RE-ENGINEERING AGRICULTURAL R,D&E TO SUPPORT MANAGEMENT DECISION-MAKING: PROBLEMS AND PROSPECTS

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Summary. Much past investment in agricultural R,D&E has paid off. Success has commonly been associated with tangible technologies to relieve specific constraints. Increasingly, R,D&E is expected to contribute to the improved management of agricultural production systems. This has to do with the way in which different technological components are combined and used by farmers and other resource managers. Success in this activity is harder to demonstrate. The principal causes underlying this apparent inability to bridge the gap between the world of professional science and that of practical agriculture are the same as those that motivate business process re-engineering. Two case studies are presented to illustrate the extent and nature of the difficulties facing current R,D&E practice to support management decision-making effectively: the APSRU and GLASS projects. The agricultural R,D&E business is in a state of transition from an output culture to an outcome culture. The principles of business process re-engineering provide a framework for completing the transition to a more responsive and responsible research culture.

INTRODUCTION

The quest for high rates of return on investment has been a consistent feature of agricultural R,D&E (5). In recent years, the focus of this activity has shifted increasingly away from the provision of tangible products towards the improved management of complex systems. This has been largely a response to the perceived failure of traditional R,D&E to impact on farm practice other than through the provision of novel technological components; to the withdrawal of government agencies from the provision of one-on-one advice; and to the rapid emergence of novel technologies for information management. However, it is more difficult to show high *ex post* rates of return on research investment in developing products aimed at bringing about improvements in managerial decision-making at farm level. In part, this reflects the extension of patterns of innovation which are appropriate for technology generation, into unfamiliar situations where they are less appropriate (2). Indeed, the current emphasis on the development of decision support products within agricultural R,D&E portfolios may be misplaced as these reflect a traditional preoccupation with *outputs* as opposed to *outcomes*. The transition from a vestigial R&D focus on achieving understanding as an end in itself, to one that accepts responsibility for achieving purposeful change in human behaviour, has been incomplete. We believe that there are substantial gains still to be made through changes in the way agricultural production processes are managed. The realisation of these gains may require re-engineering institutional R,D&E processes.

Business process re-engineering (1, 4) typically takes a high level view, surveying what current institutional arrangements are meant to deliver. It focuses on outcomes rather than outputs, as much of the value of re-engineering comes from the obsessive pursuit of customer value. And it sets ambitious goals, as it is chasing entirely new ways to achieve substantial results. These ways often require changing authority, responsibility and resource structures so that problems get resolved. This paper describes some of the problems and opportunities which provide the case for re-engineering agricultural R,D&E. The need for change is established on the basis of two case studies of major recent projects: APSRU and GLASS. Re-engineering provides a framework for developing a new model of R,D&E designed to support management decision-making.

RE-ENGINEERING PRINCIPLES

Reengineered processes are much simpler and significantly more customer-focussed than those they replace. Re-engineering seeks out simple, effective ways to deliver value to customers by re-constructing processes without the baggage of history (1, 4). There are really no rules to the process, and it is not a

once-off affair. Rather, there is a set of basic questions, the repetitive review of which will drive organisational change in a direction consistent with satisfying customer (stakeholder) wishes. These are questions of *purpose* (What is it that we are in business for?); *culture* (How do we generate another, better organisational environment?); *process and performance* (What process is most effective in getting the results that customers want?); and *people* (Who do we want to work with?).

Re-engineering attempts to replace perfectionist organisational thinking (*Get it right then keep it going*) with *Make it something else* i.e. it embraces continual questioning of both ends and means. It affirms our faith in human beings: replacing *ex officio* authority with existential authority; overthrowing the tyranny of numerical accounting; and complementing the old adversarial/competitive strategy with a supportive strategy. It actively pursues growth and service through pluralistic thinking within a culture of learned willingness and individual accountability. The hardest lesson of all is that to effect change, control and dependency must be given up.

In short, business process re-engineering is about achieving outcomes for stakeholders rather than simply generating outputs which they may or may not take up. It integrates different functions within the context of the whole organisation. Thus, even though traditional sections may have been performing within their own domain, this may not be consistent with the goals of the organisation as a whole or in the context of an integrated process. Significant opportunities may have been missed because they *fell between the cracks* that are left between the boundaries of existing institutional structures/functions. This reaffirmation of the determination of organisations to achieve outcomes for stakeholders, rather than self-serving outputs, takes place at the same time as our conception of which groups constitute legitimate stakeholders is also changing.

TWO CASE STUDIES

Case Study 1: APSRU

In preparing its strategic plan for the period 1991-1995, APSRU saw its mission as client-oriented agricultural systems R&D leading to improvements in production efficiency, risk management, and sustainability in sub-tropical Australia. The objectives highlighted in this plan included gaining a better understanding of clients' decision-making behaviour in order to identify opportunities for providing useful information products which would improve outcomes for them. Since 1991, APSRU has developed an *operational research* capability in the form of a software package called APSIM. This was a response to the emerging recognition *that a systems approach was needed to meet the challenges presented by the complexities, uncertainties and conflicts in modern agricultural production systems* (7). This view, widely accepted in the scientific community, was partly attributed to some examples of the successful use of models to aid tactical decision-making about crop production. But the connection between the predictive performance of biophysical simulation models and their ability to deliver better farming practices is still not clear.

Reliably mimicking past crop performance, and producing tightly specified yield distributions, are not sufficient by themselves for learning and gaining new insights. The strategic plan recognised that rainfall was the *main determinant of both the nature of the production system and variation in financial returns*. Hence, improvements in production efficiency and risk management could be expected to come from more effective and efficient use of rainfall. However, the concept of water use efficiency has been bypassed in favour of simulation for yield predictions: either to recreate the specifics of a past event, or to produce distributions of future yield that reflect historical seasonal variation in exogenous environmental variables. But, there is little insight in yield predictions unless the sources of variation can be identified and partitioned between controllable (e.g. stored water) and uncontrollable factors (e.g. timing of rainfall), and unless this leads to insights that pave the way to better outcomes. Description of the past is not enough. In creating a case for changes in farm practice, the emphasis shifts from providing answers to interpretation, negotiation, experimentation with different ways of doing things, and then doing things differently. Despite this, a significant proportion of APSRU's activities consisted primarily in a search for customers for a product that it was already intent on producing. It was user-seeking.

Case Study 2: GLASS

GLASS, a large-scale multi-disciplinary project, began in 1989. It aimed to provide prescriptions for the sustainable management of native and semi-improved pastures in the extensive black speargrass lands of sub-coastal Queensland. The project was to run for 10 years, but it was scaled down and will wind up by mid-1996. GLASS sought to achieve something radically different to the more traditional small-scale grazing trials that had preceded it. However, despite a more systemic and ecological focus, it still adhered to a traditional scientific paradigm, taking a reductionist approach to problem definition and basic experimental design. A working assumption was that an understanding and description of the function of a grazed system would be sufficient to provide information of value to practical managers. At its inception, this information was seen to be best provided to stakeholders (then narrowly defined as beef producers) in the form of formal decision aids, including software. Mid-way through the project, decisions were taken to strengthen the connections between the R&D team and stakeholders to align the projected outputs more closely with their information needs (6). At the same time, the range of the potential stakeholders was broadened to include other groups (including agribusiness and conservationists) less commonly identified with R&D outcomes. However, in the process substantial differences were identified between the projected value of the GLASS outputs from the perspectives of the R&D team and other stakeholders. As the experimental design and the infrastructure for information delivery were relatively fixed, it proved impossible to make substantial changes consistent with stakeholders' desired outcomes. GLASS has been a general success when judged against the original criteria which valued discipline-based scientific publications. However, its attempted mid-life reorientation towards different stakeholder groups, and its increasing customer focus, meant that the criteria of success also changed. The ground had shifted, and GLASS has been less successful in delivering outcomes against these revised criteria. At least, the R&D managers were able to see this and make the hard decision to avoid further escalation of unwarranted commitment.

DISCUSSION

We suggest that agricultural R,D&E, while paying increasing attention to stakeholder interests, has got stuck in the transition between two cultural peaks; now, it is neither one nor the other, neither science nor management. The far peak, rather dimly perceived by researchers, is inhabited by professional agricultural managers, and other stakeholders, trying to cope with the realities of performing in a complex, and constantly changing, physical, economic and social environment.

There are many symptoms of this malaise: communication is seen as a separate activity, added on after the research is done; a poor feel for the value of information, either at the margin, or in relation to the cost of getting it; grand visions are substituted for realisable projects; projects are inconsistent with objectives; because of the mismatch between rhetoric and reality, commitment to outmoded ways of operating continue to be supported; how we do our research does not respond to the different requirements of different stakeholders; and researchers are rewarded for output rather than outcomes. Failure is engineered into the way we do our work. The two case studies do demonstrate a willingness to address issues of concern to stakeholders; the projects wanted to be relevant, but did not know what that meant nor how to go about achieving it. The push for outcomes comes as much from inside the organisations of R&D providers as being imposed; and there is a renewed commitment to action. But there is still poor recognition of how sick the patient is, or the implications of the proposed changes in customer focus for how to do science. Re-engineering suggests that the big payoffs will be achieved by pressing on with this transformation, and by pursuing it more actively and overtly.

We do not propose re-engineering as a model of how to do R&D, but as a framework for thinking through these issues. Other contributions are also part of this debate. Thus, Gouillart and Kelly (3) maintain that re-engineering has serious weaknesses because it looks at established processes rather than asking broader strategic questions. The organisation can be transformed, they suggest, through *reframing* corporate direction, *restructuring* the company, *revitalising* the enterprise, and *renewing* people. This is an ambitious attempt to move beyond re-engineering in the business world. In a similar vein, Nonaka and Takeuchi (8) propose a *middle-up-down* approach to manage knowledge creation, and novel metaphors for what a knowledge-creating company does and how it does it, e.g. hypertext. In agricultural R,D&E, we

have not yet achieved the benefits of re-engineering. The case for re-engineering builds on established ways of doing things in order to realise a vision to which we are already committed. But support for it must come from the top.

We are part way through a cultural transition in agricultural science, where the rules for going about it, our recognition of the claims of different stakeholder groups, and the standards by which we gauge our success, are all changing. Re-engineering provides one framework for progressing this transition towards completion. Other frameworks that emphasise outcomes to be negotiated with stakeholders, also need to be considered. The alternative is a regressive move to opt out of our emerging responsibility as professional researchers for facilitating purposeful change in the communities in which we live. For us, there is no going back.

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