PLANNERS LEARNING THE NEW LANGUAGE!

Environmental Quantitative Evaluation and Knowledge Management Tools

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Abstract

Are planners and educators in the Arab world ready to adopt new quantitative approaches to evaluate sustainable development? What are the strengths and limitations of these new techniques and to what extent can they be adopted in the planning schools of the Arab world. Emergy indices. ecological footprint. maximum em-power and environmental loading are but a few of the new vocabulary that environmental urban and regional planners have been reading and hearing about in the last decade or so. The complicated and integrated nature of the environment. coupled with a desire to be more quantitative. has brought about various disciplines over the years that are probably less readily adopted in traditional planning projects. This paper reviews from a planner's perspective the meaning. application and applicability of these approaches. In particular the review looks at those based on biophysical. ecological and systems process theories. It is based on the various and somewhat controversial literature. in addition to a net review of current planning programs and course.

The methodology follows the contextual changes in planning since the turn of the millennium to identify their implications for the planning profession and education. It then reviews three of the most common environmental evaluation theories; monetary; biophysical and knowledge management. The final part reviews applications made to planning schools in the Arab World.

Monetary evaluation tools have been found to be the most common. although limited in scope. both globally and within the Arab world. Biophysical sustainability assessment methodologies have been found more accurate and objective. but require huge amounts of data that is not traditionally collected. Of all Biophysical tools. Ecological Footprint seems to be relatively the most widespread. while very few practical examples have been found for emergy indices. Knowledge Management tools are seen assisting planners with complex multi-party decision-making and data management problems. Their adoption by planners in the Arab world will probably be lead by practioners and large planning organizations. It may be useful however to introduce them within classes of information systems and computer applications.

INTRODUCTION: The Changing Context of Planning

"The physical design of cities and their economic functions are secondary to their relationship to the national environment and to the spiritual values of human community." Lewis Mumford , 1937

There is little question that something is changing in the way planning is practiced across the globe. The traditional boundaries that were protecting and harvesting its colonial and post-colonial birth from the womb of architecture and engineering are beginning to give way to new infusions from so many other disciplines, each bringing along their perspectives and tools. True that planning has long been a multi-disciplinary science, and that was its core strength, but today its point of influence is also changing. As Friedman (2005) observes: in trade between cities, in trans-boundary migrations, in the global 'space of flows' of finance capital, in the relation between public and private, in the fusions and hybrid creations of culture, and most of all: in the model of sustainability that is needed to make cities more livable.

Whatever the name, something very important is clearly happening. For planners, it specifically means that the traditional concern with land use needs to be brought into relation with sustainable economic growth, social diversity and justice, and the stewardship of the Earth. The changed nature of the challenges confronting cities calls for new approaches to planning. Some of these challenges have already been acknowledged in western countries and new tools are being developed to address them in planning education, but others are also thought. As Freidman (2005) states, "the old planning was limited in its scope to physical design, land use, and the pattern of transport routes. Increasingly, however, planners are challenged to address urban issues from a perspective of sustainability, with its overlapping economic, environmental, and socio-cultural dimensions. In any given situation, it is a matter of balancing these concerns, of setting priorities without forgetting that all three are as important as urban development." In response, Friedman (2005) called for a changed approach to planning education as well as to official planning practice.

This paper reviews some of these emerging new tools, their applications and implications within the Arab world. First, however, it is important to scope these global changes and challenges and specify what planning tools are being introduced to incorporate them into planning practice.

We can identify three major changes re-shaping our planning focus (Figure 1).

Sustainability of Cities: This, of course, is not new. Ever since the Brudntland

Commission report of 1987 (and even before – Rome 1974) the alarm bells have been ringing with concern over the future and the status of the environment. What is new however, are two things that stem form that. First, the ever-growing rates of urbanization – particularly in the developing world and in growing economies such as China and India. Second, is the formal institutionalization of sustainability goals in the western world – particularly Europe (through the EU) since 2002. These two factors put together mean that the planner is now more concerned with not just the capacity and livability of cities, but also with its global impact on the local, regional and global environment.

Globalization of Cities: Some view the trend towards globalizing cities as necessarily a cultural concern, one that stems from the fear over the destiny of local heritage and character of the urban area, what Friedmann (2005) calls "greater homogenization". However, globalization is being translated urban-wise into the insertion of cities into the 'space of flows' of global finance, information, and cultural exchanges. What that means for the profession of city and regional planning, (or spatial planning) is that the customer of the plan becomes no longer the current resident or rural migrant, but also and primarily a mysterious multi-lateral corporation that is in greater need for flexible plans and dynamic regulatory and policy frameworks.

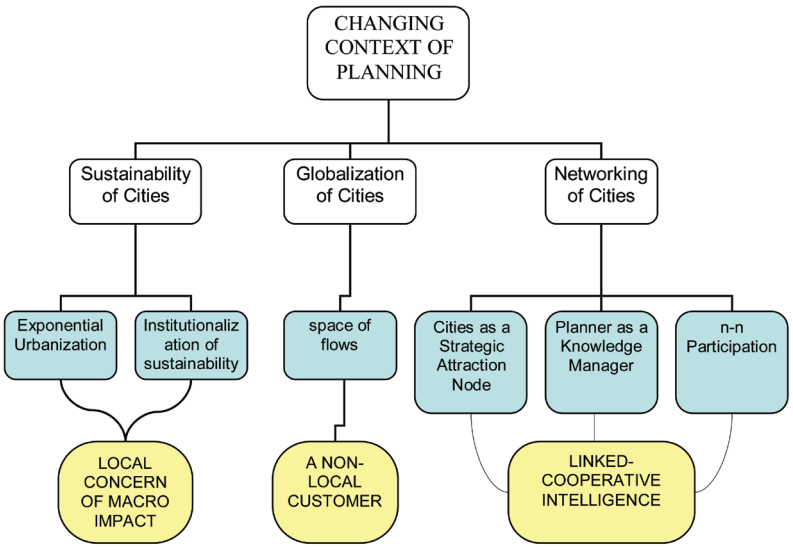


Figure 1 - Changes in the context of planning and what they mean to the profession

Networking of Cities: The turn of the century has brought about a new way of integrating information and generating knowledge. This has affected planners in three ways: first, intra-border communication has made the networked city "a strategic attraction node" in the dynamic competition for financial transactions, trade, migration, and information (Taylor et al., 2004). Second, inter-border communication means that the planner manages ever-growing volumes of data

and information that can hardly be managed using traditional data-collection tools. Third, the concept of participation is transformed from the one-to-many, but many-to-many. As Kellogg (1997) puts it "this new age of many-to-many communications will allow us to rebuild our COMMUNITIES" and "Individual genius will always have its place, but the years ahead will be defined by the genius of LINKED and COOPERATIVE intelligences".

We interpret the planners adaptive needs to these changes as essentially (1) seeking and understanding various quantitative and objective sustainability evaluation tools designed outside the traditional planner's context, and (2) learning and using multi-party knowledge management and decision support tools developed by experts. We begin by looking at the quantitative methods aspect as they relate to the planners education.

TRADITIONAL PLANNERS QUANTITATIVE EVALUATION TOOLS

Planning academics in the west seem (to some extent) in-tune with some of these changes. Ferguson traces the use of 6 skill groups of quantitative tools (based on Isserman's skill categorization) used by planners in the USA since the 1970s and until the 1990's. The changes are measured by the percentage of planning schools (sampling 40-60 schools) that require courses in these skills from their graduates. They include the following general types of more or less numerically inclined planning skills:

1. Computers (spreadsheet and database applications; planning and geographic information systems; computer languages and programming)
2. Data collection (focus groups, surveys and sampling; Census and other secondary data; literature reviews and other sources of tertiary data)
3. Forecasting (population, employment, and housing; urban growth and economic development)
4. Modeling (land use and activity systems; transportation systems and urban travel behavior; simulations, systems analysis, and operations research)
5. Evaluation (fiscal, economic, community, development, neighborhood, social, environmental, ecological, and political impacts)
6. Statistics (descriptive, inferential, and multivariate statistics; regression, factor, and cluster analysis).

The observed changes are shown in Figure 2 .

He notes that between 1974 and 1992, the four skill groups experienced

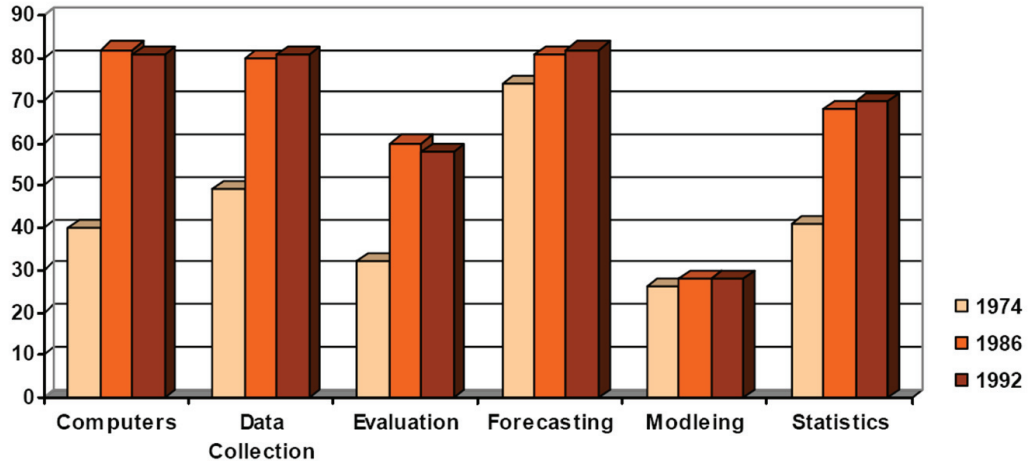


Figure 2- Changes in the percentage of US planning schools requiring certain quantitative skills 1974-1992

the major increases in teaching occurred, namely: computers, data collection, evaluation, and statistics. The percentage of planning schools with computers and evaluation as required subjects both doubled during this time. Two analytical skill groups showed no significant increase: forecasting and modeling.

Our particular concern for the purpose of this paper is in evaluation methods. He notes among other things that "economic impact and cost-revenue (or financial) analysis are included, while social and environmental impact analysis are excluded from all three". He says further, "economics is an important aspect of evaluation, but it is not the only way of looking at the world in terms of assigning values to alternative outcomes, including most particularly the choice of method employed in assigning such values in the first place". He concludes that ".. the only major topics that seem overly neglected are non-economic evaluation methods and non-regression statistical analysis." He attribute this to the current built-in biases in planning academia, which reflect its origins in terms of the disciplines called upon most frequently in earlier years to assist in the professionalization of the planning academy. This "academization" process clearly reflects major contributions from both urban economics and regional science. Other fields, (such as environmental, systems engineers, political science, and sociology) had not played significant roles in that process to that date (1990s), and have made little contributions to the global changes described in the section above. Whether this was entirely appropriate remains an open question at this time.

ENVIRONMENTAL EVALUATION THEORIES AND METHODS

The planners' world has changed a lot since 1992. Over the past fifteen years, much of the sustainability movement effort in the western world has been to

develop approaches to its environmental assessment. Among these efforts, a range of tools have emerged that push beyond the previous emphasis on environmental economic and more towards the complete treatment of human and ecosystem well-being (Hodge, 1997). Much of the critique in the literature and theory surrounding sustainability assessment have argued that current assessment methods often fail to involve sufficient vision and understanding of the interrelations and interdependencies of social, economic and environmental considerations.

This section seeks to review the underlining methodologies for the major assessment methods available for planners outlying their potentials and limitations.

The majority of the widely used sustainability assessment methodologies fall within three major categories: monetary tools, biophysical models and composite sustainability indicators (Gasparatos et al. 2007). The purpose of all three is to somehow capture the positive or negative contribution towards sustainable development, either by comparing the output of the plan/project with a certain benchmark or through the ranking of different planning alternatives in respect of their sustainability objective or in some cases through both.

1. Monetary Assessment tools:

Monetary tools – as the name suggests- attempt to put some monetary value to the cost of the plan. Usually this figure is estimated using some method of measuring individual preference. This approach has a strong theoretical foundations in economic theory have formed the backbone of most sustainability assessments especially for policy making but were not conceived specifically for sustainability assessments. Examples include evaluation tools such as the Contingent Valuation Method (CVM) and aggregation tools such as Cost Benefit Analysis (CBA). Their methodological foundations in the neoclassic economic view of humans as economic persons have had significant criticism leveled towards these tools. As Gasparatos et al. (2007) state "progress towards sustainability goes beyond economic efficiency to include equity and ethical considerations." For example, respondents in CVM surveys are asked to give their preferences as individual consumers rather than as citizens living and acting within the society. Sagoff (1998) provides examples where the elicited monetary values in CVM surveys are different when respondents assume different roles (consumer vs. citizen) or consider others in their response (individual vs. individual considering others as well). Furthermore, there is the issue of substitution, when monetisation of certain environmental and social sustainability issues (e.g. biodiversity, human health etc) brings them to a position where they can be compared with other monetised issues and

thus be substitutable with them. For example in an investment decision high gains in economic output might offset loss of biodiversity or detrimental effects in human health as a result of increased pollution. This compensability and subsequent substitutability of monetised values are essentially trade offs between sustainability issues within monetary tools and form the core of the debate of strong vs. weak sustainability (Neumayer, 2004).

2. Biophysical models:

Biophysical assessment models quantify the level of sustainability of a system using a natural science perspective. They essentially account for how much energy/matter etc. has been invested in the production of a product or a service, whether that is a commodity or a "free" ecosystem service. This concept is similar to the cost of production theory of value, but from a natural science perspective. Their advantage over monetary valuation methods when it comes to environmental issues is that they do not depend on human preference to interpret value but on biophysical parameters that can be precisely measured.

Of the large number of biophysical sustainability measures only a handful has been developed to capture several sustainability issues. Three such metrics that have gained some acceptance between academics include emergy, exergy and the ecological footprint (Gasparatos et al. 2007). Of these only the ecological footprint seems to be the only one that is being adopted - to a limited degree - by NGOs and a few policy makers.

1. **The ecological footprint** quantifies the total area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate its wastes (Rees and Wackernagel, 1996). Urban systems have large but variably sized footprints, depending on their water, food, and fossil fuel consumption (and from where those items come), availability of public transportation, and infrastructure for communication and provision of goods and services (Figure 3).

According to Wackernagel et al. (1999) the ecological footprint methodology assumes that it is possible to keep track of all the materials and human services required to sustain a human population and assimilate its wastes by converting most of them to a corresponding biologically productive area. Since different productive lands produce different commodities and to differing degrees a common currency, an indicator called the global hectare (gha), was developed.

The EF evaluation method has been extensively applied by NGOs and con-

sultants, both in Europe and around the world. It has been particularly used by some planners to evaluate progress towards achieving sustainability goals of cities (Figure 4).

Figure 3 - Graphic illustration of the concept of Ecological Footprint

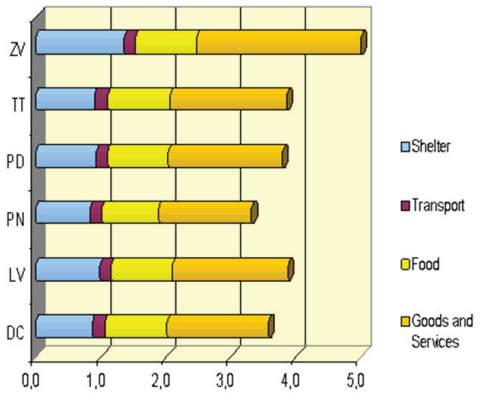


Figure 4 - Ecological Footprint of selected Slovak cities.

Indicator was calculated as sum of partial EF of food, shelter, transport and goods and services.

After Parrakova (2007)

2. **The Emergy evaluation methods** were developed by Odum (1996) to account for the different material/energy/etc flows within a system. Emergy accounting is a technique of quantitative analysis which determines the values of non-monied and monied resources, services and commodities in common units of the solar energy it took to make them (called Solar Emergy). The technique is based on the principles of energetics, system theory and systems ecology. Their shared assumption is that in every

observable phenomenon there is energy transformation and that all energy transformations within a system can be accounted for with a common denominator: embodied solar energy in the former case and available energy or exergy in the latter case. The process used can be summarized by the following figure (Figure 5).

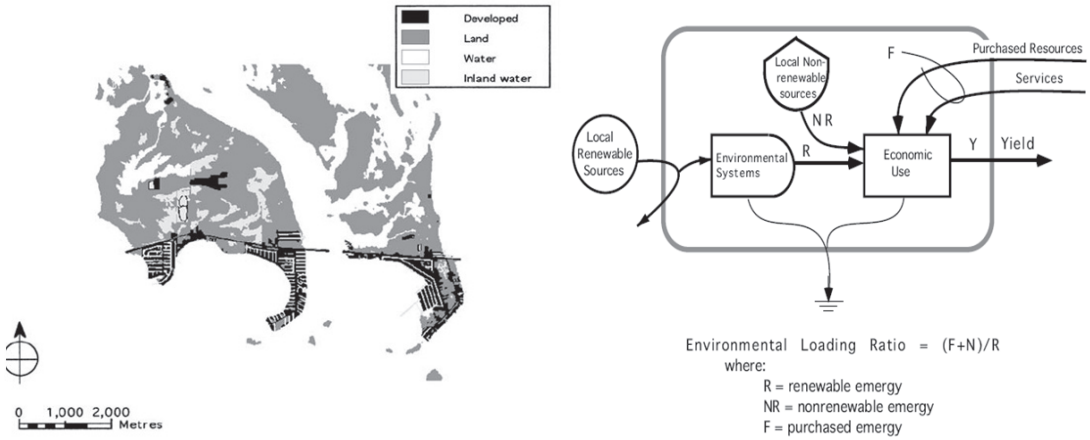
3. Knowledge Management Tools:

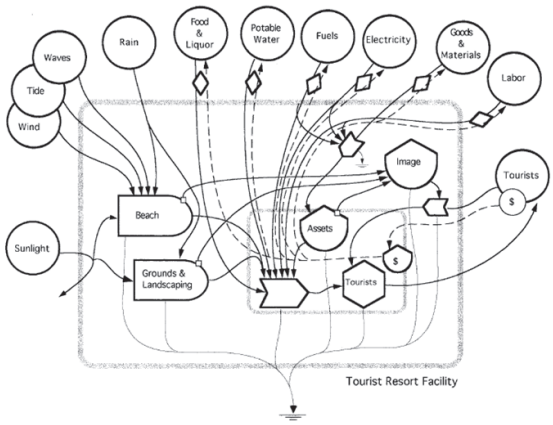
Knowledge Management Tools (KM) comprises a range of practices that began to be used in business to identify, create, represent, distribute and enable adoption of insights and experiences. KM is based on courses taught in the fields of business administration, information systems, management, and library and information sciences (Alavi and Leidner 2001). Influenced by Business Process Re-engineering BPR they aim to redesign process structures to: save costs and save time by stream-lining processes, removing non-value adding activities, and identifying where systems support is inadequate.

Knowledge Management tools are becoming widespread in many western government public sector agencies. In Norway, a survey of the use of management tools in 215 public sectors agencies found that knowledge based management tools ranked 4th with 57/150 cases reported (Lægreid, 2006). Today, in a knowledge society, value in the global economy is added by knowledge generation and transfer. With increased use of computers specific adaptations of technologies such as knowledge bases, expert systems, knowledge repositories, group decision support systems, and computer supported cooperative work have been introduced to further enhance and manage complicated knowledge extraction and utilization. Most decision-makers seek to simplify complex problems to make them manageable. In the future, however, the core competency will be to understand and manage complex structures and processes effectively without inappropriate simplification, which may remove key factors. With the advent of the Web 2.0, the concept of knowledge management has evolved towards a vision more based on people participation and emergence. This line of evolution is termed Enterprise 2.0 (McAfee 2006).

This shift has invited other fields including planning to use KM in their planning process (Rubenstein-Montano, 2000). For example, El-Dirabi et al. (2005) use a KM system to support the sustainable analysis of urban transportation infrastructure. They build it on a semantic model using the rich knowledge in the areas of value engineering and cost benefit analysis. The framework provides a means for the exchange of decision data through building a semantic grid of software systems that allows the user to send several commands to different software and then immediately see the results in life cycle cost (LCC)

terms. The framework includes three major layers (Figure 6): (i) knowledge management, (ii) decision making, and (iii) interoperability.





Land Use	Non-Renewable Empower Density (E11 sej yr^{-1} m^{-2})	Renewable Support Area (hectares/ hectare)	Synchronal Support Area (hectares/ hectare)
Natural Open lands and waters	0		
Recreational / Open Space (Low-intensity)	0.7	1.1	0.1
Woodland Pasture (with livestock)	0.8	1.3	0.2
Pasture (without livestock)	1.7	2.9	0.4
Low Intensity Pasture (with livestock)	3.3	5.6	0.7
Citrus	4.4	7.3	0.9
High Intensity Pasture (with livestock)	4.7	7.8	1.0
Row crops	10.7	17.9	2.2
Single Family Residential (Low-density)	107.7	179.5	22.4
Recreational / Open Space (High-intensity)	123.0	205.0	25.6
High Intensity Agriculture (Dairy farm)	134.9	224.9	28.1
Single Family Residential (Med-density)	217.5	362.5	45.3
Single Family Residential (High-density)	237.2	395.3	49.4
Mobile Home (Medium density)	274.8	458.0	57.3
Highway (2 lane)	308.0	513.3	64.2
Low Intensity Commercial	375.8	626.3	78.3
Institutional	404.2	673.7	84.2
Highway (4 lane)	502.0	836.7	104.6
Mobile Home (High density)	508.7	847.8	106.0
Industrial	521.1	868.4	108.6
Multi-family Residential (Low rise)	739.2	1231.9	154.0
High Intensity Commercial	1266.1	2110.2	263.8
Multi-family Residential (High rise)	1282.5	2137.5	267.2
Central Business District (Average 2 stories)	1615.0	2691.7	336.5
Central Business District (Average 4 stories)	2940.1	4900.2	612.5

Figure 5 - Diagram summarizing the calculation of Emergy and nonrenewable empower density for a land use or process

a) Image analysis of developed land use in Cudjoe Key, Key West.

b) Calculation of nonrenewable empower density for a land use or process.

c) Summary diagram of a tourist resort facility showing the main production function that provides goods and services for the tourists who are attracted by the resort's image. Dashed lines are money and solid lines are energy flows.

d) Non-Renewable Empower Density by land use types and environmental support areas (after Brown and Vivas, 2002)

Application in the Arab World

There are usually three ways through which new tools are introduced to the Arab world: the first through donor and international agencies; the second

through returnees studying or working in the west; and the third by the initiative of individual researchers. Monetary evaluation tools are quite common to the Arab world due to its adoption by the World Bank and its consultants (Hussein, 2008). Quite a number of planning studies adopted some form of CVM in the evaluation of plans (see for example Glasze and Alkhayyal 2002 and Von-Rabenau 2002). Biophysical evaluation tools are fairly new to planners in the Arab world. Its recent dissemination was sparked by the media coverage of the poor performance of many Arab countries using the EF evaluation method. In 2007 UAE was ranked the world's worst country in its EF (on average a UAE resident has an Ecological Footprint of 9.5 global hectares, the highest in the world - first published in Global Footprint Network and WWF's 2006 Living Planet Report, Figure 7).

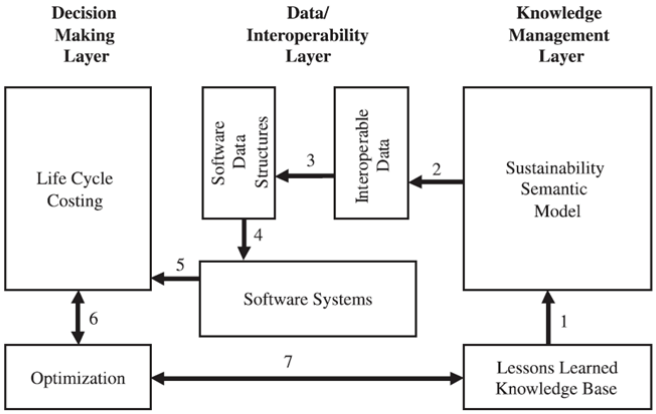


Figure 6 - Proposed architecture for a cost–benefit knowledge management system
After El-Dirabi et al. (2005)

As a response, the UAE launched the Al Basama Al Beeiya (Ecological Footprint) Initiative to understand and reduce the country's Ecological Footprint. The initiative began by bringing together Global Footprint network researchers and UAE officials to understand, review and refine the data and methodology used to calculate the nation's Footprint. Now the initiative has expanded to support a number of ambitious sustainability projects.

Up to date, very few planning examples in the Arab world are found to utilize KM software in planning processes. Only one study, for example, (Rekik, 2007) demonstrates the use of Think Tools ™ a KM software to analyze and compare effective strategies proposed in public meetings in the Safax Development Strategy Plan for 2016 (Figure 8).

Limitations and Adoption in the Arab World

Naturally each of these evaluation tools has their proponents and adversaries. Monetary tools are quite common and easy to understand. However there has been considerable objection to its application outside of the context of financial

gain-loss issues. The root of these criticisms probably stems from the fact that the most widely used valuation and aggregation tools such as (CVM) and (CBA) were not developed specifically for sustainability assessments but were rather arbitrarily adapted for such purposes. Gasparatos et al. (2007) identifies methodological, ethical and problems. Methodologically, the resulting values are inconsistent when respondents are asked to give their preferences as individual consumers rather than as citizens living and acting within the society. Ethically, monetisation of certain environmental and social sustainability issues devalues

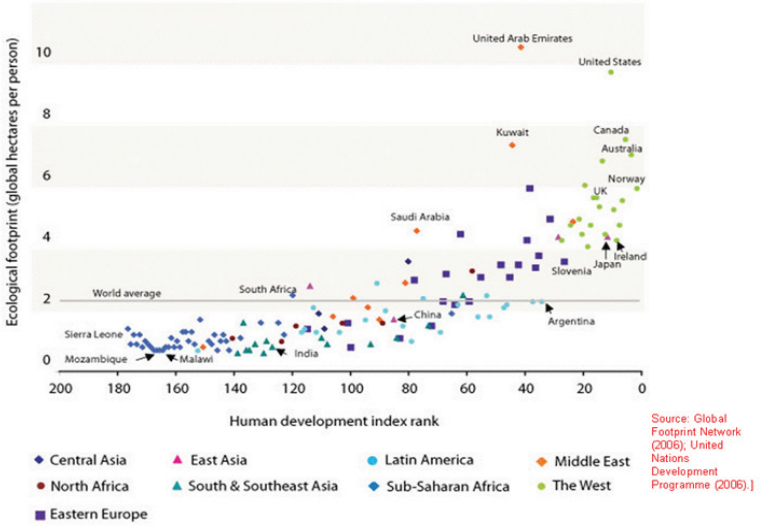


Figure 7 - Human Welfare and Ecological Footprint in 2007

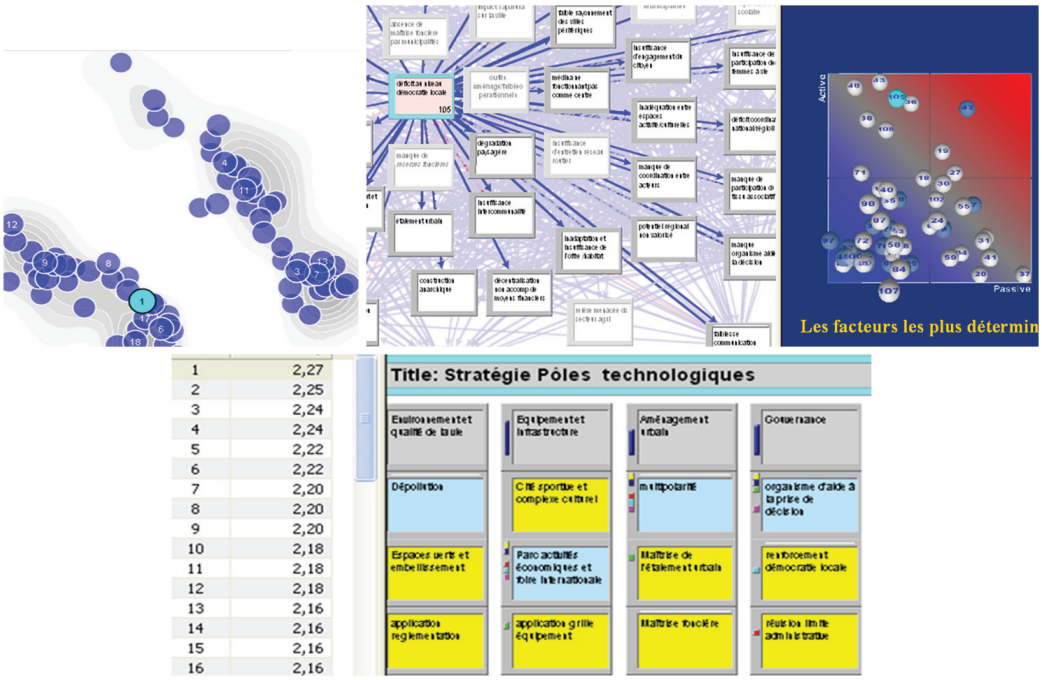


Figure 8 - Comparing effective strategies using qualitative reasoning and knowledge management software in the Safax Development Strategy Plan 2016
After Rekik 2007

these issues by making them substitutable with them. For example in an urban growth plan, high gains in economic output might offset loss of biodiversity or detrimental effects in human health as a result of increased pollution. Large gains by affluent few sectors of society can override the small but numerous loss by the squatters or the poor. This compensability and subsequent substitutability of monetised values should extensively be discussed and avoided by planning educators in the Arab world. These and other limitations form the core of the adaptability of such courses to planners' educators.

Similar criticisms can be found in the literature and for other commonly used valuation techniques such as the Travel Cost Method, Hedonic Price Method, etc. An immediate outcome of this is that monetised values fed into aggregation tools such as CBA might be highly uncertain at best or in some cases not make sense at all (Gasparatos et al. 2007).

Biophysical models appear more objective since they measure resource flow rather than individual perception of value. However, they are highly data intensive to accurately account for the metabolism of the system under study. In certain cases and in urban systems in particular these data are usually not recorded or are conflicting at best. Integral parts of emergy synthesis (solar transformities), exergy analysis (chemical exergies of substances) and the ecological footprint (equivalence/yield factors) have been calculated under very specific and restrictive assumptions. For most sustainability assessments these underlying assumptions are not the same (e.g. reference environment, transformities of global processes, bio productivity of land etc) so it is not appropriate to utilise standard values. In the Arab world, data availability, accessibility and reliability continue to be a problem. However, early arrangements and coordination with Urban Observatories that are currently growing could allow for the needed data to be collected.

Finally KM tools are essentially being developed as software. Therefore, their limitations will not be directly observable, as their theory and basic assumptions are hidden. Their adoption will become dependent upon their graphic qualities and user interface. Yet, KM tools are seen to place too much emphasis on the process, too little emphasis on human factors and to ignore costs (see Fahey and Prusak, 1998). Their adoption by planners in the Arab world will probably be lead by practioners and large planning organizations. It may be useful however to introduce them within classes of information systems and computer applications.

Conclusions

Cities have changes a lot since Mumford viewed them in the turn of the century. Yet, many of the tools planners have used to deal with them are more or less the same. As Mumford writes at the beginning of *Technics and Civilization*, "other civilizations reached a high degree of technical proficiency without, apparently, being profoundly influenced by the methods and aims of technics." The changing context of planning has forced the adoption of a new "language", one that communicates with two primarily new customers: the environment and the globe.

This paper has reviewed elements of this new pattern of languages. Among the vocabulary reviewed in this article, a focus was placed on quantitative evaluation tools and knowledge management tools.

Monetary evaluation tools have been found to be the most common, both globally and within the Arab world. However they are somewhat limited when it comes to evaluating the environment. Biophysical sustainability assessment methodologies have the advantage to account for resource flow as a measure of evaluating sustainability as well as account for monetary flows and labor inputs within an economy in biophysical terms. Of all Biophysical tools, Ecological Footprint seems to be relatively the most widespread, while very few practical examples have been found for emergy indices. Knowledge Management tools assist planners faced with complex multi-party decision-making and data management problems. They are found to be become more user-friendly and impressive showy software. Their adoption by planners in the Arab world will probably be lead by practioners and large planning organizations. It may be useful however to introduce them within classes of information systems and computer applications.

Naturally, for these tools to become main-stream, a new skill-base is needed. This skill base must emerge from universities with planning degrees offering a strong quantitative core. Review of the North American experience showed that this quantitative rise is rising. The new biophysical tools are being taught too in other departments, but not yet in core planning courses. In the Arab world however, there were little evidence that these approaches are being introduced mainstream planning education.

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المخططون يتعلمون اللغة الجديدة:
التقييم الكمي البيئي ووسائل إدارة المعرفة

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الملخص:

هل المخططون والمعلمين في الوطن العربي مهيئون لتبني الوسائل الرقمية الجديدة لتقييم التطوير العمراني المستدام؟ فما هي إيجابيات وسلبيات (محدودية) هذه الوسائل الحديثة وإلى أي مدى يمكن تضمينها في كليات التخطيط في الوطن العربي.

مؤشرات الطاقة – الأثر البيئي – الحمل البيئي ما هي إلا بعض المصطلحات الجديدة في التخطيط البيئي العمراني في العقد السابق. إن الطبيعة المعقدة للبيئة والرغبة في استخدام الوسائل الكمية أنتجت مجالات دراسات أقل قابلية للاستيعاب في المشاريع التخطيطية التقليدية. ويستعرض هذا البحث – من منطلق المخطط- معاني وتطبيقات هذه الوسائل وخاصة تلك المستندة على نظرية الأنظمة الحيوية الفيزيائية والبيئية وتعتمد الدراسة على الأدبيات المختلفة وبعضها موضع جدل وعلى مناهج دراسة التخطيط الحالية.

تعتمد منهجية الدراسة على متابعة تطور أطر التخطيط منذ بداية القرن الحالي للتعرف على تأثيراتها على تعليم وممارسة مهنة التخطيط ومن ثم يستعرض البحث ثلاث من أهم نظريات التقييم البيئي المالي، والحيوي-الفيزيائي، وإدارة المعرفة. ويختتم البحث باستعراض التطبيقات التي تمت على كليات العمارة في الوطن العربي وتحليل النتائج الخاصة بكل من نظريات التقييم الثلاث.