Rethinking Sustainability – The Technology Link

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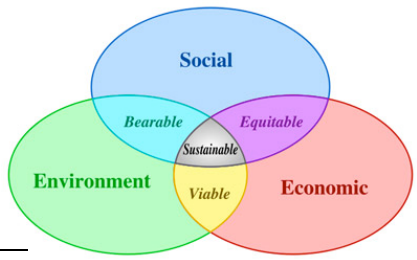
The subject of sustainability is currently a hot topic of discussion and great interest. However, there is little agreement on what sustainable behavior really is; there are a number of definitions of what is sustainable[1]. For example, there is the Triple Bottom Line, Quadruple Bottom Line, the ICLEI, and any number of definitions which can lead to a sustainability index — a ranking of just how sustainable we are. I believe that we are looking at the wrong things, and that sustainability has a problem is both in definition and in its neglect of technology.

European and US definitions of sustainability are not the same things. Europe appears to have a much more social definition of sustainability[2]. I would also comment that there is, at least from the US perspective, a whole lot of "green-washing" going on because every company wants to be "green" from a marketing point of view. This is somewhat akin to the rush to get ISO 14000 certification

I'm in favor of ISO 14000 certification, as long as it is implemented and has an active management commitment. It's just that many of us old curmudgeons have seen the cycles of caring commitment degenerate into careless neglect.

The current definition of sustainability includes a social component. See the figure below:



[1] A 2006 study *Corp. Soc. Responsib. Environ. Mgmt.* **15**, 1–13 (2008) Published online 9 November 2006 in Wiley InterScience listed 37 different definitions of Corporate Social Responsibility.
[2] With, perhaps, the exception of Yale Law School's Environmental Index.

It's how, we determine how green and good we are. But the problem is in the metrics, and how we measure some of the environmental and most if not all of the social components of sustainability. All of the metrics are are dramatically influenced by the impact of technology.

What was sustainable with one level of technology is not sustainable as new technology is introduced. Today, coal is considered a dirty technology, and unsustainable. Yet, we need the electrical energy for our civilizations. But, 40 years ago, when air pollution control technology was not as well developed, we did not worry as much about air pollution but we needed the energy. We still need that energy, and will continue to need it until we can replace it with an economical alternative. Coal, oil, uranium mining, iron ore extraction, etc., will be with us because they are the industries which support the building blocks of industry and development.

Technology changes our society in meaurable and irreplacable ways. Technology is streeet full of one way signs. We can go back under emergency conditions or catastrophic collapse but we really don't want to. Consider the computer and it's impact on health care technology. Would you really want to return to the medical practices in use 50 or even 100 years ago when technology was at a much lower level when catscans and ? As a result of technology we are healthier, and are able to combat disease scorges which ravaged much of the planet at various times.

As recently as 1967, the World Health Organization estimated that two million people were killed by the smallpox (*Variola Major and Variola Minor*) virus, but that virus was officially eradicated, by 1979! The technology driven advances included the electron microscope, precise temperature incubators, high tech diagnosis equipment, and a level of chemical, mechanical, and electrical technology not available as recently as 10 years earlier.

SUSTAINABILITY AND VIABILITY

There is difference between viability and sustainability. Sustainability and viability are two different things. A viable organism is, capable of working, functioning, or developing adequately, or capable of existence and development as an independent unit with the ability to supply itself with all its needs. This is true of a city, a company, or a society.

Sustainability is having a reasonable chance of succeeding, and relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged. Viability and sustainability come together where there is a perceived or actual limitation on natural resources of one type or another. In terms of modern society, we deplete our resources daily, and yet our societies could not exist without this depletion. Even at a cellular level, every organism needs a source of food and an ability to get rid of its waste or reactive products. We are no different.

In order for a society or an organism to be sustainable, it must first be viable. A viable society does not necessarily conduct sustainable activities over the long run because societies change and grow and have different needs and uses for resources. The difference between sustainable and viable societies is in how we utilize resources, and the impact of technology. Technology will improve or destroy the society. If used wisely, it improves it; if used unwisely it destroys the society. Societies adapt to and come to depend upon their technologies. If the technology is lost or abandoned without adequate replacement, the society declines.

Technology builds upon itself. The modern skycraper and high rise buildings were built because of the technology developed from the railroads. When deep drawn rails were found to be "too stiff" (did not have enough bending under load) for use in railroads, and these rails were used as framework steel for buildings. That led to the I-beam and a new concept in building tall, high population density structures, and it altered the way we build our cities.[3]. The high rise led to the elevator. The high rise provided greater efficiency and function in a smaller footprint, and with the greater population density,

[3] http://www.jstor.org/pss/3101720 Structural Antecedents of the I Beam, 1800-1850

new service technolgies were developed to supply the needs of the concentrated population. If we remove some of those key technology features, we move backward quickly.

Technology has both good and bad uses: consider nuclear technology. Albert Einstein, Enrico Fermi, Neils Bohr, and many others developed the mathematical theories which led to the first sustainable nuclear reactor which was built under Wrigley Field in Chicago, Illinois in the very early 1940's. That led to unleashing the power of the atom and ultimately to Nagasaki and Hiroshima. Nuclear energy brought us the possibility of unlimited energy, but it also brought us Three Mile Island and Chernobyl. With each new generation of technological change we have to look at its possible uses and where it can take us, forward or backward.

In each instance, the impact of technology made the society more dependent upon extraction of minerals and utilization of resources in what we today consider unsustainable. Iron, steel, railroads, and nuclear energy all start with the extraction of minerals from the ground, and transformation of those minerals into useful objects of the society. But, these improvements have increased both the viability and the sustainability of the society!

The Great Plains (US) Indian society was sustainable, but it was displaced by the technology of the rifle and the mouldboard plow. Yes, there was a series of conflicts which led to the defeat of the Indian Nations, but every more advanced technology has its own form of warrior or advocate which supplants a simpler technology. The Aztec and the Mayan societies were stable and sustainable, but when drought and disease struck they became un-viable and disappeared very quickly because their technology was not adequate to the challenges.

MEASURING SUSTAINABILITY

There are several measures of sustainability. Two of the most popular are TBL (Triple Bottom Line) and QBL (Quadruple Bottom Line). Both are widely used, but both have problems with their

definitions. Part of the problem is that they attempt to measure the indefinable. There are things which we can measure and things which we cannot.

We can measure and assign value, in economic terms, to scientific and economic milestones, the relative worth of invention, and profit and loss. And that's the viability underpinning of sustainability. In order for a business or a society to survive, it has to make a profit. That profit can be measured in terms of accumulated money, accumulated energy, or almost anything else. But we have to be able to count it and measure it in order to determine the viability.

The components of sustainability which we cannot measure directly are the "squishy" ones which use indirect and social indicators or judgment as a gauge to the success of the sustainability activities. How does one really measure social or environmental justice, community viability or improvement, quality of life, or even softer issues such as employee satisfaction, esprit de corps, etc.? How does one put a numerical value on these items? They can be measured only in regard to improvements in profitability or in relation to something else which we can measure. We can weigh the impact of these improvements, but only indirectly. And, the old Western Electric (Hawthorne) experiments showed that the improvements may not be real, but perceived.[4]

Profit as a measure of viability is vital to sustainability. And, it's also an economic constraint because some things are just too expensive to do. Take the modern electronic products, computers, cellular phones, televisions, etc. We do not choose to recycle all the components of the computer because it is just too expensive, even if it means disassembling computers in third world countries with underpaid labor. The expense makes recycling non-viable, and as a result the product requires new

[4] The Hawthorne Effect was first noticed at the Hawthorne Works (Western Electric) plant outside Chicago. Between 1924 and 1932. When the lighting levels on the manufacturing floor were raised, productivity increased. Productivity increased again when the lighting levels were lowered, and again when the work floor was cleared of obstacles, and work stations were relocated. The effect of the productivity increases was short lived and was believed due to the fact that the workers, (subjects of the experiments) increased productivity in response to the fact that they were being studied. It was suggested that the productivity gain was due to the motivational effect of the interest being shown in them.

sources of precious metals, water and power which are non-sustainable but necessary for our society to remain viable.

When we talk about sustainability, we should have social and societal goals in our activities and organizations, but we need to develop consistent and standardized measures for valuing and managing them. Let us work to get the metrics correct, or stop reporting and abandon them as confusing and meaningless. Arbitrary definitions and calculations mean little and inhibit our ability to evaluate the social achievements of a company or a society.

TRIPLE BOTTOM LINE AND E3 ACCOUNTING

The triple bottom line (abbreviated as "TBL" or "3BL", and also known as "people, planet, profit" or "the three pillars") captures an expanded spectrum of values and criteria for measuring organizational (and societal) success: economic, ecological and social. With the ratification of the United Nations and ICLEI TBL standard for urban and community accounting in early 2007, this became the dominant approach to public sector full-cost accounting. Similar UN standards apply to natural capital and human capital measurement to assist in measurements required by TBL, e.g. the ecoBudget standard for reporting on the ecological footprint. For societies, attempt at measurement may be popular, but is it valid? The TBL is contains social goals which cannot be directly related to the viability (or profitability) of the society. The goals cannot be monetized or measured without several pages or sometimes even reams of paper to explain the basis for the assumptions made.

Corporations (the private sector) are being pressed to make a commitment to social responsibility, and that implies a commitment to some form of TBL reporting. This is distinct from the more limited changes required to deal only with ecological issues measured by permit compliance. In practical terms, triple bottom line accounting means expanding the traditional reporting framework to take into account ecological and social performance in addition to financial performance.

Spreckley, the “father” of the TBL Social Audit wrote in 1981:

One way to investigate this balance in a practical way is to take a closer look at three important aspects of social accounting.
The first is to be able to correctly assess the various currencies e.g. the emotional currency of good or bad human relations that are in use, to be clear about the various contributions being made to produce a particular unit of wealth.
The second is the need to make appropriate judgments of the viability of objectives of an enterprise in a balanced way including financial indicators.
The third concerns the way social reporting is conducted, who carries out the audit and how the information is represented[5, 6].

Spreckley recognized the inherent social contract between a corporation and society in dealing with environmental and social challenges, but it is the third concern which is the most difficult to measure, as it depends upon personal interpretations.

"If you can't measure it, you can't control it," is a standard industrial axiom. The same is true for successful implementation of sustainable behavior. The social items we deem as important can change, sometimes very quickly, and can be quite controversial. A company's or a society's good will and reputation is something vaporous, a transient issue. Any such measure is subject to individual interpretation.

The reporting of the social contract is often neglected because the elements of the social contract are not easily quantifiable. Despite this difficulty, some companies are promoting TBL accounting—with a purpose. Steelcase, the US, the office supply manufacturer, promotes triple bottom line reporting and asserts that a well-designed workspace is an asset that can help an organization better achieve its strategic objectives[7]. Steelcase indicates that its first goal must be profitability, because <u>without profitability the viability of the firm is in question!</u>[8]

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[5] In 1981 Freer Spreckley first articulate the triple bottom line in a publication called 'Social Audit - A Management Tool for Co-operative Working' as he described what Social Enterprises should include in their performance measurement.

[6] Spreckley's social goals include items that are hard to monetize, including: employee self-realization ; individual adoption of organizational goals; mutual trust and confidence; job security; general philanthropy financial support of community projects; employment of disadvantaged & disabled; and taxes paid.

[7] And, it's also an extremely good tool for selling new office equipment.

[8] https://www.inforummichigan.org/in-the-news/steelcase-manager-urges-triple-bottom-line-people-profit-and-planet

QBL (Quadruple Bottom Line)

Quadruple bottom line reporting goes beyond triple bottom line reporting and makes businesses accountable and responsible for the economic, social, environmental and spiritual, societial or social effects of business. This idea of a spiritual aspect is gaining support because it positively affects a business' reputation and public perception. QBL concentrates on the fair treatment of human capital by providing fair wages, a safe workplace, and the performance of responsible and beneficial business practices within the community. Businesses using QBL reporting must engage in "sustainable environmental practices" and should focus on recycling, waste reduction, reducing energy consumption, and avoiding use and production of harmful chemicals. The spiritual aspect of the program seeks spiritual or societial or cultural fulfillment for all the employees who dedicate their lives and efforts to align with corporate goals.

This is nonsense! In practical terms, we cannot measure spiritual elements, let alone determine what a "harmful chemical" is. We cannot compare one organization or society with another using QBL. It's a nice idea in theory, but under close examination and practice, it falls apart for lack of verifiable metrics. If one is making a statement about social goals, he or she should be able to prove it. Otherwise, it's advertising or public relations fluff!

Social goals and a social conscience are good and necessary, but can you really measure that in monetary terms or in any standard metric? There is no standard way to calculate the TBL or the QBL. Each company must come up with its own scoring system, and that's a key problem in metrics. If each company is free to develop its' own measure of social goals and scoring system, what is the standard and how do you compare two companies? Ditto for communities. What do the large scale sustainability indices really measure? How do they benefit society or the company and how do you prove it?

POSING A NEW DEFINITION AND NEW METRICS

How far down the accounting rabbit hole do we go in our attempt to justify sustainable behavior, and where do we get our assumptions and cut off our calculations? Where are our definitions? We can recycle more, but how do we account for disposal costs and raw materials, and their impacts?

We need a definition and analyses of the behavior of resilient companies and societies. The defining metric for this different type of reporting is measuring energy. Gigajoules, or kilowatt hours should be used because it eliminates ambiguities. The measurement of the Carbon Footprint and kilograms of pollutants removed, or amount of waste recycled, are interesting measures, but what do they really tell us about comparative performance? Process differences between companies and industries preclude the 'side by side' evaluation of environmental performance[9]. Just ask the EPA. Back in the early 1980's the EPA attempted to simplify the regulation of the effluent streams from the chemical industry through "a building block approach". The strategy, soon abandoned due to its' unwieldy complexity, attempted to analyze the chemical industry by resolving it into its basic components.

If we wish to compare industries or companies, look at the energy they use per unit of production. The energy consumed by a process is relatively constant: the carbon footprint is variable and depends upon the sources of fuels. An energy footprint is irrespective of the type or amount of carbon used. Once established, an energy footprint can be used to compare the carbon credits to a common base. The energy footprint allows us to compare two companies—one using green energy and one using dirty energy. If green energy is subsidized, and dirty energy is not, that will be reflected in the cost of the energy, but not in the energy footprint it will show up in other places in the accounting

[9] Companies use different processes. Comparing a printing company's volatile emissions to a petroleum retailer's (petrol station) emissions doesn't make much sense. Part of the lack of sense is due to different regulatory compliance standards. Both can be compliant and one is excellent and the other is underperforming and you cannot tell the difference unless you know their potential to emit.

scheme. Is a company inefficiently using green energy better than a company efficiently using dirty energy?

Gigajoules or Kilowatts per unit of output is a fair comparison. For societies, it may be Gj or Kw per dwelling unit or per person or some other appropriate measure which will tell us about the society. The use of energy reporting will enable the comparison of environmental performance of competing products and societies. The goal is standardization, irrespective of fuel sources. Once the energy footprint has been developed, the comparisons between various types of energy can be readily made.

If a company or a society wants to have comprehensive social goals, that's fine. But let's not confuse them with social or environmental performance[10]. Report them as expenditures with a social purpose or as measured costs of environmental compliance. Don't try to use your social accomplishments as a measure of how good the company or society is — let the facts speak for themselves.

Yale Law School developed an Environmental Performance Index (EPI). It's show on the last page of this document. The EPI is practically meaningless because it uses sloppy and imprecise judgmental metrics. Is it well intentioned? Yes. Is it practical? NO! It represents a triumph of good intentions over practical abilities to measure the true 'profit' of a society, and expert consensus for many of the metrics. For example: The target for indoor air pollution is the elimination of solid fuels, and the target for surface waters is 1 mg/l Nitrogen – which ignores issues of ammonia versus nitrate. Some of the stated goals are arguably only marginally related to Environmental Performance.

SUMMARY

Technology impacts our society in ways both seen and unseen. Viability is the first step in becoming sustainable, but true sustainability is difficult or impossible to achieve because everything

[10] Environmental performance can only be measured with regard to the potential to pollute and the permitted allowances. Since different countries have different standards, one has to know the permitted standard as well as the potential to pollute in order to measure the environmental performance of the organization or the country.

comes from somewhere, and the building blocks of a company or a society come from resource utilization and extraction processes.

Once viability is achieved, sustainability may follow. Both are impacted by technology, and technology builds upon itself and changes the societal definitions of both viability and sustainability. Societies and corporations are encouraged to have socially responsible goals, but the reporting of those goals is often confusing and contradictory because the non-financial and non-technical goals are imprecise — they are subjective and difficult to measure or to monetize. There are few substantive and accepted metrics for determining the social impacts of their actions. The data are sparse and often contradictory. Attempting the calculation of an accurate TBL or QBL is often an exercise in fooling oneself or in "greenwashing" propaganda.

Energy consumption is a far more accurate reflection of a company's environmental performance. We can measure it very effectively, and there is a substantial database for its measurement.

We need to separate our social goals from our performance goals, and base our performance goals on energy consumption(such as KWH or Gj). We also need to develop accurate and relevant measures for those items which are part of the organization's social contract and effort. The reporting of social and spiritual goals as part of our overall environmental performance is misleading and dilutes the efforts of many environmental professionals who have dedicated their careers to reducing pollution and public protection. Let's eliminate the ambiguities and separate environmental and social goals and measure "with meaning" what really needs to be measured.

The next time someone tries to impress you with their "greenness" and talks about their social contract and the performance of it, step back and separate the social and environmental parts of the performance from one another. Then ask that person how they measure their "greenness" or "sustainability". The results may be surprising, but it will lead to an honest assessment of performance.

Table 3: EPI Indicators, Targets, and Weighting

Objective	Policy Category	Indicator*	Data Source*	Target	Target Source	Weight within Category	Weight within EPI
Environmental Health		Urban Particulates	World Bank, WHO	10 µg/m^3	Expert judgment [a]	.13	.50
		Indoor Air Pollution	WHO	0% of house-holds using solid fuels	Expert judgment [b]	.22	
		Drinking Water	WHO-UNICEF Joint Monitoring Program	100% access	MDG 7, Target 10, Indicator 30	.22	
		Adequate Sanitation	WHO-UNICEF Joint Monitoring Program	100% access	MDG 7, Target 10, Indicator 31	.22	
		Child Mortality	UN Population Division	0 deaths per 1,000 pop aged 1-4	MDG 4, Target 5, Indicator 13	.21	
Ecosystem Vitality and Natural Resource Management	Air Quality	Urban Particulates	World Bank, WHO	10 µg/m^3	Expert judgment [a]	.50	.10
		Regional Ozone	MOZART model	15 ppb	Expert judgment [c]	.50	
	Water Resources	Nitrogen Loading	UNH Water Systems Analysis Group	1 mg/liter	GEMS/Water expert group	.50	.10
		Water Consumption	UNH Water Systems Analysis Group	0% oversub-scription	By definition	.50	
	Biodiversity and Habitat	Wilderness Protection	CIESIN, Wildlife Conservation Society	90% of wild areas protected	Linked to MDG 7, Target 9	.39	.10
		Ecoregion Protection	CIESIN	10% for all biomes	Convention on Biological Diversity	.39	
		Timber Harvest Rate	FAO	3%	Expert judgment [d]	.15	
		Water Consumption	UNH Water Systems Analysis Group	0% oversub-scription	By definition	.07	
	Productive Natural Resources	Timber Harvest Rate	FAO	3%	Expert judgment [d]	.33	.10
		Overfishing	South Pacific Applied Geosciences Commission	No overfishing	By definition	.33	
		Agricultural Subsidies	WTO, USDA-ERS	0%	GATT and WTO agreements	.33	
	Sustainable Energy	Energy Efficiency	Energy Information Administration	1,650 Terajoules per million $ GDP	Linked to MDG 7, Target 9, Indicator 27	.43	.10
		Renewable Energy	Energy Information Administration	100%	Johannesburg Plan of Implementation	.10	
		CO_2 per GDP	Carbon Dioxide Information Analysis Center	0 net emissions	Expert judgment [e]	.47	

* *Note: Full indicator names, definitions, and data sources are provided in Appendix H.*

[a] *Determined in consultation with Kiran Pandey from the World Bank and other air pollution experts;*

[b] *Determined in consultation with Kirk Smith and Daniel Kammen at UC Berkeley and the indoor air pollution literature;*

[c] *Determined in consultation with Denise Mauzerall and her air pollution team at Princeton University;*

[d] *Determined in consultation with Lloyd Irland and Chad Oliver from the Yale School of Forestry and Environmental Studies;*

[e] *Strict interpretation of the goal of the 1992 UN Framework Convention on Climate Change.*