USING TECHNOLOGY TO IMPROVE THE QUALITY OF CITY LIFE

John Hadjinicolaou
Department of Building, Civil, and Environmental Engineering, Concordia University, Montreal,Canada.

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Summary

One of the consequences reflecting the awareness of the scientific community to the ecological crisis, was the development of Environmental Indices and Indicators, which led to the re-definition of quality of life and more particularly the quality of city life. Quality of life indices and indicators were developed together with Ecoindicators, indicators of urban sustainability and community and neighborhood indicators. Simultaneously new technologies for the monitoring of air, water, soil, groundwater and the improvement of the waste disposal have emerged in the applied engineering scientific front. The challenge remains to use new and old technologies in an harmonious marriage with the quality of life and in particular to develop the framework to define, study, estimate and evaluate the indices and indicators to improve the quality of city life in the 21st century.

1. Introduction

A critical theory of technology attempts to develop a dialectical optic that avoids one-sided approaches in theorizing and evaluating the genesis of new technologies and their often contradictory effects. The ideology of the global city and virtual community has both promoters and critics who both are failing to adequately conceptualize the effects of the old and new technologies to the quality of life.

We need to develop a critical theory of technology in order to sort out positive and negative features, the upside and downside, the benefits and the losses in the development and trajectory of the new technologies. It is necessary to counter the promises of technological utopia, that technology will solve all our problems, produce job for everyone, generate a wealth of information, entertainment and education, connect everyone, and overcome boundaries of gender, race and class. We also need to counter technological dystopia that technology is our damnation, the vehicle of alienation, tool of domination.

Both approaches are one-sided and reveal the need for a dialectical theory that plays off extremes against each other to generate a more inclusive position, indicating how technology can be used both as instrument of domination and emancipation, and as a tool for both dominant societal powers and of individual struggling for a better quality of life.

This positive view of technology will be explored in the following section with particular emphasis on the interrelationship between technology and quality of life.

2. Environmental Indices and Indicators

An “Environmental Index” in its broadest concept is a numerical or descriptive categorization of a large quantity of environmental data or information, with the primary purpose being to simplify such data and information so as to make it useful to decision makers and various publics. Environmental Indices can be useful in accomplishing one or more of the following objectives:

1. To summarize existing environmental data.
2. To communicate information on the quality of the affected (baseline) environment.
3. To evaluate the vulnerability or susceptibility of an environmental category to pollution.
4. To focus attention on key environmental factors.
5. To serve as a basis for the expression of impact by forecasting the difference between the pertinent index with the project and the same index without the project.

It should be noted that an environmental index is not the same as an environmental indicator. “Indicators” refer to single measurements of factors or biological species, with the assumption being that these measurements are indicative of the biophysical or socioeconomic system.

According to Hunsaker and Carpenter, Ecological Indicators have been used for many decades. Odum in 1959 suggested that some of the important considerations, which should be borne in mind in dealing with ecological indicators are as follows:

1. In general, “steno-” species make much better indicators than “eury-” species. Steno means “narrow” and eury means “wide”. Steno- species are often not the most abundant ones in the community.
2. Large species usually make better indicators than small species, because a larger and more stable biomass can be supported with a given energy flow. The turnover rate of small organisms may be so great that the particular species present at any one moment may not be very instructive as an ecological indicator.
3. Before relying on a single species or groups of species as indicators, there should be abundant field evidence, and, if possible, experimental evidence that the factor in question is limiting. Also, the species ability to compensate or adapt should be known.
4. Numerical relationships between species, populations, and whole communities often provide more reliable indicators than single species, since a better integration of conditions is reflected by the whole than by the part.

Environmental indicators have also been suggested as useful tools for monitoring the state of the environment in relation to sustainable development and associated environmental threats, by the European Organization for Economic Cooperation and Development. Indicators are being considered which would enable the measurement of environmental performance with respect to the level of (and changes in the level of) environmental quality; the integration of environmental concerns in economic policies more generally through environmental accounting, particularly at the macro level.

While some environmental indices are fairly complicated from a mathematical perspective, it should be remembered that simple comparisons of data can be useful like the following ones:

Existing quality / Environmental quality standard
Emission quantity or quality / Emission standard
Existing quality / Temporal average
Existing quality / Spatial (geographical) average

According to Alberti and Parker, it is considered that the risk of distortion that can occur in the simplification process implied by aggregating environmental variables into a single value can be minimized by the careful selection of indices their systematic usage and a comparative interpretation of results,

2.1 Development of Indices

Several generic steps are associated with the development of numerical indices or classifications of environmental quality, media vulnerability, or pollution potential of human activities. These include factor identification, assignment of importance weights, establishment of scaling functions or other methods for factor evaluation, determination and implementation of the appropriate aggregation approach, and application and field verification.

The first step is the development of factor identification. “Factor identification” basically consists of delineating key factors that can be used as indicators of environmental quality, susceptibility to pollution, or the pollution potential of the source type. Factor identification should be based on the collective professional judgment of knowledgeable individuals relative to the environmental media or pollution source category. According to Linstone and Turoff, organized procedures such as the Delphi approach can be used to aid in the solicitation of this judgment and the aggregation of the results.

The second step in the development of an index is the assignment or relative importance weights to the environmental media and/or source transport factors, or at least the ranking of these factors in order of importance. Some techniques, which could be used to achieve this step include the Delphi approach, unranked-pairwise-comparisons, multiattribute utility measures, rank ordering, rating against a predefined scale, and the nominal group process.

The “nominal group process” technique has been used in many environmental studies. In the case of importance weight assignments, four steps were identified by Canter, Knox, and Fairchild in 1987: (1) nominal (silent and independent) generation of importance weight ideas in writing by a panel of professionals, (2) round robin listing of ideas generated by participants on a flip chart during a serial discussion, (3) discussion of each recorded idea by the group for the purposes of clarification and evaluation, and (4) independent voting on priority ideas (or importance weights), with the group decision determined by mathematical rank ordering.

Several approaches have been used to scale or evaluate the data associated with factors in index methodologies. Examples of techniques for scaling or evaluation for this purpose include the use of (1) linear scaling or categorization based on the range of data, (2) letter or number assignments designating data categories, (3) functional curves, or (4) the unranked-pairwise-comparison technique.

The development of scaling or evaluation approaches should be based on the collective professional judgment of individuals knowledgeable in areas related to the environmental media or pollution source category. The techniques used can be based on published approaches used by others, or on the application of structured techniques such as the nominal group process or Delphi approach.

Aggregation of the information on the weighted and scaled (or evaluated) factors into a final numerical index (or classification) is the important next-to-last step in the development of the index. The aggregation may include simple additions, multiplication, and/or the use of power functions.

A final step in the development if an index-classification should include field verification of its applicability. This may involve data collection and statistical testing ranging from simple to complex. At a minimum, the usability of the index should be explored in terms of data needs and availability.

3. Quality of Life

3.1 Defining Quality of Life

Quality of Life can mean different things to different people. Some would argue that in order for a neighborhood to have a good quality of life, residents should feel safe from crime, live in affordable and high quality housing, and should have access to education and employment. These are basic expectations for a community. They transcend economic status, age, race, household composition, or any other demographic characteristic.

One person may define quality of life as enjoying the beauty of a sunset, while another would describe it as sharing a holiday celebration with family, working in the garden, watching football game or solving a crossword puzzle. For each individual, the definition is different and deeply personal. Each individual has his own personal standard of what is valued and what determines quality in his life.

In defining quality of life, many different factors may be considered such as: the ability to think, make decisions and have control in daily life; physical and mental health; living arrangements and social relationships; religious beliefs, and cultural values; the financial and economic situation. Each person decides what is important and what determines quality in his life.

There are however, other more subjective or less tangible factors of what makes a neighborhood an enjoyable place to live. These ideas include the appearance of a neighborhood. Is it clean? Are there parks? What do the houses look like? It includes economic vitality. Are there shops in the neighborhood? Is transportation available for those without automobiles? And finally, the physical and civic health of the residents is important. Is the environment clean? Are there opportunities for civic involvement? Are the children doing well in school?

Defining Quality of Life is a task and a challenge. Part of the challenge is the continuous reassessment of its expression.

3.2 Quality of Life Index

"Quality of Life" QOL is a term, which has been developed to indicate the overall characteristics of the socioeconomic environment in a given area in many instances, structured approaches (including indices) have been developed to describe QOL. Canter, Atkinson, and Leistritz in 1985, provided a comprehensive review of nine such approaches (or methodologies), with the nine divided into three groups:

1. *Structured checklists:* Those approaches wherein the QOL or social well-being considerations are organized into categories and associated factors.

2. *Structured checklists with importance weights:* Those approaches wherein the categories and factors have been previously assigned relative importance weighting are to allow calculation of a numerical QOL index.
3. *Structured checklists with interpretation information:* Those approaches wherein information is provided on whether the information on a given factor should be interpreted as positive or negative in terms of improving QOL. Further, it should be noted that increases in the numerical information for some factors denotes a QOL improvement (+), while for other factors increases may be negative (-), or denoting a lowered QOL.

Based upon a review of the nine approaches, and considering the availability of information, Canter, Atkinson, and Leistritz proposed a generic structured checklist for QOL, with this checklist based on the application of the following recommendations:

1. The approach (list of QOL factors) should be comprehensive in the use of "life domains". QOL consists of many dimensions.
2. The approach should incorporate both perceptual and objective QOL factors (indicators). These two basic types of indicators essentially account for different phenomena.
3. Specific factors should be chosen based on local conditions. No one set indicators should be applied across all conditions.

Table 1 contains the generic structured checklist proposed by Canter, Atkinson, and Leistritz. The framework in this table is adaptable to a variety of conditions. This framework is based on three components: (1) categories of quality of life needs, (2) domains, and (3) specific indicators (factors).

Thus, any methodology to predict and assess QOL impacts should address four categories of needs: basic, well-being, opportunity, and amenity. Within each of these categories several domains must be included. For example, basic life needs should include income and housing components:

Well being needs should include employment, health, and safety components. An approach, which fails to include this diversity of domains, is likely to distort QOL. Within each domain, a variety of indicators can be used. Selection of these indicators should be based on local conditions, the time and resources available for data collection, and the data already available.

Typically, information on most of the objective indicators is routinely available from census records, institutional databases, chambers of commerce, and the like. However, this is not true for perceptual indicators, which may require data collection activities using tools such as new surveys or questionnaires.

Simpler indices for analyzing the social and/or socioeconomic implications of development projects have been advocated by the Asian Development Bank. One example is the human development index (HDI) for developing countries. The HDI combines the three factors considered to best represent the human condition, that is: life expectancy, literacy, and income. Many other indices of this type are used by international development and aid agencies.

GENERIC STRUCTURED CHECKLIST FOR QOL

Category	Domain	Indicators (factors)
Basic Life Needs	Income	Household income distribution Real income Income per capita Cost of living index
	Housing	Percent of owner occupied housing units Median value, owner occupied, SFDU's Net housing starts Vacancy rate Satisfaction with housing
Well-being Needs	Employment	Unemployment rate Percent of labor force employed Satisfaction with employment and job opportunities
	Health	Infant mortality rate Communicable disease index Number of physicians per 1000 people Hospital beds per 1000 people Death rate per 1000 people Satisfaction with health care
	Safety	Crime seriousness index (per 1000 people) Number of police per 1000 population Percentage of crimes cleared by arrest Percentage of recovered stolen property Perceived safety
Opportunity Needs	Education	Public school expenditures per capita Public school tax base School enrollment Continuing education opportunity Satisfaction with education opportunities
	Transportation Mobility	Ratio of miles of surfaced streets to miles of unsurfaced streets Number of traffic accidents per 1000 people Motor vehicle registrations per 1000 population Percent of workers who use public transportation to work Satisfaction with transportation
	Information	Number of books in public library per 1000 people Local Sunday newspaper circulation per 1000 population Local radio stations per 1000 people
	Equality	Ratio of white to non-white unemployment rates Ratio of male to female unemployment rates Percent of families with incomes below poverty level Perceived inequality among residents
	Participation	Percent of eligible voters Vote turnout in local elections Satisfaction with opportunity to participate
Amenity Needs	Recreation	Acres of parks and recreational areas per 1000 population Miles of trails per 1000 population Satisfaction with recreational opportunities
	Environmental Quality	Air pollution index Mean annual inversion frequency Water pollution index Noise pollution index Satisfaction with environmental quality
	Cultural Opportunities	Cultural events per 1000 people (dance, drama, music events) Fairs and festivals, annual rate Sports events Satisfaction with cultural opportunities

Table 1. Generic structured checklist for Quality Of Life (QOL)

3.3 Quality of Life Indicators

The U.S. Environmental Protection Agency defines an indicator as "a statistic or measure which facilitates interpretation and judgments about the condition or an element of the world or society in relation to a standard or goal". State of the Environment (SOE), quality of life, healthy city and watershed regeneration reporting are just a few examples of how many different types of indicators are now being used. Virginia Maclaren's *Developing Indicators of Urban Sustainability: A Focus on the Canadian Experience* provides a thorough review of the different types of indicators, frameworks and applications of indicators in the Canadian domain.

Indicators have various users and uses. Indicators can be used to monitor compliance with policy and regulations. They can be a management tool to help improve the efficiency with which municipal services are provided. They can act as a source for public information, and therefore result in improved citizenship. Indicators can also help identify areas under stress, identify opportunities for improvement, set priorities, allocate resources and provide a means of measuring accountability. The usefulness of indicators is highlighted by the diverse array of potential users, varying from municipal planners and elected officials to citizens groups and teachers. Given the wide range of potential applications of indicators, their development can be guided through the use of one or more conceptual frameworks.

The educational and awareness-raising impact of indicators is extremely valuable. Widespread knowledge about the state and quality of the environment is what will form the foundation of a community, a province, a planet that is headed towards a sustainable future. Indicators are in essence, a tool that communities can use to achieve a more sustainable community. One significant user and possible facilitator of this type of information is the community-based monitoring group. Community monitoring groups are non-government organizations that monitor various indicators of ecosystem health. They rely on volunteers to do the monitoring, and aim to initiate change either through education, or through the creation of formal or informal networks of communication. Community-based monitoring groups are an organizational facility through which citizens can exercise their influential power in order to help maintain the integrity of their local environments. Citizens can use indicators to emphasize which components of the community they live in are most valuable to them. Hence, community based monitoring groups empower citizens to act upon their values and help ensure that they are respected.

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Biographical Sketch

Dr. John Hadjinicolaou has been working in the field of environmental engineering since he received his Ph.D. degree in 1983. He was a visiting research fellow for two years in Environment Canada and for eight years a senior Research Associate at the Geo-environmental section of the Geotechnical Research Centre of McGill University. Since 1983 he is teaching at McGill University in the area of Environmental Engineering and since 1999 also at Concordia University at the Department of Building, Civil and Environmental Engineering as an Adjunct Associate Professor.