ESTABLISHING AN ORGANIZATIONAL RATIONALE FOR THE AIA'S ENVIRONMENTAL RESOURCE GUIDE

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The AIA's significant initiative, The Environmental Resource Guide, (ERG) acknowledges for the first time the use of Life Cycle Assesment (LCA) methods in mainstream architectural practice. In so doing, the architectural profession in the United States is joining a global initiative to track and understand human impact on the biosphere. This paper investigates the full potential of the LCA approach beyond its traditional use as an analytical tool. It is believed that the fundamental essence of viewing the built environment as a cyclical process from a material perspective, and as a negentropic process from an energy perspective, has vast ramifications in all areas of design. Moreover, this expanded understanding could establish a rich basis to redirect the profession towards a consciousness, understanding and application of sustainable design principles. As with other disciplines, the architectural profession has to a certain extent grown into itself. Architecture, instead, needs to become a true partner and even a leader whose tentacles become intertwined with the myriad disciplines necessary to establish the only rational future - that of a sustainable world.

WHO IS OUR CLIENT?

I believe that our client is more than who we think it is. According to the July 1991 issue of Builder Magazine published by the National Association of Home Builders, "The Green Movement is not a fad but a sea change. ...a broad-based and eminently sensible social trend...(that) could offer new housing another layer of advantages over resale competition. The statistics are compelling: 79 percent of Americans consider themselves environmentalists; 78 percent want a major national effort to improve the environment; 76 percent want businesses to do more; and, among those considered environmentally aware, research shows a willingness to pay up to 20 percent more for environmentally safe products." Our allied professional organizations, including ASLA, ASID, and ASTM, have significant efforts underway that point to a similar direction. EPA's continued support of the Environmental Resource Guide, with the help of the Department of Energy, tells us the doors are opening.

The ERG's clientele includes therefore the following: we as professionals, our own clients, our allied professions, and professions we have never really dealt with before in any direct sense as partners on the job. In addition, the AIA has an ongoing commitment to education, as expressed by the education committee for many years. Just to make sure we include both existing and possible partners, the following partial list is included:

PRESENT	POSSIBLE
ARCHITECTS	ARCHITECTURE SCHOOLS
INTERIOR DESIGNERS	CONTRACTORS / BUILDERS (NAHB)
LANDSCAPE ARCHITECTS	CITY LIBRARIES
URBAN DESIGNERS	EDUCATORS
MECHANICAL ENGINEERS	CLIENTS
STRUCTURAL ENGINEERS	LAND USE PLANNERS
LIGHTING ENGINEERS	DEVELOPERS
INDOOR AIR QUALITY EXPERTS	PLANNING AGENCIES
	CITY CONSERVATION DEPARTMENTS

WHAT IS THE PROBLEM?

Designing for a sustainable world is an integrative procedure. Too many of our tools, however, force us to think and work in a linear fashion. As a good example, CSI, the Construction Specifications Institute, just placed sustainable architecture into its index system. Sustainable architecture now has a number and is considered one possibility of many under the CSI catch-all category 13000. However, sustainable architectural design is not any particular part of architecture, nor is it a category or an element. Sustainable design deals as much with all energy as it does all material issues in building (including air, water, soil, solid waste, waste water). It deals with the design and engineering of water systems, waste water systems, communications, transportation, landscaping, urban planning, site preparation. It is a procedure and a method of design. Right now, it provides a conceptual framework to get the built environment back on track so that the earthly delights around us will continue to be with us and with future generations. The fact is, however, there is no methodology for sustainable design. The ERG provides a perfect place to introduce what the methodology should be.

If we critique our thinking habits as being archaic and linear, then what is a non-linear process? A non-linear process is life with all the feedback loops built in that enables life to continue. Linear thinking excludes feedback loops. It makes believe that the world is predictable in the way that we have planned it to happen. Can our world survive by being so highly specialized that we must take the car to the kids' baseball game two blocks away since there is no sidewalk or path to walk there? My son must wait for me to have the time to take him to the game. The car, by default, becomes the only option. Conversely, life has many options built into it, and many paths can be taken if the right tools are supplied. It is essential that these options have enough flexibility to prevent the potentially disastrous consequences associated with going down a one-way path.

HOW DO WE BUILD OPTIONS INTO ARCHITECTURE?

The most simplistic answer is to mimic nature, follow her rules. There are at least four rules that are the survival tools of natural systems:

1) Natural systems are highly redundant: one system seems always to be duplicated at a scale larger and smaller than the system being addressed.

2) Conservation of resources (energy and materials) seems to occur through the integration of highly connected components that often serve multiple functions.

3) Nature limits, whenever possible, the number of conversion steps AND the distance between these steps and tends to accomplish all needs at the smallest possible scale.

4) All the actors in every living system function in a way to ensure a continuous life cycle of materials.

Now what do these rules have to do with architecture and the ERG? **Redundancy** can occur within the design at almost any project scale. Recently we analyzed a 500,000 square foot office building in downtown Austin, Texas and found that it could capture enough rainwater to supply 94% of its total water needs thus providing a basis to rethink centralized water distribution systems and their high installation, maintenance and operational costs. The problem is the unrealistically low cost of water even in a place like Texas and the amount of subsidy incurred by the taxpayer and long term bonds. The point is that with careful design we can relook at our skewed economics. We need to offer design solutions to at least partially duplicate at smaller scales what we have forced into occurring only at larger scales in as many areas of life support as possible on all projects. Can the ERG show a variety of scales in every life support system it promotes and provide economic justification examples to support it?

Integration is the kind of design rule that has always been implicit, but has had little formal backup. What occurs when only one task is accomplished with a single design element is that a project can quickly become cost prohibitive. For example, if an alternative wastewater treatment system enables one to build in a place that had been technically impossible to build on using other techniques, the first question to ask is whether the new technology is accomplishing multiple benefits to humans and the environment (i.e. something the environment can use). The second question to ask is whether there is a strategy that can make it cost-effective from a multiple-use standpoint. But perhaps the most important question is whether to build there in the first place from the standpoint of long term human or environmental impact. Recently we designed an interior wetland for a California home. In addition to treating the home's waste water, the installation provides a lush landscape during very cold winter months, which otherwise would have been cost prohibitive. As a side benefit the system also purifies the air. One system, three functions: waste water treatment, an interior landscape, and an air purifier. In our Advanced Green Builder Demonstration Home for the State of Texas, we are creating a landscape with a rock reed flower bed 40 feet in total length, a living fence, a low pressure dosage lawn, and an orchard. To have installed these plants only for landscaping would have exceeded the project's budgetary parameters but instead are absorbed in the cost of wastewater treatment.

Conversion steps and distance are perhaps the two most frequently overlooked sustainability issues. Our food system places a single food item on a 1300 mile journey before arriving on a plate. This cannot be perpetuated. Similarly, waste water treatment cannot be efficient when hundreds of miles of pipe and pumping stations are required to accomplish what nature can do in the backyard. The greatest user of embodied energy in the construction industry is the highway sector (16.44% of total construction), followed not too far behind by the construction of single family homes (12.39% of total construction). If one analyzes all energy use on a construction site, one of the largest energy users is bringing crew and materials to the site (approximately 23% in northern climates and higher in southern). There are many examples that support this view of transportation. One, of course, that is well known is to emphasize pedestrian means of travel but there are others. A building's operational energy budget over both short and long terms could be dramatically curbed by instituting teleconferencing. As a study done by AT&T and the State of Arizona showed, if only 1% of all employees of companies with 100 employees or more in a single county in Arizona telecommuted only one day per week, the following benefits would occur.

- 9.4 million miles not driven
- reduction of 185 tons of vehicular related pollutants
- 463,000 gallons of gasoline left unburned

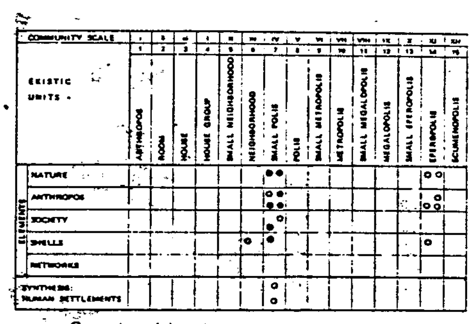
Next is the question of the number of conversion steps between source and use. The difference in efficiency, for example, between three and seven conversion processes in any particular life cycle is the arithmetic product of the number of steps, or .34 and .08 (assuming a given efficiency), more than four-fold difference. This type of quantitative analysis provides a basis to promote integrated community planning, in which such things as local production, direct buying, and other community enterprises become overarching community goals.

Finally, **Life Cycle Assessment** (LCA) is too often viewed as an analytical process. For all intents and purposes, it is impossible for the LCA to become part of everyday procedures. However, the fact is that the source to sink or, more appropriately stated, the birth to rebirth approach, is a fundamental procedure to conceptualize almost any activity. To limit LCA to materials only is falling into the trap of linear thinking, in which all other subject matter is a special case and must be dealt with differently and with different tools. If the word "assessment" is replaced by "stages within the life cycles" of energy, water, light, and any other life support issue, and adapt to scale change, then the analytical world becomes tolerable to the architect. For instance, by thinking of light as having a source, transport, conversion, and use, light becomes a more understandable concept since we can think of it within a structure that parallels how we would track a material, energy, water etc..

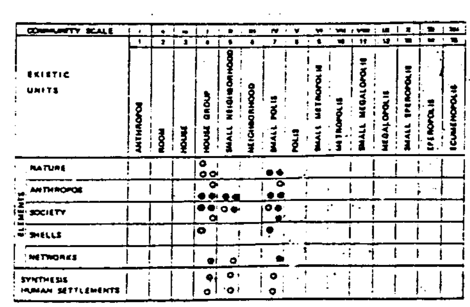
DEVELOPING AN ORGANIZATION FORMAT AND USE PROCEDURE FOR THE ENVIRONMENTAL RESOURCE GUIDE

Several working models exist that organize professional publications to facilitate their use. Few, however, have tried to introduce a design methodology or evaluate how an office may be set up to better accomplish specific goals. To our knowledge, no attempts have been made to do this based on sustainable design principles. So, what is about to be discussed could be more than we want to get into, but my own viewpoint is that "we are about to enter the 21st century folks, so let's give it a whirl."

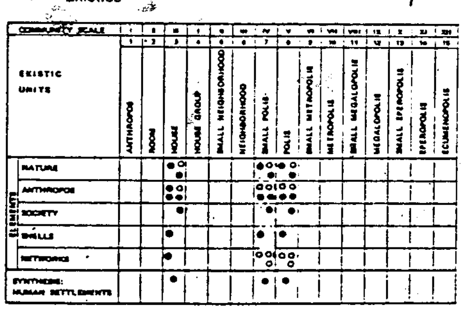
To start with, let's go back to some of those older attempts. By far the most well known is Ekistics out of Athens, Greece, Doxiodos' publication that is now some 30 years old. In that publication, every issue and every article was categorized according to a format that cross-related 15 scales of the building domain, from anthropos to ecumenopolis (the global village), with five of what were called elements (nature, anthropos, society, shells, and networks). Without spending time going too deeply into this format, some examples are supplied below.



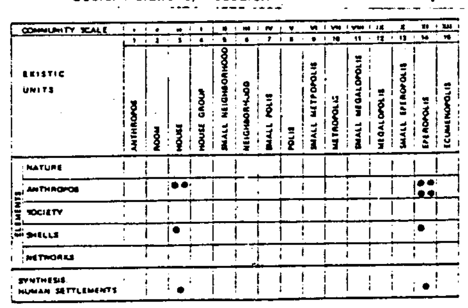
Current social and economic indicators p.256
Housing, Technology, Community Organization,
Ekistics I



A community in the making p. 271
Community Organization, Urban Design,
Social Relations, Research



Learning about settlements and energy p. 262
Housing, Urban Design, Energy, Culture,
Research, History
World General I,R



The consultant and the people p. 269
Ekistics, Anthropos, Planning Practice

Another less well known, but more thoroughly explored format, was put together by Industrialized Forum, a journal produced in the early 70's during the hallmark years of the industrialized building industry. This was a combined effort by the National Research Council of Canada and several foreign governments, professional societies and schools of architecture, including the U.S. (e.g. U.S. Department of Health, Education and Welfare, the Association of Collegiate Schools of Architecture, MIT and Washington University). As with Ekistics, each issue of Industrialized Forum provided an indexing system, in which the information was purposely relationally related in as close as one could get during that period to a Hypercard™ type retrieval. An example of this information system appears below.

HOW TO USE THE "INDUSTRIALIZATION FORUM" INTEGRAL INFORMATION SYSTEM.

STORAGE:
(read down)

Articles in IF.

I. Do you use the IF accession numbers (A)? If not, enter your own filing system numbers in the two spaces provided (B);

II. Place the article in your file or on your shelf in a position described uniquely by the number; IF numbers (A) are used in ascending numerical order (gaps in the numbers represent reserved spaces for other documents, see step V below); if your numbers are used your own system rules will apply.

Abstract Cards Provided by IF.

III. Do you use the IF accession numbers (A')? If not, enter your own filing system number in the space provided (B'); be sure to use the same number for IF articles (B) and the abstract cards referring to them (B');

IV. If you possess the original document (necessarily the case with IF articles), check the "on hand" box (G); if not, check the "not on hand" box; if you know where the document can be consulted, (e.g. in the local library) enter the appropriate indications in the space provided;

V. If you decide to order the document, refer to the information on the back of the card (*"Available from:"* and *"Price:"*); upon receipt, check "on hand" and give the document the *same* accession number as the abstract card (A' or B') and file it on the shelf in the space ready for it (see step II above);

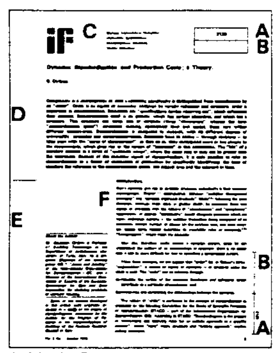
VI. Place the abstract card in a card file; if IF numbers are used (A'), the cards will be filed in continuously ascending numerical order.

Keyword Cards Provided by IF.

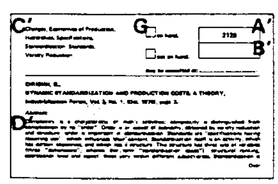
VII. Take out the cards with the keywords (C") corresponding to each of the keywords on one abstract card (C'); if it is a new keyword, enter the word on a blank card; if you do not have a card, order some blanks from IF. In all cases, enter the word on the top left hand corner of the card.

VIII. Enter the accession number (A" or B") identical to the number found on the abstract card; write it in the column which bears the same number at the top as the **last digit** of the accession number (for example, 2129 would be entered in the top available space under the 9); if you use the IF numbers (A'), the list on page 2 of this issue is a great help, and it is probably quicker to enter all the IF numbers on each of the corresponding keyword cards at once rather than abstract by abstract;

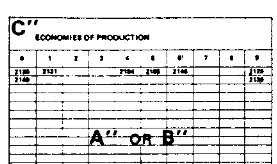
IX. Place the keyword cards in a card file in alphabetical order.



Articles in IF.
The lead page of each article contains all the information required for its proper entry into and retrieval from the system.
A = IF accession numbers, common to both articles and the corresponding abstract cards;
B = space to enter alternative numbers;
C = keywords corresponding to important concepts in the articles;
D = abstract, also reproduced on the corresponding abstract card;
E = author's biographical note;
F = start of the text.



Abstract Cards Provided by IF.
The abstract cards act as guides for information storage and retrieval, and provide quick information about the documents.
A' = IF accession numbers;
B' = space to enter alternative numbers;
C' = concepts corresponding to important concepts in the original document;
D' = abstract, usually in three parts: (i) indicative, (ii) informative and (iii) additional notes; also availability and price are given;
G = space to indicate where the document can be found.



Keyword Cards.
The keyword cards are the operative part of the system. Blank keyword cards can be obtained from IF, (use the order form facing the table of contents).
A" = space where IF accession numbers are entered;
B" = space where your system numbers are entered;
C" = keyword.

RETRIEVAL:
(read up)

V. Retrieve the original document from your file or shelf (locations described uniquely by A or B), or obtain it from the most convenient local source or from the publisher.

IV. Go to the abstract card file and take out the cards bearing the corresponding numbers (A' or B'); scan the keyword list (C') and the abstract (D') to confirm relevance; ascertain (from entries G) whether you possess the original document or whether you wish to obtain it and how;

III. Compare the keyword cards for common accession numbers (A" or B"); this is made easier (i) by scanning the columns vertically and (ii) by starting with the numbers on the card with the fewest entries; common numbers are the accession numbers of the documents which include all those concepts; if no number is common, eliminate the least important concept and corresponding keyword card; if too many numbers are common, add a further keyword to orient your query more exactly;

II. Corresponding keyword cards (C") are selected from the alphabetical file; if no card exists for any of the keywords, this means that you do not have an abstract of a document containing that concept in your files yet;

I. Formulate the subject of your query clearly in natural language; select appropriate keywords from the thesaurus (*) that best express the principal concepts in your query; usually 4 or 5 keywords will be chosen;

**use order form facing table of contents.*

In certain ways, the ERG reflects these efforts: a loose leaf binder ready for personal filing and a mixture of good general-to-technical information concerning any given topic. Today, however, the opportunity to evolve the ERG as an organizational tool has greatly improved. For example, the 15 Ekistic categories can become more universally accepted data sets and biogeographic boundaries. Specific organizations can be used as technical support associated with many of these boundaries scales, according to the specific topic being addressed. In our version (below) we come up with 16 categories that serve as identifiable scales.

Now we must determine what sustainability topics would be addressed and how they coincide with accepted architectural practice. The path I am suggesting consists of ten topic areas that cover all sustainability issues. Over time, these would have much more detailed content explained. The topics would be cross-related to Masterformat categories, but placed in a sequence that relates more to the sustainable design process from concept development to infrastructure issues. This would result, for example, in shifting some of the first sections that have limited impact on this process. These categories would be cross-related to the 16 scales above. Together, they would supply the context that every article (theoretical, technical or built) would be categorized under. Sustainability topics would then relate to the life cycle stage that each of these areas deal with. The purpose is to match each one of the 16 scales with information on that topic and to show the extent to which work has been accomplished on a technical basis with life cycle assessment.

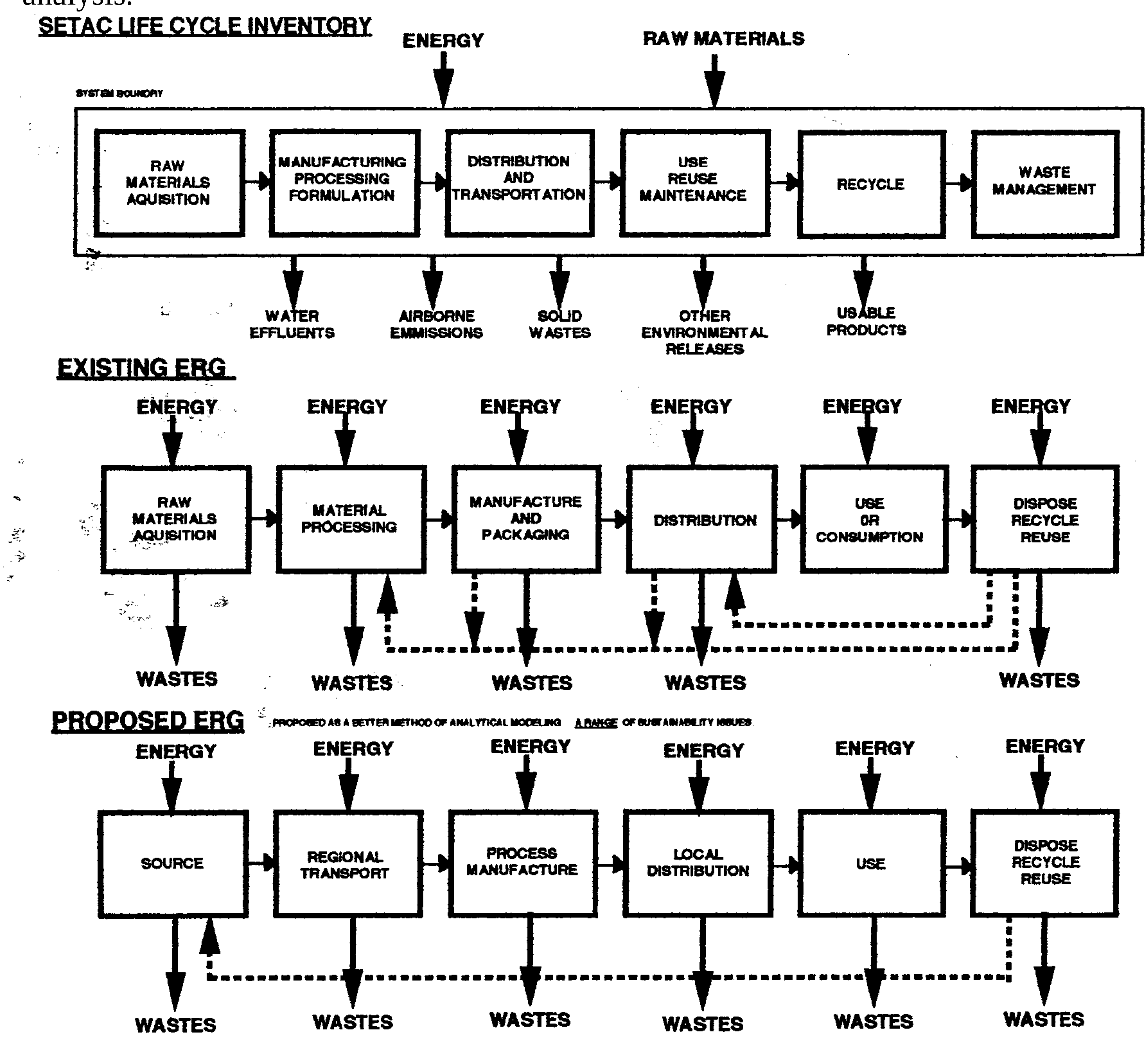
ERG INFORMATION CATAGORIZATION	SCALE OF ACTIVITY															
	1	2	3	4	5	6	7	6	9	10	11	12	13	14	15	16
CONTEXT	BIOSPHERE	BIOME	COUNTRY	MEGALOPOLIS	PLANNING REGION	COUNTY	CITY	TOWN/SECTOR	NEIGHBORHOOD	SMALL NEIGHBORHOOD	CLUSTER	SINGLE BUILDING	ASSEMBLAGE	BUILDING COMPONENT	ELEMENT	CONSTITUENT
SUSTAINABILITY TOPICS: A GENERAL REQUIREMENTS ANALYTIC MODELS																
B SITE PLANNING, SITTING, LANDSCAPING,																
C ENERGY SYSTEMS RENEWABLE, NONRENEWABLE																
D MATERIALS, STRUCTURE, SHELL, FACIA																
E WINDOWS, DOORS, NATURAL LIGHTING																
F M,ECHANICAL, HEATING/ COOLING, /VENTILATION																
G CONVEYING, TRANS-PORT SYSTEMS																
H ELECRIC DISTRIBUTION, COM-MUNICATIONS,CONTROL SYS																
I INTERIOR FINISHES, FURNITURE, PAINT																
J WATER,WASTEWATER, SOLID WASTE																

ERG			LIFE CYCLE STAGE					
CONTENT		MASTERFORMAT CSI INDEX DIVISIONS	SOURCE	TRANSPORT	PROCESS	DISTRIBUTE	USE	REUSE/RECYCLE
A	GENERAL REQUIREMENTS ANALYTIC MODELS	01000						
B	SITE PLANNING, SITTING, LANDSCAPING,	02000 13000						
C	ENERGY SYSTEMS RENEWABLE, NONRENEWABLE	13000						
D	MATERIALS, STRUCTURE, SHELL, FACIA	03000-13000						
E	WINDOWS, DOORS, NATURAL LIGHTING	08000						
F	M,ECHANICAL, HEATING/ COOLING, /VENTILATION	15000						
G	CONVEYING, TRANS-PORT SYSTEMS	14000						
H	ELECRIC DISTRIBUTION, COM-MUNICATIONS,CONTROL SYS	16000 13000						
I	INTERIOR FINISHES, FURNITURE, PAINT	09000 12000						
J	WATER,WASTEWATER, SOLID WASTE	11000						

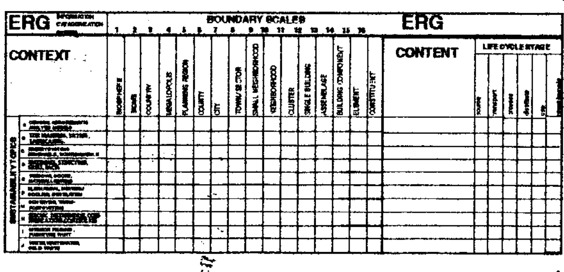
Scale of activity and life cycle stage are the two essential ingredients to understand and use the proposed ERG re-organization. All information concerning processes or products can first be associated to a scale or scales of activity, and these scales (from the actual chemical element through to the home and finally to the city, region and biome), along with the particular sustainability topic, become a quick referencing base. Three articles from past ERG supplements will serve to illustrate: 1) On-Site Wastewater Treatment: Septic System Design and Alternatives 2) Preventing Non-point Source Pollution: Controlling Urban Runoff and 3) Resort Development in Partnership with Nature would be categorized as follows:

	1.	2.	3.
SUSTAINABILITY TOPIC	J	B	A,B,C,D,F,J
SCALE OF ACTIVITY	12	6-12	11
LIFE CYCLE PHASE	P	T,P,	S,T,P,D,U,R,

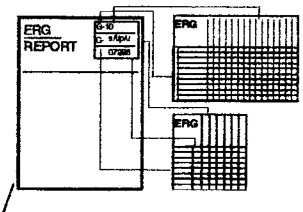
The reader will note that our life Cycle sequence is slightly different than that accepted by the present ERG as developed by EPA and the Research Triangle Institute. Both the method proposed and the ERG use six steps, however, step three in the proposed method lumps processing, manufacturing and packing together while placing transportation in the second step (as diagrammed below). There are two reasons for this: <u>first</u> different groups (i.e. SETAC, EPA) choose different sequences for the LCA depending on their goals while still retaining identical overall end results, <u>second;</u> from a regional planning standpoint there are usually at least two distinct transport phases in the life cycle of any product and they appear often in regional analysis.



THE ERG APPROACH

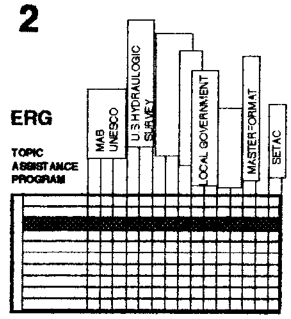


1



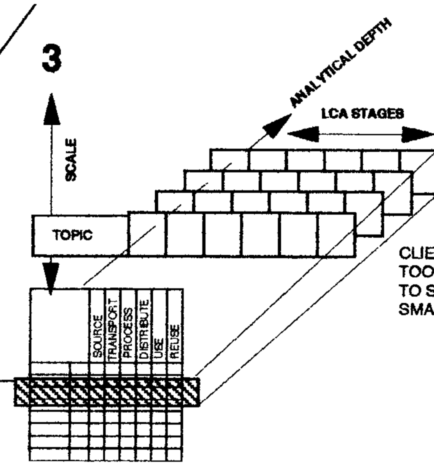
DATA ORGANIZING STORAGE AND RETRIEVAL INCLUDING THE ERG

2



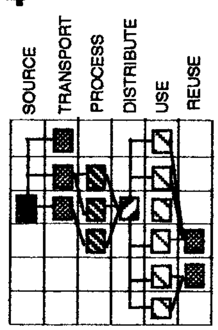
ASSISTANCE ORGANIZATIONS LOCAL TO NATIONAL TOPIC BY TOPIC

3



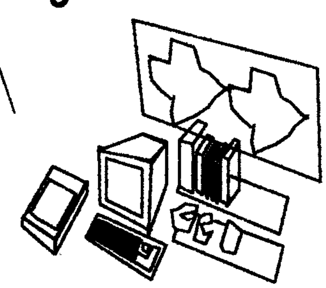
CLIENT AND EDUCATION TOOLS FROM GENERAL TO SPECIFIC AND FROM SMALL TO LARGE SCALE

4



MODELING PROCEDURES FROM ENERGY TO WASTEWATER AND FROM LIGHTING TO MATERIALS USING THE SAME PROCEDURAL FORMAT

5



THE SUSTAINABLE OFFICE USING ELECTRONIC VS PAPER STORAGE, TELECOMMUTING VS THE HUGHWAY, AND DISPLAY SYSTEMS RELEVANT TO REGIONAL SUSTAIANBILITY CRITERIA