically one project is contracted at a time. But the outcome of the race may take several years to determine. The owner is the driver and he has 'contracted' with the other participants for a 'victory' in the sustainability race. Despite their best efforts in 'car building' and auto mechanics, if the driver doesn't drive, the car won't win.

Given the significant impact of how a facility is operated on its overall environmental impact, how should this impact be accounted for within the contract?

The inclusion of performance targets into the contract introduces a risk to the design and construction parties which they must take steps to mitigate. If the owner has a legal recourse within the contract to evaluate the building's 'performance' relative to the targets, the design and construction parties must establish some guidelines or criteria for operation to verify proper usage – a quality control manual for operations.

An approach to establishing such criteria can be developed during the design phase and included as a part of the contract for acceptance by the owner. During design development, the engineering analysis process requires the creation, evaluation and refinement of various criteria to evaluate the performance of the systems and building in response to various design options. Once optimized, the inputs or assumptions and criteria used in that optimization should form the basis of the operating guidelines used to measure the owner's adherence to the designer's intent.

The values, operating schedules, weather profiles and setpoints used to select the appropriate design strategies create the final operating manual. This is not the traditional operating manual which provides 'bits and pieces' type information on the various pieces of equipment in a building, but deals with the intended and expected methods, modes and schedules of operations for the facility. This translates not only the 'what did I say' aspects of the design, but the 'what did I mean' aspects as well. This information should be readily available at the end of design development or preliminary engineering.

These operating guidelines can be presented to the owner for review, modifications and acceptance at the conclusion of design development and included with the Basis of Design or project specifications as a part of the contract. It might also be prudent at this time to develop a maintenance guideline or specifications for inclusion into the contract.

With the completion of the energy and resource utilization models, operating and maintenance guidelines, it is possible to prepare a much more accurate total project cost model. Thus enhancing and enabling a shift in focus from first cost and simple payback analyses to true life cycle costing which is at the heart of sustainability. This gives the owner a chance to evaluate just how large an investment in sustainability he or she is willing to make and a measure of the return on that investment.

This approach to achieving sustainable design may have some interesting impacts to the process of contract formation and the negotiation of terms and conditions. In order to establish performance targets for a particular project, the prudent owner would want to have an idea of what is customary for such projects based on size and location. The prudent owner would want to have some idea of what is 'reasonably possible' within the context of his or her project and the respective industry. Lastly, the prudent owner would also want to have an idea of the cost of such a facility. If the owner has no such knowledge based on internal research or prior experience, it may benefit the owner to take one of the following paths: commission an investigatory project to research the 'typical', the 'possible' and the 'probable' and the associated costs of same or execute the contract with design-construct team using a two step process. The first step would be to perform such an analysis, most probably on a 'time and material' or cost-plus contract basis and at the conclusion of design development, shift to a fixed fee or lump sum contract once the scope has been properly defined and the targets set and agreed upon. This may be perceived as problematic in some process industries, but it is the author's opinion that suitable performance targets can be set without unnecessarily restricting process technology options. This process may be seen as raising the cost of design, but it might well be argued that this is one of the costs of achieving 'sustainability'.

WHY DO THIS?

The benefits of sustainable design have to be evaluated in multiple contexts. The typical pro argument is that it is simply good stewardship of our planet to be conscious and considerate of our impact upon it. I think few would disagree with the inherent 'rightness' of this argument, but the rationale extends to some more practical areas as well. Within highly developed regions, there are inherent limits to what capacity or demand the existing infrastructure can support. The typical con argument is that it is too expensive compared to 'traditional' solutions. However, the price of alternatives varies depending upon the market.

A simple analogy: if personal computers had continued to increase in 'processing power' without decreasing the electrical power input required per unit of 'processing power' it is probable that the desire to 'computerize' many business operations would be dampened by the limitations in electrical carrying capacity inherent in many existing buildings.

Their incoming feeders and 'load-side' distribution infrastructure would be insufficient to handle the processing load, thus there would be a clear and quickly arrived at limit to the 'amount' of computing capacity that could be installed in an existing building or carried on an existing utility grid. Would the increase in productivity attributed to the spread of 'distributed computing' be sufficient inducement to warrant the complete overhaul of building electrical systems and associated utility grids or overcome the 'stranded investment' costs associated with abandoning those facilities and relocating to increasingly more remote locations where new, adequate infrastructure could be built? Not likely.

Had the power consumption of computers not dropped almost as an inverse of their increase in computing power, there would have been a significant roadblock in their spread throughout the business world.

A similar issue will come to be in play in the sustainability world. As economic 'density' increases in already developed areas, there will be an increasing need to wring that last drop of economic 'juice' out of existing infrastructures without totally gutting and replacing or abandoning that infrastructure and moving elsewhere. The cost impacts of transporting workers, finished goods and building new infrastructures will make the costs of designing sustainable economies a practical economic alternative.

Thus the achievement of sustainability will have a significant impact on the 'cost of doing business' and the economic performance of a project. This economic impact can begat debate and contest over the variance between expected results and actual outcomes.

The Distribution of Liability in Multi-Party Contracts

Typically liability is apportioned between multiple obligators in a contract based on their respective portions of the reward, unless a different risk model is presented. Within the sustainable project model, however, we see that the ultimate success of the project is contingent upon what could best be described as a reversal of roles over the life of the project. The design and construction teams have an obligation to provide a suitable facility to the owner and the owner has an obligation to operate the facility in a suitable fashion once it has been delivered. A failure on the part of either party would constitute a breach of the 'contract' and render one or more terms of same void. While the owner's failure to live up to his or her obligations in operations would not necessarily open the door for the design or construction team to make a claim for damages under the contract, it could negate a claim by the owner that the facility did not meet the expected performance.

So what happens in a partial breach? What happens if the owner makes some necessary change to the operation as a result of business conditions, but the change is not of such a material nature that the new conditions could be said to be completely outside of the expectation or anticipation of the design team? What tools are available to evaluate this variation from the intended theme?

Let us return to the engineering model. To the extent that the new conditions are able to be characterized as an 'extension' or variation upon the agreed upon operating scenario, the model may be adapted to show the anticipated performance at the new conditions. The degree of deviation between the predicted and actual performance can form the basis for evaluating the performance of the parties relative to the contract. Traditionally, collecting the data necessary to evaluate such scenarios has been time consuming and cost prohibitive, but the proliferation of computerized control and monitoring systems has made such collection almost a by-product of normal operations.

There must be a factoring effect taken on the overall performance due to time. All systems and equipment degrade in performance over time, even those with excellent maintenance programs. Looking back at the race car analogy, it is unreasonable to expect the horsepower output to be the same at the 100th race as it was at the 10th race.

SUMMARY

Sustainable design is seen more and more as a value-added practice and approach. This value is likely to increase as the cost of supplying necessary resources increase and the practice of sustainable design and construction becomes infused into the mainstream. A natural result of this assimilation into the 'custom and practice' will be the tendency to try to evaluate performance in a contractual manner that is consistent with the 'custom and practice'. However, there are significant and subtle differences in the real world execution, delivery and evaluation of sustainable and green design projects which necessitate new approaches to defining a successful project – and evaluating contract compliance.

Thus, in order to effectively evaluate the performance of parties in the delivery of a suitable, sustainable project, it is necessary to develop some new tools and methodologies. These include:

- Definitions and targets for ‘sustainability’ relative to the specific project and over a set time period. These targets should include all of the relevant components identified in the sustainability objective and should define whether such targets are resource specific or overall performance based.

- The development of targets should be done using ‘reasonable’ goals relative to the costs associated and currently available technologies.

- The performance goals should include criteria for the on-going operation and maintenance to help ensure that the design is ‘deployed’ to its most ‘reasonable’ advantage.

- The evaluation of the performance should be conducted over time, but such evaluations must take into account the effects of time on the performance of systems and equipment. An appropriate factor must be developed and mutually agreed upon during the design stage for use in project performance evaluations done at a later date. The maximum time frame in which performance evaluations are seen as meaningful must be agreed upon as well.

- The allocation of responsibility or, in less controversial terms, determination of the impact of operation relative to design relative to construction on the overall achievement of the sustainability targets will be critical to measuring the long term performance.

The spread of sustainable and green design techniques and technologies will usher in a new era of cooperative team dynamics for designers, builders and owners alike. These new dynamics may initially strain our preconceived notions of what a good project is compared to a bad project, both technically and contractually, but this pain will ultimately lead to a positive outcome for all concerned and a higher level of quality in the built environment. Remember, no pain, no gain.

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