Peter Linnell, C2 Critique of paper;

A Sensitivity Model (SM) approach to analyse urban development in Taiwan based on sustainability indicators

Factual Summary

i) This paper attempts to address the issue of resolving the complexity of inputs required to make good policy decisions in planning for sustainable development. Beginning with the known limitations (static model, lack of predictive insight), of a Sustainable Development Indicators (SDI) model the writers attempt to introduce a dynamic systems modelling technique developed by Vester and Hesler (Vester F and Hesler A 1982), Sensitivity Model, (SM) to test the relationships between factors, in particular their mutual impact or feedback relationships.

ii) The paper presents a clear statement of the existing SDI model in use for Taiwan, followed by examples of impact assessments using qualitative methods. The authors give examples of semi-quantitative methods employed to provide inputs to numerical modelling tools. Illustrations are given of some flowcharts indicating feedback loops. Modelling outputs are presented in graphical form as “Impact Matrix” and “Systemic Role” scatter chart (outputs are also presented in ordinal tabular format.) Finally, output from one run of the simulation model is offered in graph form comparing “business as usual” with an altered scenario.

iii) The authors begin with a definition of sustainable development and brief summary of issues impacting on selection of indicators, notably various conflicts. They argue for the importance of analytical tools which are multi-dimensional as a decision support mechanism. They lay out in detail the various stages between the static SDI model to the eventual SM dynamic model. In their own use of Sensitivity Model they argue that the relationships between input (indicator) variables must be derived from a consensus of expert knowledge and experience, as indeed must the calibration of the simulation. From the outputs of their simulation they argue for it's widespread adoption as a device for testing the potential consequences of different development policies.

The Taipei 101 tower, outstanding demonstration of development thinking in Taiwan.

Contextualisation.

This paper appears to go to the core issues of the module, dealing with tools to aid urban planners arrive at policies which support sustainability. The issues covered by the “Cities and communities” and by the “Sustainable transport” lectures go to the heart of the selection of SDI criteria and their weighting in a numerical modelling analysis. Finding and evaluating tools to aid policy development which take into consideration Environmental Impact goes to the core of the lectures on “Ecological Modernisation and Sustainable Development” and on “Environmental Impact Assessment.”

Critique

i) **Structure.**

The paper is structured in a typical straightforward way. The Introduction offers a summary of existing work specific to Taiwan itself, the SDI model, and contextualises this with a range of background papers demonstrating the authors pathway to the current issues. However there is some bleed-over with the following section on methods, where the authors laboriously build up a description of the source papers for each step in the methods employed. The authors supply examples in tabular and graphic form to illustrate the logical steps between different parts of the systems analysis, including breakdowns of more detailed elements of sub systems. All of this aims to clarify their combination of qualitative, semi-quantitative and systems analysis tools. This is fully supported with tables and graphics showing systems relationships, however close reading often requires hunting through pages for the relevant figure or table. In fairness it must be said that reading the paper electronically in a HTML reader across multiple desktops using hyper links and navigation keys permits much simpler cross over between text, charts and graphics than struggling with a hard copy. Despite this there is a lack of clarity of the relationship between the graphic **Figure 2**. *Procedures of SM* (central to the paper) and other elements.

ii) **Data – Adequacy and relevance.**

The foundations of this paper are the existing SDI model as illustrated in **Figure 1** *The 22 categories of Taiwan's SDI* and Vester and Hesler's Sensitivity Model. The SDI model represents the state of existing sustainability thinking in Taiwan. Other sustainability models include more factors pertaining to social and political justice for example. (Chambers, Simmons, Wackernagel 2000).). The figure shows a level of indicators below the named categories, with only **Table 1** *Categories of Indicators for Taiwan's urban sustainability* giving the metrics employed as indicators, and no actual data appear. The elephant in the room is the implied treatment of Taiwan as a closed system, there is no treatment of external inputs, be it investment capital or crude oil.

From here on, the "data" presented are all derived from a sequence of treatments of the SDI model, beginning with refinement to a variable set by group discussion. There is no comment on criteria for inclusion/ exclusion or amalgamation, but it is noted that

> *"The completeness of the variable set from a system's viewpoint is examined with a cybernetic checklist called the criteria matrix. "*

(N.B.*Unless stated otherwise all italicised quotes are from the source paper)*

No example of a Criteria Matrix is given.

Phase 2 of the Sensitivity Model, examining relationships between variables by graphically presenting an Impact Matrix and a Systemic Role scatter chart are derived from " pattern recognition." This process depends on the outcome of a small (19 members) expert group sub-divided into three. The authors fail to comment on the risks inherent in small group process (Kerr & Tindale 2004,Linnell 2008) The outputs from these groups are presented as a single consensus impact matrix yet it would have been helpful to know the range of original opinions between individuals; (requiring a different tool set.). **Table 3** *Example of impact matrix showing the strength of impacts among the variables* shows the derivation of the values used in the scatter chart,from Active and Passive interactions between variables, impact strengths (*P* value) as the product of A and P sums and involvement (*Q* value) as the ratio of A and P sums. It is not stated if this output comes from a sub-group or the overall consensus.

The impact matrix is used to select "Partial Scenarios", of variables which can be trialled in simulation runs. Two outputs are presented using 10 variables, one a "business as usual," the other altering inputs to reflect policy changes. Without references, we infer use of Vester and Hesler's 1982 work. The output graphs use scales of rounds (representing years) against a numbered scale of 0 to 30 with no legend to indicate it's meaning. The graph is poorly drawn, making differentiation between variables challenging. Unfortunately the graphic offered as output of the adjusted policy simulation gives the same graph as both before and after, rendering it worthless.

iii) **Argument; logic, clarity, implications, assumptions, omissions.**

For a paper predicated on Vester and Hesler's Sensitivty Model there is a lack of clarity of explanation of the requirements and shortcomings of the model. That the authors are capable of such an exposition is demonstrated by their earlier paper, (Chan and Huang 2004) yet neither compare to that given by malik,(malik 2009) management zentrum st.gallen (www.malik-mzsg.ch) the present carriers of Proffessor Vesters' torch. Several stages of the application of the model are either glossed over, (variable set, criteria matrix) or omitted (effect matrix). The presentation of a complex multi phase process such as SM in a one dimensional linear format (text), even supported with graphics, is always difficult and this paper exemplifies this. The authors stated secondary aim of identifying the role of urban development on the system of Taiwan SDI as a whole appears to have been lost among the complexity of the description of the modelling. The application of SM to a partial scenario of a selection of urban centric variables is covered in depth, but there is no integration with the wider context.

The final part of their discussion allows a dissection of the weaknesses inherent in their application of the SM method.

> *These system analytical processes incorporated in this study do highlight the importance of communication between different stake-holders.*

This fails to consider the importance of the selection criteria for stakeholders. In this paper they are represented by an expert panel of only 19 participants. Whilst the disciplines are not specified I would expect them to be drawn from a narrow conventional spectrum. Vester's work emphasises the importance of including all possible stakeholders.(malik 2009)

> *But it is also noteworthy that the data used to develop the consensus simulations were obtained through a series of discussions and consultations with our experts. We also observed that the* ***judgements of expert stakeholders are sometimes different from the statistical data.***
> *(emphasis mine)*

The product of a conceptual framework consensually held by the prevailing establishment of the country, impacting on the selection of indicators, categories and how these are divided or related. Most importantly the treatment of Taiwan as a closed system in the model contradicts Vester's own emphasis that all systems are open systems. (malik 2009)

> *Discussions among experts from different disciplines do not immediately result in consensus, in part because of the use of semi-quantitative data.*

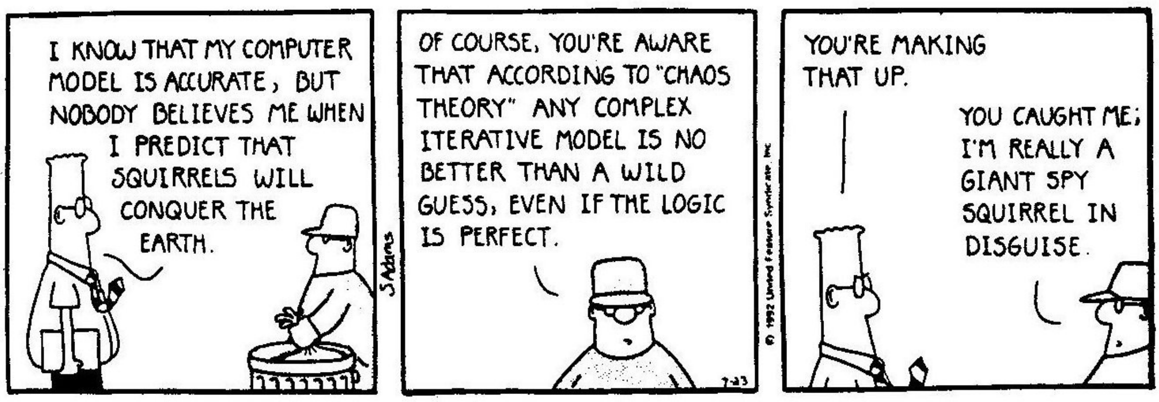
The paper suffers from a lack of consideration of the range of views expressed, as does the SM toolset in general, and fails to consider the impact of group process effects. (Kerr & Tindale 2004, Linnell 2008)

> *Sensitivity Model Tools, however, does provide interfaces that will allow simulations of the relationships between development policies and urban sustainability, and as a result we feel that it represents an important tool for building a sustainable future.*

It is crucial to understanding Vester's work that the SM method be treated as means of mediation, not as an end in itself. (malik 2009) There is a straightforward risk that the application as used here lends itself to manipulation by unstated assumptions at all levels from selection of starting metrics (the SDI model), selection of experts, selection of variables for the partial scenarios. If the aim of the tool is to empower decision making by illustrating complex interactions in a more easily comprehensible form it is critically dependant on the conceptual integrity of the tool users.

In their concluding remarks the authors suggest two specific continuing uses of the SM tools. In both cases they suffer from the limitations as described above, by limiting the range of participation to expert or elite groups, and by treating even complex urban systems as separate closed systems.

A major drawback of such a complex multi-dimensional non linear modelling as this is that it attempts to consider sensitive dependence on initial conditions; (aka Chaos) especially important in attempting to predict (for example) the behaviour of living systems, crowds of people or non local economic issues. Lack of space precludes a full examination of the philosophical underpinning of chaos theory and systems modelling but a summary can be found in Kellert "*In the wake of chaos*" 1993



Scott Adams *The Dilbert Principle* 1996

Conclusion

i) Overall judgement of case made.

The paper attempts to argue for the use of Vester's Sensitivity Modelling approach to aid decision making in sustainable development policy. Much of the paper is taken up with an attempt to describe the application of the toolset which is potentially extremely confusing to non-expert readers and lacks the clarity of explanatory materials available from the originators of the tools. Within this explanation lie the seeds of strong counter arguments, revealing as it does the critical dependence on the collective opinions of a small expert group. Absence from the paper of any of the original data of the SDI metrics prevents an independent criticism of the application itself. Criticism of the SM tools is inhibited by lack of access to the underlying software.

ii) Implications for discussions in the field

The authors' comments show understanding of the limitations of the SDI type of model and illustrate this with critical comments from a wide range of papers mostly pointing to a need for more systems based approach. Other thinkers and critics of development policy take different views. In Tools for Conviviality, Illich comments

> *"At present people tend to relinquish the task of envisaging the future to a professional elite. They transfer power to politicians who promise to build up the machinery to deliver this future. They accept a growing range of power levels in society when inequality is needed to maintain high outputs. Political institutions themselves become draft mechanisms to press people into complicity with output goals. What is right comes to be subordinated to what is good for institutions."*
> Ivan Illich *Tools for Conviviality 1972*

By contrast a methodology for determining development policy by wider participation, known as "Participatory Appraisal of Needs and the Development of Action" (PANDA) (White and Taket 1997) has the potential to act as a similar mediatory tool to that intended by Vestor, with a much greater range of participation and input from all strata of the relevant community. This is not dependent on complex computer simulations, nor does it offer any predictive modelling, but it does offer wider ownership of outcomes.

iii) Further research required

There may be merit in considering replacing the input stages (SDI) of the SM model with outputs from a PANDA approach. This would combine broad spectrum participation with the best available predictive simulations, as additional participatory feedbacks could be involved at the various phase changes of SM. This may go some way to overcoming the criticism identified by the authors that some expert opinions diverge from the observed data, as well as the more radical criticism of elite institutional monopoly in Illich,(1972). Ideally as a matter of policy no software should be used to aid public policy decision making unless it can be subject to critical examination, (i.e. open source). In terms of the specific tools of sustainable development models more work needs to be done on agreeing definitions and paradigms for discourse on these issues; no model can be taken seriously if it treats a city or a nation as a closed system.

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