Visualising program logic: Two new graphic conventions

Doug Fraser

This article[1] introduces two new kinds of graphic representation which have been developed by the evaluation and policy teams in two Commonwealth agencies, Environment Australia and Agriculture, Fisheries and Forestry Australia (AFFA), to assist in understanding the logic of complex programs.

The traditional type of program logic diagram was intended to serve two purposes at once. One was to provide a basis for detailed analysis of the program, the sequence of actions and consequences, and the inputs and results required at each stage. The other was to allow a reader who was unfamiliar with the program and its context to seize in a single page the most important gist of what the program did and how it was expected to work.

Most people who have used the standard technique have quickly found that the normal conventions serve both purposes adequately only when the program is a relatively simple one – ideally, one with a single intervention strategy and a single output. As soon as the program develops multiple strands, or has an outcomes hierarchy extending beyond a couple of levels, the traditional boxes-and-arrows diagram falls down on both counts. On the one hand, any account of the program simple enough to be captured in a single logic tree on a single page misses much of the content and strategic detail, in particular those aspects that make the program strategy unique. On the other hand, the number of boxes and the thatch of arrows that connect them rapidly become so confusing (often even to someone who knows the program) that the whole purpose of diagrammatic representation is defeated.

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Matters become several orders of magnitude worse when one comes to deal with environmental and Natural Resource Management programs of the kind which are becoming increasingly common in Australia and elsewhere. Such programs use multiple strategies to address complex problems of management and rehabilitation, involving a multiplicity of causative factors – biophysical, economic, social and political – and have a variety of objectives, not all of them strictly compatible. The difficulty is all the greater because in many such cases, however well the program works, it is unrealistic to expect to identify any clear sustained impact on the variables affecting resource condition (i.e. the true high-level objectives of the program) until anywhere between 10 and 40 years after the cessation of program funding.

In such cases, it becomes all the more important to model the complex interactions as rigorously as the science and the evidence permit, simply to enable program managers and funders to establish with some confidence within the funded life of the program whether or not it is on track to achieving its real objectives. To be sufficiently informative, such models must necessarily be detailed and intricate.

Conversely, the complexity of these programs is such that even those who work in quite strategic positions within them often have great difficulty in identifying where they fit into the overall scheme, or exactly where their work leads, without some form of road map. Imagine how much worse the challenge must be for a new minister coming into the portfolio for the first time, for a community-based group trying to adapt to the new program structure, or for a parliamentary committee attempting to come to grips with it in order to assess its effectiveness.

At this level of complexity, it is no longer feasible to combine both purposes in the same kind of model. The kind of model needed for detailed planning could only be described in

connected sentences, preferably in a matrix format familiar to users of Logframe or of Sue Funnell's work. But for the purposes of enabling outsiders, and even insiders, to visualise the program structure, it was clearly necessary to develop a new kind of graphic convention which forfeited any pretensions to that kind of analytical precision.

This article deals only with the latter purpose. In evaluating these depictions, it is important to remember, firstly, that they represent relatively early stages of a work in progress, and secondly, that they do not purport to show the full workings of the program or provide a basis for precise modeling. Their purpose is solely to provide two different ways by which people can find their bearings.

The context

The models as presented here are based on a generic type of large-scale NRM program, rather than any specific one, current or envisaged. Some of the key features that distinguish programs of this kind are:

- a quadruple bottom line involving restoration of the environment, adoption of ecologically sustainable agricultural practice, social/amenity benefits (e.g. maintaining the presence of small rural communities, improving the quality of drinking water) and economic outcomes (e.g. future viability of agricultural production, reductions in repair costs to municipal infrastructure);
- a strong emphasis on voluntarism, with a high proportion of the direct interventions being carried out by, and largely on the initiative of, volunteer community-based groups;
- an emphasis on integrated NRM planning at the regional level as a basis for the direct interventions;
- a complementary emphasis on addressing the incentive structure at the government level through new governance standards, the adoption of market and quasi-market mechanisms, etc.;
- a relatively short funded program life of five to seven years, coupled to high-level resource condition objectives (e.g. reversing the effects of salinity at the landscape level) which will take decades to achieve; and
- a requirement for planning to be based on hard science and large bodies of data, counterbalanced by an awareness that both the models and the data available at the time of program design are often neither complete nor reliable.

While this combination of characteristics is arguably peculiar to NRM policy, many of the same problems in describing the program logic arise with programs in other areas that involve complex interventions to achieve multi-faceted outcomes over a relatively long timeframe. Examples that come to mind are development of major industries, and urban renewal projects.

The purpose of the models

These visual models result from an attempt to address three perennial problems with the traditional inputs-processes-outputs-outcomes model, which become particularly acute in such contexts.

The first is that people who look at such a model almost inevitably confuse logical sequence with temporal sequence. Because C follows B follows A in logical order, it is all too easy to suppose that A is pursued through to completion, then B begins, and once B is finished, then C begins, and so on. This is a misleading assumption in multiple-strategy programs where many processes are going on simultaneously, at different stages in their logical sequence. It is even more so in a context where certain activities at the 'input' level – e.g. improving and refining the currently inadequate infrastructure of models and data – need to keep going all through the program life, and well beyond, even to enable the objectives to be satisfactorily defined.

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The second is to help the uninitiated understand the magnitude and inevitability of the lags between action and high-level outcomes. If a program has been running for 10 years or longer without achieving spectacular environmental outcomes except on a purely local scale, it is understandable that politicians, the media and auditors will take some persuading that it has not been a waste of money. In some cases, indeed, this will be true. In others, the program may well be on track to start achieving significant change within, say, the next five years, provided the effort is maintained. But traditional logic sequence models do little to help distinguish one case from the other.

The third problem is that the very terms 'input', 'output' and 'outcome' have become value laden. It is far too common to see inputs dismissed as something relatively unimportant which ought to have been there in the first place, and which are not really the responsibility of the program itself. At the same time, in the kind of accountability system currently favoured by the Commonwealth, where programs and agencies are meant to deliver outcomes, an output is far too often looked down on as an inferior, less than sexy kind of result – with the consequence that most internal performance measurement frameworks would far sooner capture a nebulous and easily fudged outcome than a real and useful output. Once again, this can be highly misleading in cases where strategically important outputs – e.g. strong predictive models or good

knowledge bases – are often the most valuable thing a program produces within its funded life.

To address the third of these problems, we have found that the actions and consequences in most NRM programs can be subdivided into four levels:

- **FOUNDATION** – that part of the program which involves investment in knowledge (including data collection and change models), skill development, awareness raising and basic institutional infrastructure, without which the subsequent phases of the program cannot proceed effectively;
- **ACTION** – the measures taken by the program which address the resource condition (i.e. the state of the environment or particular ecosystems), either through direct interventions or through modifying the regulatory and incentive structure;
- **CHANGE** – trends of change in the main variables of interest which are attributable to the program and represent progress towards its final objectives; and
- **ACHIEVEMENT** – fulfilment of the stated or implied (usually high-level) objectives of the program.

Note, though, that 'achievement' is not necessarily confined to the top levels of the logic chain. Enabling legislation is all too rarely drafted with program logic in mind. Consequently, programs often have formal objectives that range through several levels in the hierarchy of outcomes, from the aspirational through to what are essentially details of the administrative infrastructure. While this makes logic modelling even more awkward, it does at least make it possible for the program to achieve some of its objectives fairly early in its funded life – with obvious benefits for morale, political survivability, etc.

1 The sequence map

The particular purpose of this type of diagram (Figure 1 opposite page) is to illustrate when things can be expected to happen over the program's lifecycle, and beyond. Essentially, it is a development of the Gantt chart and similar devices used in project management. It promises to be particularly useful for demonstrating, for example, how sustainable environmental outcomes cannot reasonably be expected until late in the program's life or well after it, or why generation and maintenance of the knowledge base is something that has to continue rather than being a one-off investment at the beginning of the program.

It is much less effective in showing logical sequence, and is not intended to do so in any but the most impressionistic fashion. The boundaries between the four bars are perhaps best thought of as permeable membranes, with the logic sequence moving from one stage to another continuously all along the line of intersection. This can cover a variety of processes – for instance, in moving from the 'Change' to the 'Achievement' level, individual local condition changes may lead to sustained landscape-scale change by paths that include cumulation, critical mass, and the achievement of strategic interventions at all the critical points in a flow. It can also include feedback loops, even between non-adjacent bars (for example between 'Change' and 'Knowledge base'), which may be explicitly drawn in where necessary. Within each bar, moreover, there are often several levels of logic, each with its own set of inputs and outputs/ outcomes (another reason for abandoning the traditional terminology).

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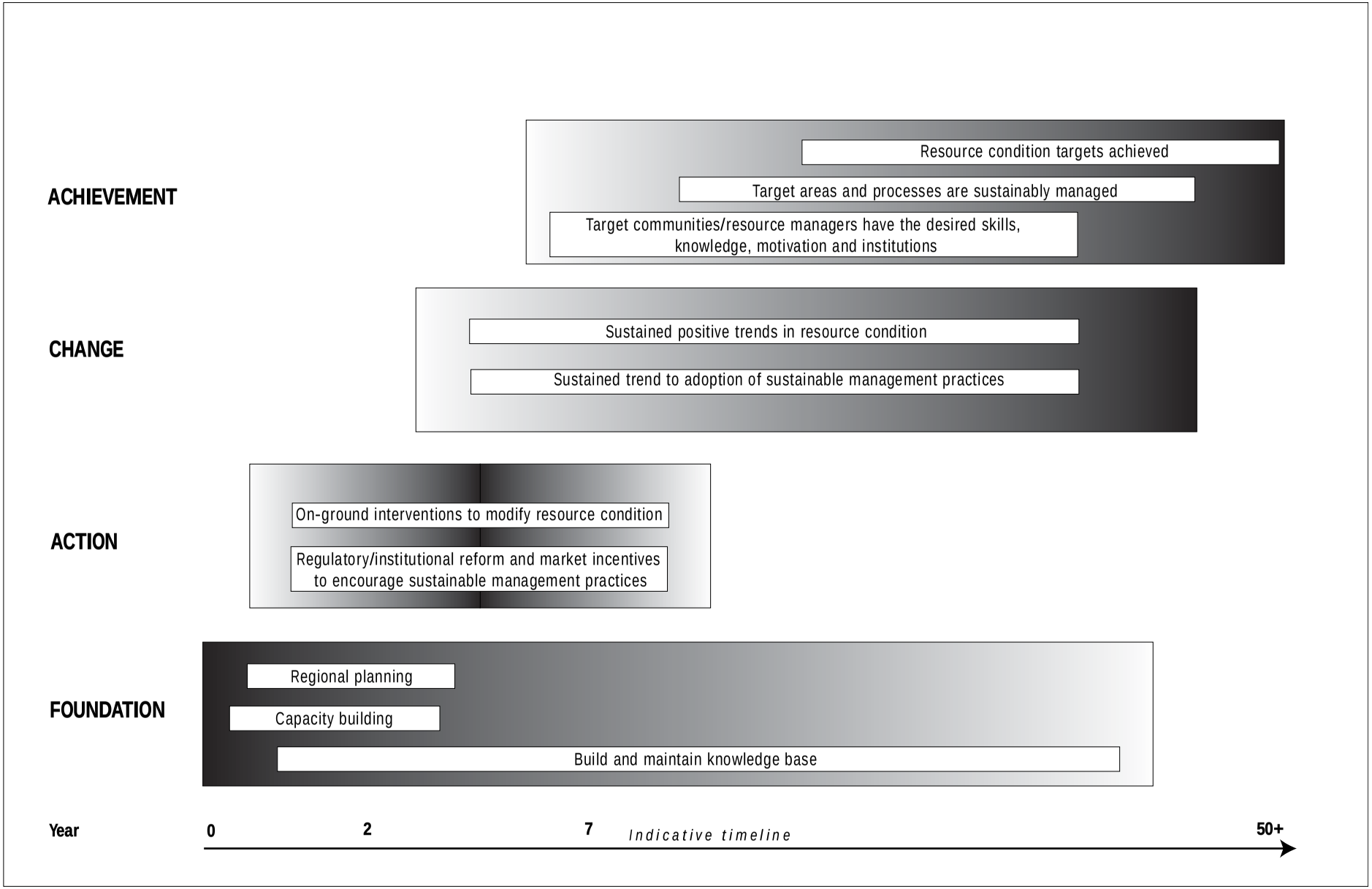
The graded shading is intended to show how activity in each phase varies according to the stage in the program lifecycle. Activity in the Foundation bar is most intense at the beginning of the program, whereas in the Action phase, it reaches its peak in the middle. By contrast, the impact in both Change and Achievement bars is cumulative, building up to its greatest intensity towards the end of the logical cycle.

Note, once again, that this is a very generic example, based on the generic program logic common to most programs of this kind. The length and placement of the bars, and indeed the actions and events which belong in each, will vary from program to program. By adding more program-specific detail, the reasons for lags in effect can be made more intuitively evident than this very simple example would suggest.

Although this device is not intended as a proper project planning tool, it is possible to populate the bars with more specific and detailed content, up to the limits imposed by the available software, fonts and page size. Thus it becomes possible to base the length and arrangement of each bar on detailed analysis of individual actions or processes, making it a useful basis for reality-testing. For this purpose, it is probably most useful when drawn by hand on a large whiteboard.

Note that the scale on the time axis, in both diagrams, is meant to be roughly logarithmic. In other words, the first half of this axis, representing

FIGURE 1: GENERIC NRM SEQUENCE MAP



that actual funded life of the program, really represents only about 10-15% of the total time period covered by the model. By the end of the funded program cycle, it would normally be expected that the planning structure would be fully operative (including effective reviews), the capacity and institutional objectives more or less wholly met, and at least some of the sustainable practice ones achieved or close to it.

2 The logic map

This model (Figure 2 opposite page) complements the first, and is meant to show the logical dependencies. However, unlike traditional approaches, which try to draw linear paths of causation between individual events, it maps them on a two-dimensional continuum. Although of limited usefulness for conventional planning purposes, it arguably provides a more accurate picture than linear diagrams of the kind of environment in which much of the cause-effect process occurs through relatively amorphous mechanisms such as influence, critical mass, legacy, feedback loops, virtuous and vicious circles of reinforcement between simultaneously occurring events, probabilistic causation, 'force-fields' and the various mechanisms associated with complexity theory.

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The lower left triangle represents the input side. Items in the boxes in this triangle are 'investments' that need to be made for the program to proceed. Although 'inputs', they represent part of the actual program strategy (i.e. actions taken under the program) rather than pre-existing resources or conditions. In other words, this side of the model corresponds mainly to 'Foundation' in the sequence map.

The upper right triangle represents the output (outcome) side. The boundary between the two is the point at which the program begins to make a difference. As the program proceeds, the pattern of events shifts from being heavily concentrated on the input side, with little or no impact, to the end point (typically many years beyond the end of the program itself) where almost all activity takes the form of impacts.

The boxes ranged along the line of intersection are ongoing changes which the program will bring about (or accelerate) if it is working. They can and should be tracked on a continuing basis to identify the degree of change, and are meant to continue happening, from the point in the time sequence at which the boxes first appear through to the end point of the program logic. These correspond to the 'Change' bar in the sequence map.

The boxes along the top of the diagram correspond to the 'Achievement' level. They represent outcomes which can be monitored on a bivalent, point-in-time basis. Most or all of them represent the achievement of stated objectives of the program. Logically, however, they make up a sequence of short-term, intermediate and high-level outcomes.

The block arrows represent the crucial change mechanisms by which the program moves from the input to the output side. They correspond broadly to the 'Action' bar; the primary focus of any evaluation strategy, especially formative and continuous evaluation, would be to ensure that they are working, i.e. that the transition is actually taking place. They appear at the point in the sequence at which each mechanism begins to take effect, but each would be expected to continue for at least the remaining funded duration of the program.

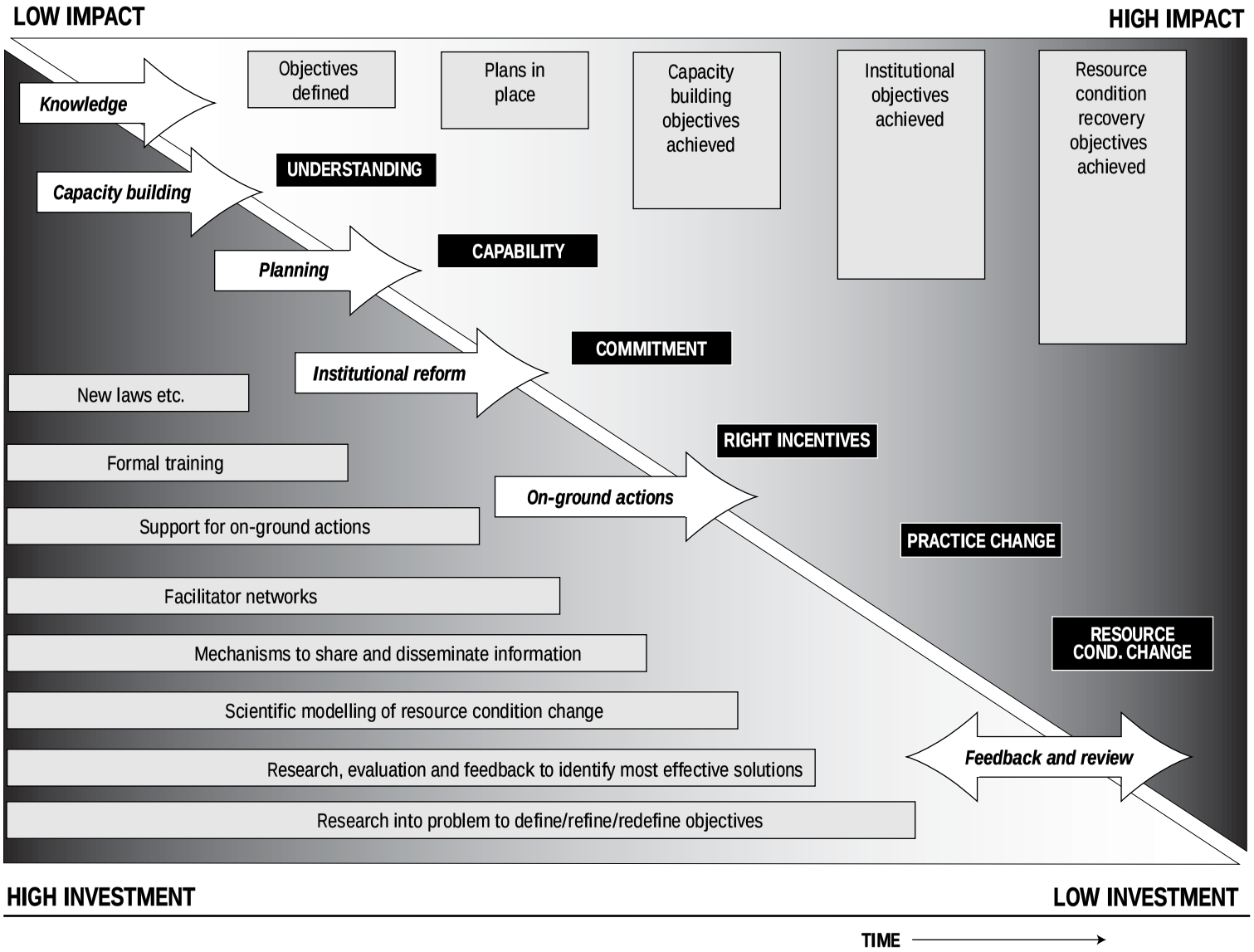
Once again, with the exception of the block arrows, the map does not explicitly show causal links. There will be a large number of these within the output side in particular, which are vital to the ultimate success of the program and need to be addressed in the evaluation, and possibly in the monitoring framework as well. Similarly, it does not show the feedback loops, which are critical to the success of this type of program. However, the two-dimensional mapping concept embodies the assumption that both the detailed causal links and the reciprocal, 'force-field' effects are equally important elements of the total process by which the program is meant to bring about change in the outside world.

Conversely, the time sequence is only indicative. The sequence map is the more accurate and informative convention for showing timelines, lags and overlaps.

Broader implications for program theory

Essentially, both these devices – the logic map in particular – prefigure techniques of modelling that have yet to be invented. As program logic and theory-based evaluation grow more sophisticated, so the view is becoming more widespread among specialists that statements of the kind 'A causes B' are often neither a particularly rigorous nor a particularly informative description of what happens when real programs operate in a real environment. Yet if one wants to obtain the benefits

FIGURE 2: GENERIC NRM LOGIC MAP



in clarity, coordination, shared understanding and prospective reality-testing that come from a detailed up-front analysis of program logic, there is currently no real option but to work from models that treat the causative process as linear.

As so often, the price of rigour is a suspension of disbelief. The best one can hope for is that the suspension should be a conscious one. Alternative graphic conventions like these two may not yet lend themselves to being operationalised; but by showing that there are more ways than one of capturing the workings of the program, they serve as a continuing reminder to program designers, managers and ministers that models, in the end, are no more than that.

Note

1 The views expressed in this article are those of the author. However, the development of these depictions has been a cooperative effort involving many people from both departments. The idea for the logic map originated with Karen Cody of AFFA. Others who have made a significant contribution are Kerry Rose, Ian Gaze and Penny Scott from Environment Australia, and Michele Akeroyd, Wendy Goodburn, Dr Ian Dalziell, Dr Jim Derrick, Mike Lee and Ian Thompson from AFFA. Intellectual property in the graphics as published here vests in the Commonwealth of Australia.

in profile

HOW DID I END UP HERE?

Ruth Temple-Smith

AES Tasmanian Regional Representative

I am the Evaluation Coordinator for the Natural Heritage Trust in Tasmania. As this phase of the Trust comes to an end, the task before me is to evaluate the impact of this very substantial investment in the environment in Tasmania over the last five years. When I am trudging through cow paddocks in gumboots, I sometimes ponder:

'*How did I end up here?*'

When I was growing up in Sydney, if someone had dared to suggest I'd be here now, I would have thought they were crazy. I doubt I had even heard the word *evaluate*. I had heard of Tasmania.

The journey has been interesting with the usual twists and turns life takes. When I left school, I studied to be a teacher of mathematics. After teaching for a short period in NSW, I married and went to live in Papua New Guinea. During my time there I had two children and kept teaching whenever possible.

The next stage of the journey was to Tasmania. I spent some years teaching children with special needs and went back to university to improve my formal qualifications. My target was a Batchelor of Education. I was offered a position in the Education Department's Evaluation Research Unit supporting some research into student behaviour and supportive school environments. The years I had spent assessing student performance, diagnosing errors and implementing strategies to improve their learning outcomes, proved to be an ideal background to become an evaluator.

I stayed with the Department for a number of years gaining skills in evaluation, research and educational measurement. I kept studying - Graduate Diploma in Science (Statistical Applications). I chose courses directly related to my work in evaluation.

Time to move on. The next stop was Evaluation Coordinator for the National Landcare Program in Tasmania. My days in gumboots in paddocks had begun. I continued my studies – Master of Education.

A few years on I had completed two degrees and a graduate diploma when the Natural Heritage Trust came into being. I have spent the last four years monitoring, evaluating and reporting on projects funded by the Trust. I found time to remarry. At the end of next year, phase one of the Trust comes to an end. There are plans for phase 2 but it remains to be seen whether or not I hang up the gumboots.