Challenges for catchment management agencies: Lessons from bureaucracies, business and resource management

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Abstract

Catchment management agencies (CMAs) have no tested precedent in South Africa and will have to evolve in complex and changing business, social and natural environments as they strive to ensure that equity and social justice are achieved within ecological limits. Traditionally, very different styles of management have been used for resource exploitation and resource protection and this will present a serious dilemma for CMAs.

As the human population has grown and natural resources have declined, there has been increased effort to control nature in order to harvest its products and reduce its threats. Initially such "command-and-control" management has been successful as agencies prosper on short-term gains. However, when natural variation is reduced the ecosystem loses its resilience and ability to "bounce back" from disturbances. The first lesson we can learn is that the longer term consequence of command-and-control management is always either a reduction or cessation of resource supply.

The second lesson comes from adaptive resource management (ARM). ARM acknowledges that, because nature is in a continual state of flux and our understanding of ecosystem functioning is poor, a fundamental problem for decision makers is that they must deal with uncertainty from an imperfect knowledge base. A learning-by-doing approach becomes a prerequisite for effective management. Unfortunately, there has been a tendency to superimpose adaptive management on bureaucratic institutional structures. Such flouting of the fundamental management axiom "form must follow function", has thwarted many attempts at adaptive management. This provides our third lesson.

Recognition that authoritarian, command-and-control, bureaucracies respond too slowly to survive in changing environments has led managers in government, industry and businesses to create "learning institutions" which combine adaptive operations and generative leadership (lesson four). Effective knowledge management is seen as a critical success factor in turning command-and-control management into adaptive, learn-by-doing management (lesson five).

CMAs which recognise the dangers of excessive command and control, the need to integrate stakeholder values and activities, and the potential of an adaptive and generative management approach, will need to structure their activities carefully.

At present there is much focus on the structure of CMAs and much less on how they should function. Form is preceding function in many instances. When function is discussed it centres on how regulatory mechanisms and permit systems will keep resource use under control. The concern is seldom with how the ecosystem will be managed. This sort of thinking could lead to a classic command-and-control management approach if not tempered with a more adaptive process.

Strategic adaptive management (SAM) is a local derivative of ARM designed to generate consensus management which is inclusive, strategic, adaptive and creative. SAM is a process in which effective knowledge management is central to building a partnership between science, management and society to achieve a common vision. It has considerable potential for application to CMAs.

Introduction

South Africa's new Water Law is commendable for its mix of "water use for development" and "protection of the resource" but are we aware of the dilemma this creates for the catchment management agencies (CMAs) which must protect the ecosystems which supply the resource they use.

The dilemma comes from the different styles of management which have been traditionally used for resource exploitation and those that are needed for resource protection. In most countries these two functions are performed by different agencies. It is a dilemma compounded by paradigm shifts which democratisation of decision making and the global explosion of knowledge, force on managers and government in South Africa. For example:

- CMAs have no tested precedent and will have to evolve in complex and changing business, social and natural environments. They will have to be adaptive, learning organisations. This will be no mean feat for an organisation born out of a government bureaucracy.
- CMAs will find that by far the majority of decisions in a catchment are made by individual land owners/resource users. They will need to ensure inclusive, participatory management which exposes and meets the needs and values of stakeholders.
- CMAs will find themselves relying on consultants to perform many functions and this will fragment and dissipate any knowledge base they attempt to build. Effective knowledge management will be paramount to successful service delivery and resource protection.
- CMAs will have to ensure that equity and social justice are achieved within ecological limits if they are to meet the full requirements of the new Water Law. Sustainable development and sustained ecosystem functioning will need to have explicit and audited outcomes.

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These problems are, however, not as unique as one might expect and are receiving attention in disparate fields of natural resource management, business and governance. We should take time to learn from others during this period of renewal in South Africa.

When learning from others we need to make a particular effort to understand the paradigms or mental models (Senge, 1990) which lie behind their approach to the problem. In each case a discipline has its own terminology which provides important definition of its guiding principles. We recognise that one person's "jargon" may be another's definitive criteria and, in this paper, have tried to remain faithful to the range of disciplines from which we draw inspiration. Where discipline-specific terms differ from common English usage they are either explained or referenced.

There are three complementary sources of concern and inspiration for the topic under discussion:

- Recognition of the consequences of command-and-control management as practiced by bureaucracies.
- The discipline of adaptive resource management (ARM).
- Moves in industry, business and even government to build "learning institutions" which will promote the transition from the information era to the knowledge era.

Command-and-control management

Control is a deeply entrenched aspect of contemporary human societies. As the human population grows and natural resources decline, efforts are increased to control nature in order to harvest its products and reduce its threats, and thus to produce predictable outcomes (Holling and Meffe, 1996).

When the behaviour of people, institutions or nature violates the norms, desires or expectations of society, command and control are brought to bear in an effort to move the institutions, and/or the ecosystems, to a stable and therefore predictable state. We dampen extremes of ecosystem behaviour to attain a predictable flow of goods and services, or to reduce "undesirable" behaviour of natural processes. A universal result of command-and-control management of natural resources is a reduction of the natural range of variation in ecosystem properties and processes (stable flow regimes in rivers, canalisation of rivers, stable animal numbers at so-called carrying capacity by culling or harvest quotas, suppression of fire, mono-cultures of crops etc.). When the range of natural variation in a system is reduced the system loses resilience and its ability to "bounce back" from the human and natural disturbances it will inevitably experience. The longer term consequence has always been a reduction, or even cessation, of resource supply (Holling and Meffe, 1996).

The initial phase of command-and-control resource management is nearly always successful as agencies prosper on short-term gains. Consequently the agencies shift their attention from the system under management to increasing efficiency of operation and delivery to society. Though a laudable goal in itself, this generally results in a myopic introspective focus which shifts from research and monitoring of the resource response, to exploitation, to internal agency function and power plays. Then, when the inevitable vagaries of nature, or economics, intervene the agency takes too long to respond from an out-of-date, superficial knowledge base. A decline in quantity or quality of the resource is inevitable.

Institutional bureaucracies themselves are an exercise in variance reduction through regulation and control. A certain amount of administrative procedure is always needed but its purpose must be to improve service delivery, not control social behaviour. Too often bureaucracies adopt as their main purpose regulation and control to eliminate extreme behaviour and promote conformity to a specific set of standards. Sometimes administrative procedure is abused and, instead of providing a service, it limits personal freedom. We saw some extremes of this during the apartheid era.

Entrenched bureaucracies are characteristically resistant to change and unable to respond to challenges because the system discourages innovation or other behavioural variance. The difficulties experienced in transforming parastatal institutions, regional and national government in South Africa are good examples.

It is imperative that we consider carefully the type of institution and operating style we wish to develop for CMAs if we want to avoid this pathology of natural resource management and ensure the protection of the ecosystems which provide the water resource.

Adaptive resource management (ARM)

Although the concept of ecosystem management is generally accepted there is only one widely recognised model for management of natural resources, and that is ARM (Walters, 1986, Holling, 1978). ARM is an approach to management which acknowledges that because nature is in a continual state of flux and our understanding of ecosystem functioning is poor, dealing with uncertainty from an imperfect knowledge base is central to effective management. The original intent of adaptive management was therefore that it be an inductive process utilising well planned interventions in nature to test hypotheses of ecosystem response to management and thus learn-by-doing (Walters and Holling, 1990).

Adaptive management has a sound theoretical base but planning adaptive management systems has proven easier than implementing them on a long-term basis. The main problem and a dominant theme in current international literature is how the process can be institutionalised (Walters, 1997; Rogers, 1998) without invoking a command-and-control response. In instances where there has been no appropriate, explicit and sustained institutionalisation, adaptive management systems have tended to be unsustainable. Our synthesis and interpretation suggest that contributory issues are:

- Decision making becomes overwhelmed by too much information which in unsifted form can paralyse the decision-making process.
- Implementation becomes bogged down by the tyranny of modelling and modellers in pursuit of the ultimate model/technology. Walters (1997) has termed this "the battle of the models".
- Monitoring programmes designed to support an adaptive approach to management have generally been too ambitious (Walters, 1997) and unachievable within the organisation's resource constraints.
- There is too much turf protection by "managers" and "scientists" who both pay lip service to co-operation and are not sufficiently committed to effective science/management partnerships (Rogers, 1998) which can only work as groups of equals.
- Individuals and organisations are unable to adapt to the new ways of thinking, functioning and structuring which institutionalising an adaptive philosophy and approach demands. There is a tendency to superimpose the adaptive management process on old, usually bureaucratic, institutional structures and processes. In other instances the old familiar operating rules soon "roll back" when the new system leaves staff feeling out of their comfort zone. Both ignore the fundamental

management axiom of "form must follow function" when planning or changing institutions.

Recent conferences and workshops on CMAs revealed that many regional Department of Water Affairs and Forestry (DWAF) offices are falling foul of this axiom. There is a rush to set up structures to form the precursors of CMAs, without due regard for the processes needed to perform their intended function. These structures are being designed under old, or only partially modified paradigms which have not fully explored the sorts of issues raised in this paper.

Once again we must modify the structure and functioning of our organisations to ensure that they can deal adaptively with the resource use/protection dilemma, and other problems the CMAs will face, in a learning-by-doing manner.

Creating adaptable "learning institutions"

An equally recurrent theme in business management is the understanding that sustainable business requires the capacity for on-going learning and continuous transformation (Allee, 1997). Over the last decade managers in industry and businesses have become aware of the need to "create learning institutions through a combination of adaptive and generative leadership" (Senge, 1990). Senge describes an adaptive process as one of "coping" and a generative process as one of "creating". Such a distinction has not been made in resource management but perhaps it should be, especially in the context of creating learning institutions for adaptive management.

The need for learning institutions in business and industry has been empirically demonstrated. Most Fortune 500 companies have a life half as long as a person's work life but the few which have survived for 75 years (a short time in the context of water resource management) or longer, did so because they ran "experiments" to explore new business AND organisational opportunities continually (Senge, 1990). Such companies also changed from "top down control" (where the person at one organisational level instructs the person at a "lower" level what to do) to "integrative thinking and acting on all levels". This change is due to recognition that authoritarian bureaucracies respond too slowly to survive in the changing environment which is a fact of life for all operations today.

There is now much emphasis in business on making "on-going learning" an explicit part of management, and on making knowledge management (as opposed to mere data or information management) an explicit and successful part of learning. Knowledge has come onto centre stage for successful business and is seen as "information, combined with experience, context, interpretation and critical reflection". Reynolds (1998) emphasises the need for reflection to be critical. This is the antithesis of what happens in a typical bureaucracy. Davenport et al. (1998) surveyed 31 knowledge management projects in 21 companies and identified success factors for creating, transferring and using knowledge more effectively:

- Knowledge-friendly culture
- Clear purpose and language
- Senior management support
- Multiple channels of knowledge transfer
- Change in motivational practices to reward learning as opposed to doing
- Appropriate technical and organisational infrastructure
- Link to service performance
- Flexible knowledge structure.

This learning and knowledge orientated paradigm shift is not restricted to private enterprise. In the United States, a National Performance Review is evaluating how to "reinvent government" by assessing how government organisations can be made more hospitable to learning and creativity in improving service delivery. Barth and Bartenstein (1998) suggest that the emphasis on reflection and theory testing found in academics can be combined effectively with the action orientation of practitioners to generate creative, learning organisations even within government bureaucracies. They emphasise the value of such an adaptive organisational structure and process for maintaining effective service delivery in response to changing societal demands.

An explicitly learning institution is therefore seen as the viable alternative in business, natural resource management and government to the command-and-control bureaucracies, the limitations of which are now broadly accepted. Improving knowledge management is the common theme in moves to create learning organisations which in turn are seen as essential for success in a rapidly changing environment. Effective knowledge management could be a key success factor in turning command-and-control management into adaptive, learn-by-doing management, and we ignore it at our peril.

Strategic adaptive management (SAM)

The concept and practice of SAM (Rogers and Bestbier, 1997; Rogers, 1998; Rogers and Biggs, 1999) is a local derivative of ARM designed to generate consensus management which is inclusive, strategic, adaptive and creative. SAM is a process which is both dependent on and instrumental in, building a partnership between science, management and society. It is explicit about developing context and encouraging reflective (adaptive) interpretation. Like ARM it is dependent on explicit management of the knowledge at its disposal, and needs a formal model to guide institutionalisation.

Central to SAM is a consultative process whereby stakeholders (science, management and society) utilise scenario planning to integrate their visions (Rogers et al., 2000) into a consensus view of the desired state of the system to be managed (Fig. 1). The desired state takes the form of an objectives hierarchy which translates a consensus vision of future societal needs and values, into operational goals (Rogers and Bestbier, 1997). These goals provide managers on the ground with both institutional (administrative) targets, and specific ecological endpoints for ecosystem management (Rogers and Biggs, 1999).

The process of incorporating values into the desired state and defining it in achievable terms, is one way of condensing knowledge into manageable units. A second is enshrined in the process of selecting a small group of indicators which is used to measure achievement of goals. Monitoring is focused on these indicators and is expressly designed to be practical within resource constraints.

Further scenario generation is coupled with predictive modelling to outline a range of possible management actions and their likely consequences (Fig. 1). Relevant stakeholders within the science/management/society partnership are thus equipped to select the most appropriate management options for implementation. Such explicit evaluation of alternatives avoids the all too common response of reactive selection of the most immediately available solution (Rogers and Biggs, 1999).

Following implementation, monitoring of the chosen indicators is expressly aimed at auditing goal achievement against the desired state (Fig. 1). Future scenario projections can be used to

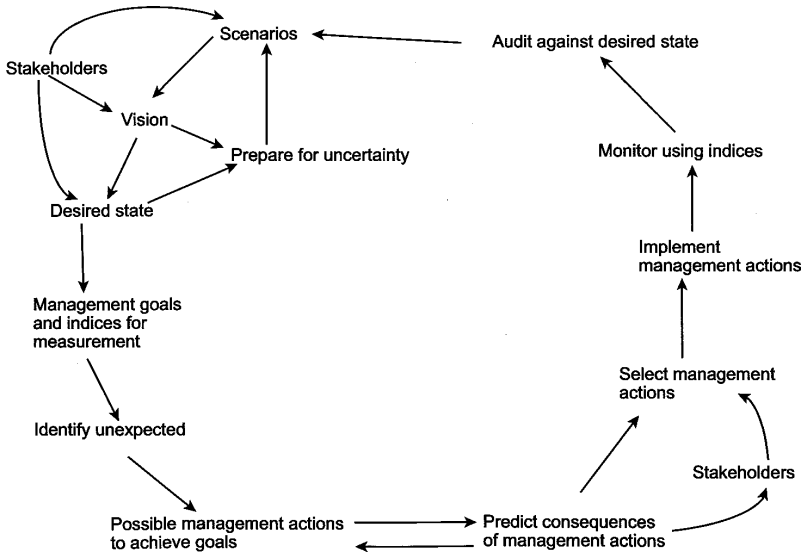

Figure 1
The fundamental components of a strategic adaptive management system

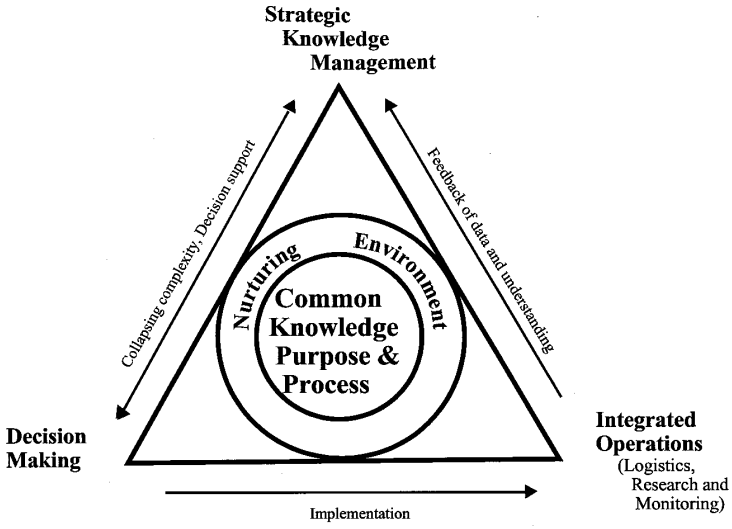

Figure 2
A framework for institutionalising strategic adaptive management

complete an iterative loop, adapting and learning at each iteration. The process must be iterative and must treat all scenarios and goals as hypotheses, or best estimates, to be challenged and tested as the knowledge base grows.

Institutionalising strategic adaptive management

CMAs which recognise the dangers of excessive command and control; the need to integrate stakeholder values and activities; and the potential of an adaptive and generative management approach, will need to structure their activities carefully. The above discussion suggests five factors critical for successful institutionalisation of a process such as SAM (Fig. 2):

- **Integrated operations**. It is essential to reduce territoriality amongst stakeholders and to blur the lines between who are managers, who are scientists/researchers and who are the deliverers and receivers of goods and services. All are contributors to service delivery and resource protection in the context of an inclusive, learning institution adopting SAM. Within an institution it is important to redefine "Operations" as involving both scientists and logistics personnel who undertake actions supporting increased system assessment, evaluation and understanding through collection of data and knowledge. They differ only in the emphasis on physical action by logistics personnel who manipulate the ecosystem and the emphasis on hypothesis testing by scientists who audit goal achievement (Rogers and Biggs, 1999). Defining the role of other stakeholders and integrating their activities into overall catchment management activities is a largely unexplored arena in South Africa.

- **Strategic knowledge management**. This node is responsible for generating wisdom which leaders use for decision making. Control of the quantity, quality and form of information reaching the leadership (Fig. 2) node is imperative for effective decision making. Knowledge management is about strategically and creatively reducing the complexity of data and information into knowledge and wisdom in order to facilitate effective decision making (Meyers, 1996). As such it moves an organisation well beyond the confines of mere information management. The work of a knowledge manager has three foci:
  - generation of knowledge which entails its creation, acquisition, synthesis and adaptation;
  - codification of knowledge centres on its capture, transformation and representation;
  - transfer of knowledge between locations and, most importantly, ensuring its absorption by the recipient (Meyers, 1996).

  Reducing knowledge of ecosystem structure/function and stakeholder needs into an objectives hierarchy and a few achievable goals is an important aspect of knowledge reduction in SAM. Integrating the stakeholder knowledge base, including the fast disappearing indigenous traditional and cultural knowledge will be a central challenge of this node.

- **Decision making**. Joint forum decision making ("acting on all levels"; Senge, 1990) is essential in institutions adopting SAM. This does not and should not remove responsibility from the agency, or its executive management, for decision making but rather facilitates it. Such decision making can entrench intra-institutional integration and reduce the chances of operations becoming a self-serving bureaucracy. The desire for action by staff on the ground must be balanced by reflection about the

problem and potential solutions (c.f. Rogers and Biggs, 1999).

- **Common knowledge, purpose and process**. Ensuring that all stakeholders operate from a common knowledge base and with united purpose (e.g. for an agreed desired state) will markedly reduce conflict and increase co-operative governance within a catchment. Its central importance must not be underestimated and considerable effort will need to be expended in activities to serve this node. Common purpose is achieved by collaborative goal setting and auditing. It provides the cement and building blocks of integrative, shared and creative management. Processes/protocols for setting visions/goals and running an organisation adaptively must be explicit, documented and adhered to. Command and control will inevitably appear as the agency grapples with the dual needs for participatory, adaptive management and the common process needed to streamline operations. The challenge will be to keep it within the bounds of administrative procedure and prevent it from limiting participation by society in decision making processes.

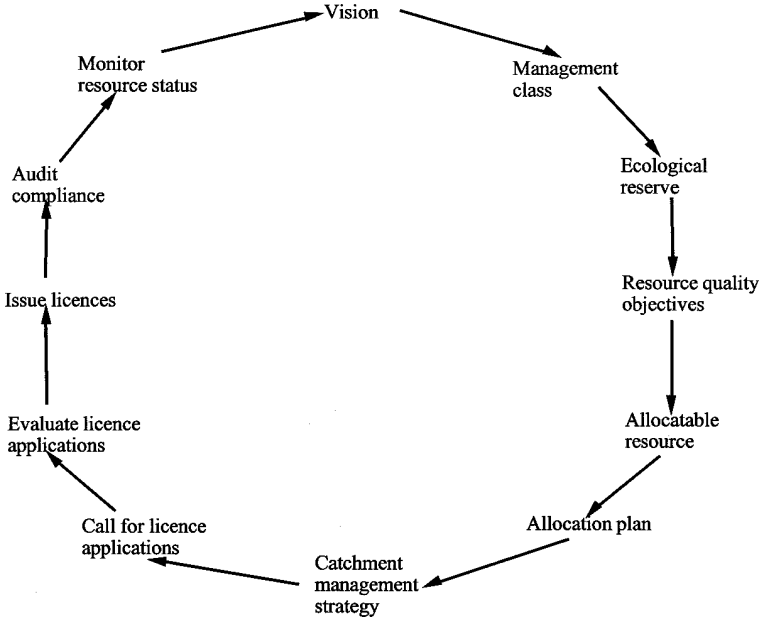

Figure 3
An interpretation of the management cycle for implementing the new South African Water Act

- **Nurturing institutional environment.** None of the above will be achieved without the unambiguous creation of a culture which stimulates institutional learning and embodies the philosophy behind SAM. The culture provides the inspiration for integrative, shared and creative adaptive management. The essence of such a culture would be to promote:
  - sharing of responsibility amongst stakeholders rather than apportioning blame;
  - a shared-territory/stewardship across boundaries spirit;
  - learning-by-doing;
  - inspired and critical reflection/hypothesis testing;
  - dealing with uncertainty, complexity and change as given factors;
  - balance demands for altruism with personal incentives;
  - in a South African context, Ubuntu (I see you the individual), Simunye (we are one) and Batho pele (people first).

Developing this culture requires a move away from regulatory, authoritarian line management, towards a new style of generative leadership (Senge, 1990). Generative leaders are defined as:

- **designers** of common purpose and core values, of strategies and structures for guiding decisions, and of effective learning processes.
- **teachers** who help people achieve more accurate, insightful and empowering views of reality.
- **stewards** for both the people and the vision of the enterprise.

This kind of leadership is imperative if CMAs are to serve the common purpose of resource delivery and protection in our emerging democracy.

Discussion

The authors have collectively participated in many formal and informal discussions on this subject. We acknowledge that our knowledge is incomplete, but are nevertheless concerned that there is insufficient awareness of the potential for command-and-control management of water allocation to dominate CMA activities. Resource protection is in danger of playing second fiddle.

To highlight this concern we contrast two perspectives of how the Water Act may be implemented. The first perspective (Fig. 3) was gained from discussions on the Water Protection Policy implementation which DWAF personnel are tackling so professionally and courageously (DWAF, 1999). We emphasise that this is our interpretation and recognise that the issue is under debate even within DWAF. We hope the contrast we make here will promote discussion and aid in achieving more clarity.

The initial impression is that of an iterative, and therefore potentially adaptive, process (Fig. 3). However, the way this iterative loop is portrayed (Fig. 4) and the way some managers seem to be interpreting it (e.g. the absence of an ecosystem manager in proposed CMA structures), also conveys the impression that the resource, in particular the ecological reserve, would not itself be managed. It would only be protected by default through application of an administrative system which limited the number of permits/licences for water use. This would amount to a classic case of command-and-control management.

This is clearly not the intention of the National Water Policy which requires that a "balance" be achieved between the setting of Resource Quality Objectives to be achieved by the ecological reserve; and a system for managing and controlling water use through authorisations and licences. In other words the aquatic ecosystem must also be explicitly managed to achieve the desired resource quantity and quality as described by the Resource Quality Objectives. Simply limiting the amount of water use by command-and-control licencing does not constitute ecosystem management and explicit provision must be made in CMA strategies and structures for appropriately trained ecosystem managers.

This illustrates why it is so difficult to combine resource use and resource protection in one organisation, particularly when that organisation (e.g. a CMA) is built from the expertise of another (e.g. DWAF) which has no history of managing ecosystems. It will

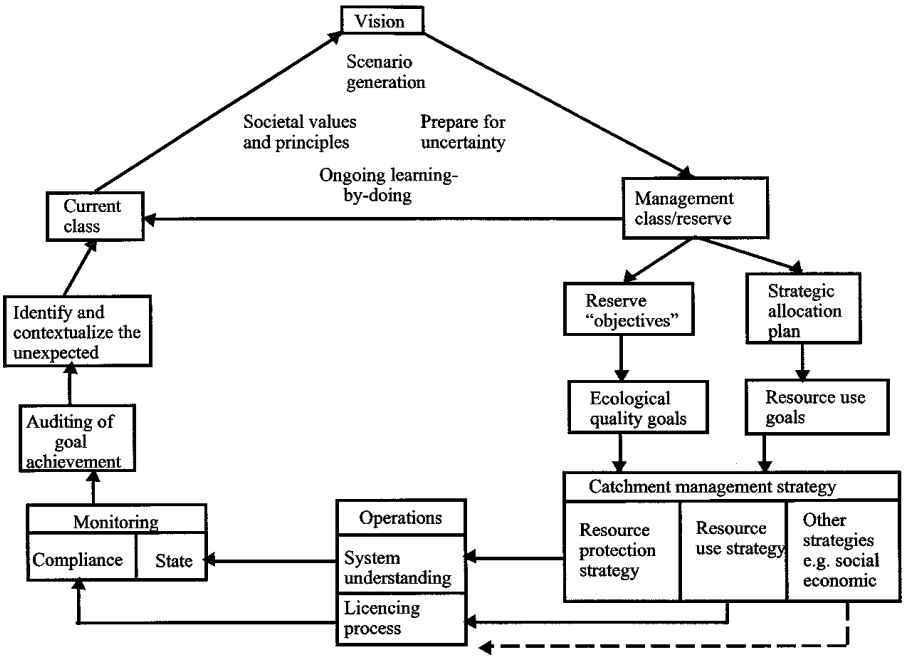

Figure 4
A strategic adaptive perspective for implementation of the new Water Act

TABLE 1
A contrast of leadership style, organisational structure and organisational culture in conventional bureaucracies and adaptive organisations.

Issue	Conventional bureaucracies	Adaptive organisations
Leadership style	Primarily command-and-control Transactional/paper shuffling	Primarily to coordinate and facilitate Generative (designer, teacher, steward)
Structure	Functional hierarchies Vertical communication Work **for** one boss	Dynamic teams with blurred boundaries Horizontal dialogue Work **with** colleagues across boundaries
Culture	Thinking at the top, doing at the bottom Collect data and manage information Follow rules and regulations Internal competition This-is-our-product/empire syndrome Observe and criticise mistakes Rather make no decision than a wrong one View uncertainty, complexity and change as threats	Develop common purpose through collaborative goal setting Generate, codify and transfer knowledge Driven by vision and values Integrated operations across stakeholder-service provider boundaries Enthusiastic sharing of knowledge (trust and openness) Learn and adapt through hypothesis testing and critical reflection Recognise when new knowledge allows you to make the next better decision Treat uncertainty, complexity and change as opportunities for learning and improvement

take considerable adaptation of mindset to over come these problems. A contrast of the leadership style, structure and culture of conventional bureaucracies with adaptive organisations should provide water managers with examples of such adaptations in mindset (Table 1).

To assist discussion around this subject we merged our SAM process (Fig. 1) with the perspective we gained from DWAF (Fig. 3) to develop a prototype model for a strategically adaptive process for managing both the water use (licencing) and resource protection components described in the Act (Fig. 4). Perhaps the model is naive but it may provide a basis for discussion. The key features are:

- An iterative process of relating current state of the system with desired state in the context of unexpected changes to the system.
- A hierarchical process for decomposing the management class into achievable goals.
- Parallel but interactive strategies for the range of social, water use and protection catchment management activities.
- Similarly parallel processes for monitoring goal achievement and responding to changes in state.

This model emphasises general processes. It will be extremely challenging to convert these into operational processes but that is beyond the scope of this paper which aims only to highlight issues

which need serious debate as we attempt to implement new policy.

At present, much discussion centres on the structure of CMAs and much less on how they should function to facilitate the implementation of these processes. Form is preceding function in many instances. When function is discussed it often centres on regulatory mechanisms and permit systems. These are essential elements but have the potential to invoke a classic command-and-control *modus operandi* if not tempered with a more adaptive process. We hope that the contrast above provides a basis for holistic planning to avoid such an approach and to stimulate parallel and actively managed mechanisms for balancing resource use and protection.

South Africa is in a unique phase of renewal in which there is unprecedented opportunity to implement lessons already learnt elsewhere in the world. These lessons are not easily implemented in countries where entrenched bureaucracies hinder progress (c.f. Gunderson et al., 1995). We should not waste this opportunity to catch up with, and even pass, other global economies and democracies. The use of our Water Law as a text book example by international universities (Mackay, 1999) indicates that it has achieved this status. We must be sure that the institutions we set up to implement and administer this law are equally innovative and do it full justice. If not, the progressive legislation will flounder in the face of bureaucracy.

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