Learning from the historical failure of farm management models to aid management practice. Part 2. Three systems approaches

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Abstract. Part 1 analysed the difficulties experienced in the field of academic Farm Management in making complex theoretical models relevant to farming. This paper highlights the important connections developed between the field of Farm Management economics and 3 key ‘systems’ ideas and tools in agricultural science in response to difficulties and opportunities. The first systems approach reviewed is the 20-year experiment by agricultural economists in using crop and animal production simulation models in management analyses. The second systems approach reviewed is Farming Systems Research (FSR), an approach characterised by on-farm experimentation with a management orientation. Many pioneers of FSR were Farm Management economists disenchanted by the inapplicability of economic theory to farm management. The FSR that emerged is interpreted as a scion of the early era of Farm Management prior to the coup by economics theorists in the 1940s. A third systems approach reviewed is a ‘soft’ intervention to facilitate farmer learning. Although evolving from FSR, this approach has surprising similarities to the ‘goal adjusting’ consulting performed by the legendary Australian Farm Management consultant cum academic, Jack Makeham. The paper concludes with discussion of a recent innovation that combines these 3 approaches. It uses a soft intervention approach that features farmers shaping their goals and expectations by ‘experimenting’ in a local, but virtual, environment provided by simulation of the production system using ‘hard’ models.

Introduction
The history of Farm Management (FM) is extraordinary in both its duration and its substance. Since the establishment of the Office of Farm Management in Washington, DC, in 1902 until recently, there has persisted a professional field aimed at providing support for farmers in operating farms as businesses. Part 1 of this series (McCown \textit{et al}. 2006) dealt with the rise—the ‘takeover’ of the field from agricultural scientists by agricultural economists who claimed that economic modelling was essential to the future of the field—followed some 3 decades later by the demise, characterised by admission by leading agricultural economists that the models had proved to be inapplicable (Dillon 1979; Malcolm 1990).

Our main aim in this series is to understand this failure and to suggest a way forward. For our inquiry, we have adopted the structure used by Malcolm (1990), who reviewed four, largely successive, modalities of FM thinking and practice: production theory, activity analysis/mathematical programming, decision analysis, and systems approaches. In Part 1 (McCown \textit{et al}. 2006), we looked at the performance and developments within the first 3 of these approaches. For further structure we drew on the insightful dichotomy created by Schultz (1939) who distinguished between \textit{planning} and \textit{expectation formulation} in the management of farms, and the claim that the importance of the latter greatly exceeds that of the former. Consequently, in Part 1, we hypothesised that ‘late era’ FM has been mistakenly preoccupied with intervention to provide theoretically rational plans when the greatest need of farmers in their planning and decision making, is support in forming more realistic expectations. In this second and concluding paper, we pursue Malcolm’s FM fourth theme by examining 3 very different systems approaches and the possibility that their limitations are reduced in an approach that combines them.

The earliest of these systems connections to FM is ‘systems analysis and simulation’. This was seen as a means of enhancing farm models, especially by enabling dynamic treatment of production system processes instead of static ‘production functions’. Dent and Anderson (1971) pioneered this experiment in systems analysis and simulation. Their book in 1971 brought together various scientific modelling efforts into a farm management economics perspective. Although for Anderson, this digression was temporary, for Dent, it was the start of a new ‘systems’ career path. In the present paper, successive updates on views and activities...
of Dent and his students provide a significant resource for tracking trends in systems approaches in FM.

The second ‘systems’ strand is that of Farming Systems Research (FSR). Instead of being a reform within FM, FSR is, in 2 respects, a scion of FM. First, a large proportion of the pioneers of FSR in the 1960s and 1970s were ‘refugee’ economists from FM. Of these, the person most central in our story is John Dillon, who underwent a late-career ‘systems’ conversion experience (McCown et al. 2006). Second, early FSR tended to resemble ‘early era’ FM, with its on-farm, consultative, research approach (Norman 2000).

The third connection between FM and ‘systems’ centres on Jack Makeham, a farm management consultant-turned-academic, whose approach to intervention both Dillon (1979) and Malcolm (1990) singled out as especially successful. Makeham described himself as ‘a professional goal adjuster’ (Makeham 1965). This was a rare instance of formalised FM intervention practice that featured facilitation of expectation formulation in management instead of theoretically rational planning.

The final section sets out a logic of combining key aspects of these diverse systems approaches: situated simulation modelling, on-farm research, and facilitation of farmers’ formulation of expectations. The logical case for this combination is augmented by brief reference to an actual case of such an eclectic systems approach that has been evolving for over 10 years.

Simulation of farm production systems and their management

By the late 1960s, Anderson and colleagues were calling attention to serious inadequacies of ‘response analyses’ that used simple, static production functions for representing relations in the Production System (Fig. 1) between certain controllable factors and outputs (Anderson 1968; Byerlee and Kristensen 1992).

At about this time, simulation models of production processes were emerging from research in various disciplines in agricultural science, having been stimulated by modelling in Operations Research 2 decades earlier (McCown 2002a, p. 13). With reference to Fig. 1, this section examines the 20-year ‘experiment’ in using simulation models of the Production System, together with decision models of the Management System, to provide rational plans for farmers. The focus is on ‘if’ and ‘in what way’ better production system models overcame past impediments to realistic analyses.

Our starting point is the assessment by Dent and Anderson (1971) of the potential in FM for the simulation models that were appearing in various fields of agricultural science. Even today, 35 years later, their arguments for investing in simulation, the identification of general problems, and speculation on development pathways remain salient. Anderson and Dent (1971) concluded that in all but one of the cases, what made the choice of simulation compelling was the inherent complexity of management resulting from multiple dynamic interrelationships and the pervasive influence of stochastic factors. They foresaw that the major benefits from models so enhanced ‘must stem from the improvement in decision-making about the real system following experimentation with the model’ (p. 387). The major challenge in achieving this was improving the capability of models to credibly mimic system performance. In addition to enhanced models, this would depend on overcoming the high costs of specifying models for sites/enterprises of actual farms. They had reason to believe that the model development enterprise would flourish, driven by incentives of scientists and institutions quite distant from improvement of farmer decision-making. But they were concerned by the infeasibility of applying models to specific sites and enterprises. They imagined ‘...the possibility of establishing autonomous modules representing relationships that apply with acceptable accuracy over a region. Such modules may then be linked together so that they form the core of a model; to this core, the unique characteristics of the overall system to be modelled may be added. These additional sections often will be constructed relatively easily and quite simply linked with the selected modular core. The behaviour of the complete model then can be examined in relation to the specific environment that prevails for the problem’ (Anderson and Dent 1971, p. 388).

Over the next few years, Anderson (1972, 1974) critically and comprehensively reviewed the field of simulation methodology and application in farm management economics with the focus on ‘the interpretation of output

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**Fig. 1.** The farm abstracted as a humanistic management system cybernetically linked to a biophysical production system (after Sorensen and Kristensen 1992).
Farm management models 2

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for managerial decision making’. Anderson (1974) saw problems falling into 2 categories of relationships: between the model and the real world and between the researcher and the farmer. Whereas the former was a matter for biophysical modellers, the economist had something to say about the latter: ‘It will be useful to introduce the idea of a manager or decision maker charged with the responsibility of interpreting the output from a model constructed by a [systems scientist] in his employ. [...] The [systems scientist] is asking the manager if one [output probability] distribution is in some sense better for him than another’ (Anderson 1974, p. 26).

The dual challenges of good models and affordable specification/customisation for actual sites/enterprises identified by Anderson and Dent (1971) have since dominated research in this area of FM. In the quest for model credibility, a major challenge for modellers was to ensure that models were sufficiently sensitive and comprehensive to adequately mimic behaviour of the production system, yet remained sufficiently small and simple to be easy to understand and affordable to maintain. Deficiency in a model’s ability to mimic production processes takes 2 forms (Thornton et al. 1991, p. 331). The model can possess inadequate sensitivity to small changes in input conditions that are important in the real world. Alternatively, the model may omit entire processes that are important in an application in the real world, i.e. it may have inadequate comprehensiveness. In either case, an enhancement almost always involves elaboration of the model, and elaboration increases costs (additional and/or more expensively obtained data, increased software complexity and maintenance costs, reduction in comprehensibility, etc.).

Customisation to a specific farm situation contained issues of both models and data. Charlton and Street (1975) explained that although they would have preferred simpler models of both financial and production aspects of pig and dairy enterprises, ‘...simple models would have been incapable of being applied to a specific farm problem. The complexity of the models arose not from the introduction of sophisticated relationships but from the need to provide detail and adequate flexibility’ (Charlton and Street 1975, p. 262; emphasis added). The conflict between process elaboration in models and the feasibility of their use in practice has continued to be a perplexing issue. The focal point for a great deal of research attention became how to make it cost-effective to customise models for a specific farm. Blackie and Dent (1974) considered the following 2 approaches. ‘The first involves the development of a ‘representative’ farm or enterprise model which can be used to examine the effects of differing management policies. This type of model is largely confined to examining the implications of major management changes. The results from such models cannot be applied directly to an individual farm and therefore are unable to provide specific management guidance. The second approach relates to the construction of a ‘skeleton’ model which represents the logical structure and includes only the basic parameters of the real system. Such a model becomes functional only when ‘coupled’ with data from an individual farm and, in its ‘coupled’ state, is unique to that farm. The model must be capable of reflecting both the sequence and timing of feasible decisions in order to reflect individual management policies. Systems may appear similar except with regard to their detail, the model must have the capability to adequately distinguish and mimic all such systems’ (Blackie and Dent 1974, p. 166).

These authors saw private consultants as important facilitators in generating farm data from individual farm information systems, with farmers acting to update these systems through low-cost enhancements of their normal monitoring of the production system and the external environment. In 1975, in a review of systems applications that featured skeleton models and coupled information systems, Dent confidently predicted the application of skeleton models for management purposes on individual farms ‘in the not too distant future’ (p. 123). Development was at an advanced stage for pig and dairy enterprises, but ‘To be operational, the information system, in which the skeleton model is embedded, requires considerable investment in carefully designed computer systems and in extension effort to introduce farmers to the information systems and to oversee its operation’ (Dent 1975, p. 123).

Four years later, Dent and Blackie (1979) still saw farm management information systems containing skeleton models as pivotal in the links among basic research, applied research, farm systems, and industry and government policy (fig. 7.8, p. 171). But by this time their emphasis had shifted strongly to the information component. They judged that the financial burden of farm data collection and storage was best shared with industry and government who, it was argued, needed this information for policy and administration. The CANFARM management information system (MIS) in Canada was held up as an innovative venture with relevance to both farmers directly and to public administrators. But
The contribution of simulation to management of farms was still ‘hoped for’ within the MIS program: ‘The role of information systems in gathering production statistics about farming or farming systems has been outlined..., and if many farmers are involved in an information system, this surveillance leads to the possibility of gathering aggregate current production statistics on a scale not previously possible and on a time scale hitherto unachievable. The availability of such aggregate data has immense potential from a farm policy point of view either by government or by commercial firms. In either case, agricultural extension agencies are bound to be influenced. But it would be hoped that the major impact on extension would be by the way of the information system permitting [customised simulations that aid] (1) planning of farm strategies to meet the objectives of the individual farmer; (2) controlling the farm business both biologically and financially’ (Dent and Blackie 1979, p. 172).

Although no explanation is given, both CANFARM and the skeleton model saga seem to have ended at about this time, without affecting the issue of site-specific relevance. Two decades later, Carberry et al. (2002) confirm that the site specificity sought by using skeleton models may often be a necessary condition for making simulation meaningful to a farm manager.

Anderson (1974) proposed 2 logical strategies for addressing the problem of relevance of models to farm situations. One was to make the FM model more like the farm. Applying his views to Fig. 1, the key to achieving relevance to management of the model of the Production System may lie in the specification of the model of the farmer in the Management System. Clearly the chance of model outputs crossing the threshold of relevance would be enhanced by direct elicitation of the real decision maker’s views of the world (Anderson 1974, p. 34). The second strategy was to encourage farmers to behave more like the models: ‘...the practical value of the theory in decision analysis depends upon the feasibility of convincing real-world managers of the merits of a systematic approach to their decision problems and on their assessments of the relative costs and benefits of systematic vs. intuitive decision making’ (Anderson and Hardaker 1972, p. 171).

Twenty-five years on, these 2 strategies remain central to intervention in farming practice using simulation models (McCown 2005). In theory, Anderson (1974) showed that these 2 strategies could be pursued by using decision analysis, but in practice he still regarded the relevance gap as an enormous challenge. The 2 components of Fig. 1, the production system and management, could be represented, respectively, by a simulation model and decision analysis. The output was a formal solution to an important, but abstracted, problem, to be made available to interested managers. In summary, Anderson introduced the notion of dialogic interaction between farmer and a professional with a model (Fig. 1), but took it no further than a metaphor to aid structuring of data collection for formal optimisation and generation of notionally ‘best’ plans.

In their closing remarks in the 1971 book, the emphasis of Anderson and Dent had been on enhancing and demonstrating model competence in simulating farms and farming. By 1974, Anderson was departing the field, and his emphasis was on the relevance gap between the situated practice of a farmer and the scientist’s recommendations of theoretically best practices:

‘[The] problem that pervades all modelling in systems work, and not just simulation, concerns the relationships between the modelling and the real world, and between the modeller and the real world decision maker. Focusing on simulation, it seems reasonable to conjecture that a considerable majority of studies have received little or no acceptance by real-world decision makers and have had little or no impact outside professional circles. Presumably the chance of a [modeller’s] conclusions crossing the threshold of relevance to have an impact on real-world decision making depends crucially on the acceptability and accuracy with which he conceptualises his model of the real system and the way in which he presents his model and his results’ (Anderson 1974, p. 34; emphasis added).

Modelling of a farm had progressed to where there was a real prospect that simulation combined with decision analysis in FM could mimic the crucial time-dependent behaviour of a specific management system of a farm. But there were numerous barriers to reaching Anderson’s ‘threshold of relevance’, which were to continue to occupy attention of economists and scientists for the next 3 decades.

The 1990 symposium held in honour of Prof. Colin Spedding’s contributions to the field of agricultural systems provided a significant opportunity for assessing progress of the ‘simulation-for-management-intervention experiment’ during the 1980s (Jones and Street 1990). But the scope of economist-supported intervention was spreading from economic analysis for allocation of scarce land, labour, and capital resources to including supporting technical control of production processes in uncertain environments (e.g. Dent and Thornton 1988; Thornton and McGregor 1988). Progress
management considerations

level [in providing] a vehicle for assessing a range of
might have applications at the whole farm or whole enterprise
was upbeat, displaying 6 pages of examples of models which
might have applications at the whole farm or whole enterprise
level [in providing] a vehicle for assessing a range of
management considerations ... These covered cattle, sheep,
pig, poultry, crop, and mixed crop and livestock enterprises.
The comprehensiveness with which farming systems could
be notionally simulated had increased, and Bywater observed
that the ‘use and usefulness of production system models
are increasing’ and that ‘if modelling and model use have
not come of age, then they are certainly well on their way
to doing so’.

Other contributors were disparaging of the lack of effect
and prospects for effect of modelling on practical farm
management. However, there was no unanimity concerning
causes and promising remedies. Dent (1990) lamented the
failure of models to approximate the purview of real farming,
and concluded that this was due to over-investment in models
of the Production System and under-investment in models
of the Management System (Fig. 1). ‘Trivial’ resources
had been spent on the determinants of the behaviour of
the farm family with respect to consumption, investment,
risk, and ‘the equally important social parameters including
attitudes, values, traditions, peer group pressure and culture’
(p. 126). The gap was an unsatisfied need for holistic, but
still prescriptive, intervention; more comprehensive systems
research was required to provide these.

To Dent, the degree that research in the on-farm practice
situation is ineffective is due to failure of the research practice
to be sufficiently organised and scientifically rigorous:
‘The whole process of what has been termed
‘adaptive research’, whereby developed and
tested technology goes through a process
of adaptation, evaluation and adjustment in
real farming situations before the adoption
process becomes effective, appears to be
without the accepted professionalism of
agricultural research. Linkages between
extension agents and scientists are informal
and the experiences of advisers are not
reported in the research literature’ [and hence
are not subjected to public evaluation] (Dent

This ‘broadside’ was directed at the on-farm experimentation
of FSR (following section) for its perceived lack of scientific
rigour. In terms of Fig. 1, the rigorous systems approach
that Dent envisioned would have models of the production
system and management system so comprehensive that they
would provide a basis for policy on technology development
to fill gaps:

‘In a holistic sense, however, technology
should be developed only in relation to the
farming systems in which it will play a
part: knowledge of the potential impact on
enterprise systems, farm household systems,
and therefore, potential adoption rates should
be assessed in advance’ (Dent 1990, p. 126).

Subsequent publications by Dent and colleagues featured
comprehensive descriptive research on farm households
(Austin et al. 1998a, 1998b; Willock et al. 1999a, 1999b),
but they do not reveal relationships concerning management
behaviour that might enable anything like ‘potential adoption
rates [to be] assessed in advance’. There is certainly no
evidence of any new research paradigm, the absence of which
concerned Dillon (1979, p. 12), if ‘mere description’ of
households was to be avoided.

The critique by Doyle (1990, p. 167) was no less harsh
than that of Dent. He bemoaned ‘the failure of systems
concepts and simulation models to have any practical
impact on farming’, and identified 2 main reasons: the
failure of researchers to liaise with farm decision-makers
and the preoccupation of systems researchers with model
building rather than application. However, unlike Dent
(1990) and Malcolm (1990), who argued that the relevance
‘gap’ resulted from insufficiently comprehensive models,
Doyle (1990) argued that pursuit of comprehensiveness was
impractical. The problem was not that models were too
‘partial’, but that they were not partial enough. He advocated
the scaling down to target problematic aspects of farms and
their management:

‘The very complexity of biological systems
and their susceptibility to unplanned
variations make it difficult to design
adequate representations of the real world.
Nevertheless, the systems approach to
analysing processes and resource decisions
on farms potentially opens up the prospects of
using models as aids to control of individual
farm processes’ (Doyle 1990, p. 108).

This simpler approach to using models was characteristic
of the Decision Support System (DSS) that had come to
prominence in agricultural research during the 1980s (but was
to have similar problems in ‘crossing thresholds of relevance’
in farm decision making) (McCown 2002a).

Farming Systems Research, its links to Farm
Management, and the evolution of a ‘soft’,
participative research and intervention paradigm

Dillon’s disenchantment with theory-based FM resulted from
his conclusion that it was ‘inapplicable’ to the management of
farms. There was a need to be ‘orientated better to the realities
of the whole farm system and its management problems’ (Dillon 1979, p. 12). The primary need was for the essential technical and business aspects of farming to be treated in the unique local physical and human contexts. To Dillon in 1979, the farm was a ‘dynamic, open, stochastic, and purposeful’ system and farm management activity must somehow be treated as practice that was essentially social.

The most feasible platform for designing professional intervention in such practice appeared to lie within the ‘systems’ paradigm:

‘. . . in arguing that FM has become too oriented to research techniques and theory rather than problems, some critics mention the need for a multidisciplinary basis to FM and a focus to farm-household relations. However, they present no paradigm in which to orchestrate such a development. My view is that systems analysis constitutes such a paradigm – at least until the next revolution comes along’ (Dillon 1979, p. 12).

However, there was no confusing the systems approach envisioned with that of ‘systems analysis and simulation’:

‘I see no quick resolutions in terms of fancy mathematical or computer modelling – the farm system and its management are too complex and human for that’ (Dillon 1979, p. 12).

This ideal of ‘holism’ was so fundamental that diagnoses of the crisis of relevance in FM centred on the failure of analysts to model sufficiently comprehensively the ‘whole farm’ (Dillon 1979; Malcolm 1990, 2000). The models of agricultural economists were whole-farm models in the limited sense of analysing the competition for resources across the production system, but a far broader approach to holism was required to capture the social dimension. In Dillon’s words:

‘As yet, there is no significant body of principles relating to the non-technical, non-financial elements of farm systems, little factual data is available, and methodologies for studying these components are generally lacking. The research need is great but prior conceptualization is necessary to get beyond mere description’ (Dillon 1979, p. 12).

FSR adopted the revolutionary strategy of taking the research into the social practice situation. The significance of this seems to be captured well in the ‘swamp’ metaphor of Schon (1983):

‘This dilemma of “tough or relevance” arises more acutely in some areas of practice than in others. In the varied topography of professional practice, there is a high, hard ground where practitioners can make effective use of research-based theory and technique, and there is a swampy lowland where situations are confusing “messes” incapable of technical [or analytical] solution. The difficulty is that the problems of the high ground, however great their technical [or theoretical] interest, are often relatively unimportant to clients or to the larger society, while in the swamp are the problems of greatest human concern. Shall the practitioner stay on the high, hard ground where he can practice rigorously, as he understands rigour, but where he is constrained to deal with problems of relatively little social importance? Or shall he descend to the swamp where he can engage the most important and challenging problems if he is willing to forsake technical [or analytical] rigour? [ ] There are those who choose the swampy lowlands. They deliberately involve themselves in messy but crucially important problems’ (Schon 1983, pp. 42, 43).

FM economists who pioneered FSR in the developing world left the high ground and entered the swampy lowland of professional practice. Although it was not initially clear just how practice should change, a new, adaptive approach did evolve. It began, more than a decade prior to Dillon’s ‘conversion experience’, in Asia, Latin America, and Africa during the 1960s and early 1970s. Western FM economists working in smallholder agriculture became progressively disen-chanted with their training and tools (Norman 2000; Norman and Matlon 2000). There was a turn towards greater engagement with farmers in their situations as means of ensuring relevance of research and intervention.

The nature of the approach that emerged has recently been described by Norman and his contemporaries, ‘revolutionaries’ who had been trained in the theoretical approach of the ‘late era’ of FM, but the approach that evolved in response to failures was

‘. . . based on the premise that one had to begin with understanding of the problems of farmers from the perspectives of farmers. Solutions had to be based on a proper understanding of their objectives and their environments, including both biophysical and socioeconomic components’ (Norman and Matlon 2000, p. 25).

In the epigraph to another paper specifically about the influence of FM on the farming systems approach, Norman (2000) declared that

‘Philosophically, the . . . farming systems approach, as practiced mainly in low income countries, has much more in common with
the ‘earlier’ farm management approach in the high income countries’ (Norman 2000, p. 293).

Norman’s positioning of this as an epigraph highlights the irony that as a farm management economist trained in the theory and methods of the ‘late era’ of FM, he nevertheless found that the key to achieving relevance to the management of farms was to return to the commonsense approach of the early FM era, an approach thoroughly discredited by the mentors of Norman’s generation for lacking a theoretical basis (McCown et al. 2006).

One widely reproduced representation of the farming systems approach was that of Collinson (1982) and shown here in Fig. 2. Using this flow diagram, several important features of this research approach can be highlighted: (a) it has a focus on technological change rather than improved business management, (b) it is oriented to solutions of farmers’ problems, and (c) it embeds ‘systems’ concepts of the day and foreshadows some of the future.

**Technological change**

The focus of late era FM research and intervention was on resource allocation for production, given the technology; the focus of agricultural science, on the other hand, was on the economic benefits of technological change to the production system. By the 1960s, some agricultural economists were recognising that the major increases in farm incomes were attributable mainly to such improvements. Dillon (1979, p. 12) applauded the successful consulting strategy of Jack Makeham, which placed top priority on dealing with ‘how to incorporate new technology profitably’. At the same time, FM economists from high-income countries were studying smallholder agriculture in low-income countries and were concluding that farmers ‘were rational (i.e. economising) in the methods they used’ (Norman 2000) and, although farm households were often poor, they were generally efficient in resource allocations (Schultz 1964). In contrast to their traditional stance, FM economists were now arguing that the best opportunities for improved farm performance lay in improving technology.

Although the core of the change process implicit in Fig. 2 is new technology, what most characterises the approach is the extent to which research activities depart from ‘tradition’, in that relevance to farms, farmers, and their problems is primary. The process ‘begins and ends with the farmer’ (CIMMYT 1980) rather than with theory held by the professionals.

**Solving farmers’ problems**

The implicit logic of the research process in Fig. 2 concerns a problem-solving process made up of 3 stages: diagnosis, planning, and testing. The problem solving takes place in 2 complementary research environments forming 2 intersecting ‘loops’. The first loop represents the researcher’s interaction with the farmer and the farm. The second loop is that of the researcher’s interaction with sources of research capacity and products, located in the ‘research station’ but later broadened to include many other important sources of ‘materials and techniques’ (Collinson 2000, p. 393). Part of the, so-called, ‘planning step’ that links the 2 loops, is the judgement as to whether the materials and technical practices needed on the farm are available or need to be developed. If the latter is the case, then specifications need to be given, based on diagnosis at the farm level, for development or acquisition of these.

**Engagement with the farmer**

Concerning practice was the strategy for ensuring relevance of scientific intervention. In Fig. 2 this takes place both at the problem diagnosis stage and in final on-farm testing of innovations. In the FSR collaboration between agricultural scientists/technology developers and agricultural economists, the latter assumed the role of managing the interface between farmer and the researchers (Collinson 1982).

**Systems concepts and paradigms**

Figure 2 contains the, then, contemporary theory of management of designed, purposive systems, strongly influenced by Herbert Simon. Simon (1966) had comprehensively critiqued the theoretically normative approach that was central to late era FM and successfully advanced an alternative **behavioural** approach based on learning from managers’ demonstrably successful behaviour (discussed in Part 1 of this series, McCown et al. 2006):

‘The task of a comprehensive logic of action is to describe or prescribe the [actor’s] rules that govern current reasoning about the occasions for action, the discovery of action alternatives, and the choice of action. [The] starting point is to ask what the practitioners actually do’ [ ] By examining their reasonings, we shall perhaps...
be relieved entirely of the task of constructing a new logic of norm and action: at worst, we shall have to make explicit what is implicit in practice, correct it, and improve it' (Simon 1966, p. 1). Okali et al. (1994) took this 3-step 'logic of action' of Simon's that is contained in Fig. 2 to be the underlying structure of all agricultural research. ‘... research, whether formal, or informal and involving scientists or farmers, will be considered to be a more or less deliberate and systematic process that proceeds through three general stages: (i) identification of opportunities (perhaps more commonly referred to as problems or constraints), (ii) identification of ideas or options and (iii) testing and/or adaptation of the ideas and options’ (Okali et al. 1994, p. 13).

Collinson elaborated on the first, diagnostic, step in this approach:

'A Farm Systems Economist [FSE] attempts to understand how a farmer allocates his scarce resources of land, labor, and cash between crop, livestock, and off farm production in a manner which best satisfies his and his family's priorities. This is essentially the economic problem. The FSE's professional task is to understand a farmer's decision criteria, and to identify how and why, in managing his farm, the farmer compromises on the optimal technical management of any one enterprise in order to raise the productivity of the whole system' (Collinson 1982, p. 3).

Okali et al.'s third step of testing focussed on value to the farm family and operationalised the ideal of a holistic, ‘whole farm’ approach that was assumed to be needed if relevance to farm management was to be achieved (e.g. Malcolm 1990, 2000).

In the application of these 3 aspects of FSR (i.e. diagnosis, assessment of options, and testing), 2 other significant aspects became apparent. These were a marketing orientation and engagement of farmers in the research process. The significance of the marketing orientation, as well as its progressiveness, was indicated by Roling (1988). In lamenting the failure of agricultural extension, generally, to learn from the marketing research tradition, Roling observed that ‘Farming Systems Research, a systematic procedure closely following marketing research routines, to develop and test ‘appropriate’ agricultural technology with client populations has so far not been widely adopted [in extension]’ (Roling 1988, p. 30). Moreover, the relationships of researchers with farmers in early FSR went beyond study of client practical behaviour to client engagement in the process of research: ‘Farmers’ needs and circumstances are always specific to local situations. Relevance in research demands that local farmers provide their own perspectives in planning experiments and their own decision criteria in evaluating the results. FSR attempts to understand the way farmers make decisions and it encourages farmers to participate in the research process. FSR has the capacity to strengthen linkages between researchers and their small farmer clients’ (Collinson 1982, p. 3; emphasis added).

Thus, the early FSR, led largely by economist refugees from FM, created an approach to research and intervention that differed radically from the FM in which they were trained: interventions were aimed at improved technologies rather than more efficient resource allocation plans; intervention was based on solving local problems rather than applying theory to routine practice; reference criteria for identification by professionals of best practice were those of good farmers rather than theory about the market; and farmers began to be co-researchers as well as target clients. In analysing the paradigm change in the FSR experience, we have used the distinctions between 3 paradigms for scientific intervention in farming practice outlined by McCown (2001). FSR began by breaking with ‘late era’ FM and the latter's normative paradigm of theoretical design of plans or ‘best practice’ for farmers. Instead, research and intervention in FSR was strongly guided by observed behaviour of successful farmers in real farming situations (a behavioural paradigm). Although developed more fully later, there was a tendency towards inclusion in the research process of the farmer with his/her subjective purposes and practical theories of action based on experience (an action, or participative, paradigm). In terms of the prevalent ‘hard’–‘soft’ typology of ‘systems’ paradigms (e.g. Flood and Jackson 1991), the behavioural paradigm marked a start on the path of change from the traditional ‘hard’ systems research and intervention paradigm, based on the objective knowledge of researchers ‘outside’ the system, to a ‘soft’ paradigm featuring creation of circumstances in which farmer subjects discover new technical possibilities, experiment with change in their own systems, and construct new relevant knowledge from the ‘inside’.

In what van Eijk cast as ‘a gradual shift in paradigms’, researchers came to recognise that ‘... only farmers can bring realistic “holism” to a research project ... “Technology” is only part of the story. Important political, social, and the religious concerns affect
This change in thinking marks a shift from ‘systemic thinking’, or ‘soft systems thinking’. Soft systems thinking is concerned with situations as they are defined through action. People have intentions that lie behind each action that they perform. Neither observation nor theory provides sufficient understanding to be sure of those intentions, that is, what is happening. It is necessary to progress beyond observation and theory to come up with an ‘authentic’ explanation about what is going on in the minds of involved people and hence meaningful action that might be taken. 

... to achieve a meaningful understanding of any situation, it is necessary both to study the cultural aspects of the context as well as the interpretations and perceptions that people form within the cultural context. Authentic understanding of any action context requires participation of all people involved in taking action (Flood 2001, pp. 137, 138; emphasis and interjections added).

The paradigm shift in this scion of FM centres on achieving the long-sought goal of relevance to practice, not by an adequately holistic treatment of the system by the ‘outsider’, but by inclusion, in the processes of system diagnosis and evaluation of change or proposed change, of the farmer with a systemic perspective from the ‘inside’. This requires profound farmer participation, and the term ‘participatory’ is far from an adequate descriptor of the phenomenon. Ambiguity results from the fact that the field of FSR has differentiated into a family of participatory approaches to on-farm technical research that are distinguished mainly by the way power and responsibility are shared between farmers and scientists in various arrangements. Participation in FSR is sometimes switched: the subject becomes researchers and researchers become men of action (Checkland 1981, p. 152).

In the histories of other fields of management science, crises of relevance of a ‘hard’, science-based, rational intervention paradigm have been followed by the emergence of a ‘soft’ paradigm that recognises the human nature of management and the requirement of participative engagement for effective intervention in practice (Rosenhead 1989). This pattern, conspicuous in advanced stages of FSR, is conspicuous by its absence in the history of FM. An interesting question is whether FSR was FM’s paradigm reform, or is it yet to take place.

Making sense of the successful Farm Management intervention approach of Jack Makeham

In their discussions of the failure of late era FM to be relevant to farm management, both Malcolm (1990) and Dillon (1979) singled out the exceptional case of Jack Makeham, who Dillon described as a ‘successful academic and erstwhile farm management consultant’. Malcolm (1990, p. 34) highlights the side of Makeham’s intervention approach that deals with farming as a human activity system. A brief consideration of Makeham’s work combined with the above analysis of systems paradigms leads us to a proposal for future research:

‘Makeham had described working in farm management as being a ‘professional goal adjuster’. This involved working with the farm family towards the achievement of their short and long term goals, starting with the human element, given the technical, economic, financial, and institutional limitations of the situation’ (Malcolm 1990, p. 34).

Makeham’s own account of the nature of an engagement with a farmer is revealing:

‘... after a probing discussion, one or two patterns will emerge. The consultant’s job then is to match the physical characteristics of the property (including its financial position) with the attitudes and intelligence of the owner. The farmer may state definite objectives but may not see that his physical and management resources don’t match his desires. Or he may have ‘visitas unperceived’ and could be persuaded to lift his sights higher. 

The report has an inspirational role when the goals are limited compared with the present and potential resources’ (Makeham 1965, p. 3).
factor allocations to farm production (Malcolm 1990; McCown et al. 2006). But Makeham’s emphasis on farmer goal adjustment is something very different. In Part 1 (McCown et al. 2006), we called attention to the insight of Schultz (1939) of the 2 cognitive components of farm management, ‘planning’ and ‘expectation formulation’. The latter was, perversely, both the more important and the one that FM was least-equipped to assist: ‘We know that the prices and outputs which farmers expect are at best probable, very often nothing more than guesses, and sometimes even only hunches. Economic theory, however, is not able to give us much help. The price and output that is realized by the firm is usually something different from what was expected. The divergence between expectations and realization is a highly important matter from a practical point of view. […] Yet relatively little has been done in farm management to try to show how it might be possible to reduce this divergence between expectations and realizations, in spite of the fact that the gap between them is a positive measure of what is probably the most important source of inefficiency and waste in present day farming. Moreover, one may safely predict that no one would welcome assistance and guidance on how to lessen these divergences as much as the farmer, for he is quite aware that his most costly mistakes can usually be traced back to faulty expectations (Schultz 1939, pp. 585, 586).

Although we can find no reference by Makeham to Schultz, we feel that Makeham’s intervention practice would have satisfied Schultz as being a rare example of FM intervention to aid farmers’ formulation of expectations. Both the theoretician, Schultz, and the practitioner, Makeham, recognised the low potential of economic theory to meet farmers’ management needs even when efforts were made to incorporate descriptions of farmers’ expectations in the analysis. Inclusion of farmers’ beliefs and preferences in the model provides for analysis that more realistically describes the farmers’ planning outlook and the production of a more realistic production plan, but it does nothing to contribute to more realistic expectations by the farmer, which both Schultz and Makeham recognised as the key requirement for better farm management. Makeham and Malcolm (1981) summarised the debacle of the theoretical approach: ‘There have been major difficulties in converting many of the insights of utility analysis into a form which is usable by either farmers or their advisers. It would seem to us that utility analysis was a well-bred horse, who performed encouragingly in the trials. Some of the boys backed it heavily for the big race. It led early, but fell in a hole halfway up the straight. The lads did their brass’ (Makeham and Malcolm 1981, p. 176).

In addition to Makeham’s attention to the personal side of farm management, Malcolm (1990, p. 34) noted that Makeham also placed ‘great emphasis on the dynamic and risky nature of the management task’, an aspect of management poorly served by economic theory. As Makeham put it in what Dillon (1979) referred to as ‘by far the best text on farm business management yet produced’: ‘The two major challenges to today’s farm manager: (a) how to incorporate new technology profitably into his existing business organisation; (b) how to be sufficiently flexible, mentally and financially, to adjust his resource management to meet both changed economic circumstances and widely varying climatic conditions’ (Makeham 1971, p. 19).

In both these challenges, Makeham has identified the need for support in formulating expectations rather than in provision of rational plans. In addition to being subject to the uncertainties of volatile world markets, Australian dryland farm firms and households bear extraordinary climatic uncertainties. Makeham’s approach appears to reflect the earlier observation by Schultz (1939) that ‘… the greater the uncertainty, the more nearly one must approach a state of planlessness, for uncertainty places a premium upon a short time span or flexibility in production’ (Schultz 1939, p. 578).

In addition to Makeham’s emphasis, noted by Malcolm (1990), on ‘the social’ and on ‘uncertainty about the environment of farming’, there is a third emphasis, i.e. the challenge to farm management of change in the environment (Makeham 1971; Makeham and Malcolm 1981, 1993). In introducing their book, ‘The Farming Game Now’, Makeham and Malcolm (1993) claim that ongoing change is implicit in modern farming and that much of what distinguishes ‘good farm management’ is ability to make appropriate and timely change. An implication of the insight of Schultz (1939) is that success in this aspect of management requires formulation of realistic subjective expectations of new, uncertain, possibilities.

Jack Makeham, in common with his FM colleagues, understood economic theory and was trained in the use of economic tools in FM. But he also had an understanding of the nature of the practice of managing a farm, which was uncommon among his academic colleagues. He certainly shared Dillon’s later view that economic theory was inapplicable to farm management, and it seems likely that his enlightened experience of this in practice influenced Dillon’s rethinking of theoretical FM.
Farm Management as systems research and intervention

We began this 2-part analysis of the FM experience by suggesting that FM originated as part of a change in industry and government that occurred around the turn of the 20th Century, which centred on making customary production and administrative practices more ‘scientific’. Establishment in 1902 by the ‘progressive’ American government of the day of the Office of Farm Management flagged the beginning of a process intended to rationalise and professionalise the traditional practices of family farm management. This aligned with broader societal changes. However, by the 1960s and 1970s the social pendulum had swung back. Changes in community sentiment towards the professions and new government regulatory interventions were ‘...rooted in a deep questioning of the professionals’ claim to extraordinary knowledge in matters of human importance. [...] Finally, and most significantly, professionals themselves have shown signs recently of a loss of confidence in their claims to extraordinary knowledge’ (Schon 1983, p. 5).

Professionals in FM were not exempt. Dillon (1979) made a convincing case that theoretical FM was actually not extraordinary knowledge about the management of farms as was widely assumed, but something quite different. He reflected that ‘...the discussion seems to have been conducted without drawing adequate distinction between farm management (i.e. the farmer’s activity) and Farm Management (i.e. the professional activity)’ (Dillon 1979, p. 11).

Somewhat more poetically, Malcolm (1990) later reinforced this point: ‘...over time, there emerged an increasingly commonly-held unease, and occasionally conviction, that these were trails which, if followed, soon led from the complex and difficult whole-farm pastures of plenty to simpler and easier analyses characterised by incomplete and inappropriate disciplinary balances and resulting in work which was not really about farm management’ (Malcolm 1990, p. 49).

Having judged that FM had relinquished any claims to extraordinary knowledge about the management of farms, Malcolm envisioned an indirect role for FM in the future: ‘That role is in the production of better agricultural economists and scientists through highlighting the limitations of their models of reality. So, academic work in farm management can contribute, even if almost accidentally at times, to the process of farm management’ (Malcolm 1990, p. 50). However, a concluding point in Malcolm’s (1990) review points in another, more intriguing, direction: ‘...systems approaches to farm management problem-solving would prima facie appear to have the potential to be more relevant than more disciplinary-specialist inquiries to problem-solving in farm management’ (Malcolm 1990, p. 47).

Although in 1990, he was no less critical of the systems approach than of the other 3 FM modalities he reviewed, by 2000, Malcolm was proposing his own pragmatic systems approach for FM. A future FM approach should not only be problem oriented rather than technique oriented, but multi-disciplinary and multi-methodological, and feature analyses for real farm situations. Without using the term, ‘systems’, he set out a systems manifesto: ‘The farm management approach remains by definition the whole farm approach. If the management of farms is characterized as being a process involving human, technical, economic, financial, risk and institutional (beyond-the-farm-gate) elements, then processes of answering questions about farm management ought to have plenty of scope to incorporate aspects of all of these elements, in an appropriate balance, looked at from a small number of angles, for some imagined futures, as required. As Jack Makeham put it, “we’re woods persons, not trees persons”’ (Malcolm 2000, p. 20).

Although Malcolm (2000) presents a step forward, his methods do not capitalise on the advances in systems practices in recent years. In a recent attempt to foretell FM in the 21st Century, Mullen (2002) offers a diagnosis of the problem faced and a proposal: ‘...there is a need for increasingly sophisticated modelling of the impacts of complex technologies at the farm level. [...] How information from this sophisticated modelling is made available to farmers and policymakers is another issue that is perhaps important enough to make the agenda for the 21st century. It is not clear to me how results from complex models are best explained to farmers and policymakers. It seems to me that farmers are unlikely to take on faith answers from black boxes nor will it be in their interest to fully understand a dynamic programming model of soil acidity, for example. Malcolm (2000) seemed to be
Learning from a century of Farm Management

"In theory there is no difference between theory and practice. But in practice there is."

-Origin obscure and contested

FM is one of a family of management sciences. It is concerned with better practical farm management through the application of theory/models to design of farming decisions and plans. Effect of a management science on practical management can be analysed in terms of the quality of its ‘science’ (research, theory) and the quality of its ‘intervention’ (implementation, application). Management sciences have a characteristic history of being found wanting in affecting practical management, and in these histories, failure is a failure in intervention, the notorious ‘problem of implementation’ in operations research/management science (McCown 2002b).

Late era FM conforms to these other histories in the failure of its economic theory of farm management to enable better farm management practice. Conceding failure must have been especially poignant for John Dillon in 1979. It had been only 30 years since the political victory of the theorists over the pragmatists in North America, which resulted in FM being ‘reinvented’ by agricultural economists, chief among them, Dillon’s mentor, E. O. Heady. It had been only 15 years since Dillon became the foundation professor of the first university Department of Farm Management in Australia, and one committed to application of economic theory. Yet by 1979, he was convinced that what still seemed like sound theory was inapplicable to farm management practice.

This series of papers aims at explicating this surprising conclusion and pointing to a potential way forward. Part 1 (McCown et al. 2006) used a unique aspect of the history of this particular management science: the experience in an earlier era with importantly different science, different intervention, and greater effect on farm management practice. The especially reflective theorists, John Dillon (1965, p. 181) and Glenn Johnson (1963, p. 13), acknowledged that the earlier work had achieved a considerable degree of practical relevance and significance. But Johnson (1963) went on to point out a significant lapse in effectiveness of the early work. During the 1920s and 1930s, drastic changes in the farming environment took place and new problems arose. FM failed to lead in dealing with these new challenges, a failing that Johnson attributed to a loss of focus on farmers’ problems. This led to the ‘takeover’ by agricultural economists in the 1940s and 1950s, which Johnson (1963) explains and justifies in terms of relative preparedness to address management problems.

Farms are purposive systems. In contrast to natural science, economics embraces human purpose. Economists claim that means—ends analysis through mathematical
optimisation using problem owners’ utility functions provides solutions to problems. The disturbing fact is that in 30 years of trying, such analyses had minimal effect on farmers’ real problems. This has been repeatedly blamed on the failure of models to be sufficiently comprehensive. The models leave out key aspects of the farm and its management, thus rendering optimal designs based on ‘partial’ models, inapplicable to the more complex practice situations. Johnson (1963) recognised this problem and ‘petty details’ must be complemented by an ‘integrating’ or ‘synthetic’ method which aims at reconstructing ‘the whole process’ . . . Not one example of a scientific description of the whole, concrete social situation is ever cited’ (Popper 1964, pp. 78, 79).

Popper was, however, sympathetic to an alternative notion of holism, one in which selective observation might reveal an abstract concept for organising inquiry. This concept of a unifying theme that gives meaning to a complex reality was taken further by Lilienfield (1978):

‘The world is seen as an unlimited complex of change and novelty, order and disorder. Out of this total flux we select certain contexts; these contexts serve as organizing gestalts or patterns that give meaning and scope to a vast array of details that, without the organizing pattern, would be meaningless or invisible. Thus, an organizing context creates a “theme” . . . It “fuses” into a unity items that in other contexts appear as discrete entities’ (Lilienfield 1978, p. 9).

FM (the professional activity) can only be about the theme (e.g. a management problem or an opportunity) that is defined by the researcher. The farmer has a different, ‘inside’ perspective, and a different set of unifying themes. For relevance to be achieved, reconciliation of these unifying themes of insiders and outsiders needs to be achieved through mutual understanding of each other’s views and negotiation of meanings. The interpretation by Taylor (1994) of the relationship between FM and agricultural economics can be seen in this light:

‘Farm management was less theoretical than agricultural economics. [ . . . ] While containing the agricultural economists’ general categories, the farm management literature was addressed to farmers and their immediate problems. The distinctive factors of production were subordinated to the subjective unity of labour, management and capital in individual farmers. The task of agricultural economics was to deconstruct this unity to reveal the economic unity beneath its surface. The task of farm management was to use this reality to mediate the reconstitution of the unity for individual farmers on individual farms’ (Taylor 1994, pp. 52, 53).

Although this seems descriptive of farm management consulting, it seems that an adequate consciousness of this reality concerning differences between unifying theory and the subjective unity that constitutes practical farm management was all too rare among researchers in the late era of FM.

The fact that this function for FM in ‘bridging’ between economic theory and farm management practice was so seldom realized, led to the next step in a logical progression of innovations in intervention methodology. In FSR, joint
participation of farmers and scientists provides an interface where these different themes of complex farming reality can be shared and negotiated:

...farmer's perceptions of problems are confounded by life: labour peaks, gender specialisation and social obligations. Their perceptions of opportunities are confined by the scope of their world-view. Only an analytical framework that penetrates below the surface to the problems of the system they operate has the full potential to reach into their lives. The importance of an interface with both inside and an outside understanding (neither of course perfect) cannot be overemphasised' (Collinson and Lightfoot 2000, p. 400). This revolutionary concept for scientific intervention is summarised nicely by Van Eijk (2000):

'Only by having seen the whole, can one ask the right questions about the parts. In multidisciplinary teams with various single-discipline trained specialists, or in interdisciplinary teams with generalists trained in several disciplines, the researchers look from the outside to a whole, in our case a farming system. Approaching matters from this direction leads to confusion because the whole can never be seen from the perspective of the disciplines. We must reverse the arrows, and look outward from the perspective of the whole at all available knowledge from the various disciplines. Only the persons who are directly involved in, and manage, the whole, may command the outward-looking prospective vital to their particular management needs. This puts the farm-household members centre stage, and underscores the importance of participatory approaches... ' (Van Eijk 2000, p. 328).

The upshot of this recognition of the radical difference between practice and theory—the distinction between farm management (i.e. the farmer's activity) and Farm Management (i.e. the professional activity)—is that solutions generated by the so-called problem-solving approaches of interventionists with models, are not solutions to the problems faced by farmers, so they are 'inapplicable' to practice.

An alternative in FM to solving problems for farmers has always been assistance to farmers in solving their own problems in their terms. Both Johnson (1963) and Plant and Stone (1991) championed formal (rule-governed) problem solving for farmers, the former with theory, the latter with formal heuristics. But both conceded the pragmatic value of provision of simply facilitating the decision maker in getting information relevant to the situation:

'...the early descriptive, non-theoretical work in farm management was relevant for the solution of practical problems. The philosophy of science which guided these people was [] essentially positivistic. Though positivism avoids purpose and leads eventually to difficulty in defining and solving problems, the charge of irrelevance could not be levelled validly at the early farm management workers. The closeness of these workers to farmers and their problems insured that the positivistic work they did involved the determination of facts which were relevant to the solution of problems facing farmers' (Johnson 1963, p. 13, original emphasis).

'Providing information doesn't solve problems, although it can make a problem's solution trivial' (Plant and Stone 1991, p. 11).

The key components here are selective description and a participatory approach that together reconciles the respective unifying themes used by the insiders and outsiders.

FARMSCAPE features what Anderson left out. Using the representation of Fig. 1, in this mode, instead of 'Decision models' and optimised plans, farmers join researchers in 'gaming' using simulation models from his review:

'Gaming models frequently process many of the dynamic, stochastic and structural features of typical simulation model (and indeed have often been termed "simulations"). However, there is one additional and distinguishing feature, namely direct human interaction in running the model' (Anderson 1974, p. 8).

FARMSCAPE features what Anderson left out. Using the representation of Fig. 1, in this mode, instead of 'Decision models' and optimised plans, farmers join researchers in 'what if?' inquiry concerning management of the production system aided by a flexible simulator of the production system. By their participation, life-world themes such as felt problems, are represented interactively, and in the 'gaming' activities of dialogic systems analysis and synthesis, new expectations and new relevant possibilities are often constructed (Carberry et al. 2002; McCown 2005).

Congruent with this perspective is the proposal by Pannell et al. (2000) and Malcolm (2000) for use of spreadsheet budgets to conduct 'a few figurings'. Instead of intervention with formal problem-solving/planning techniques, professionals can be relevant to management practice by providing conceptually simple tools to support...
farmers’ formulation of certain types of expectations and deliberations leading to decision and action. The FARMSCAPE experience confirms the feasibility of Mullen’s (2002) ambitious idea of using powerful scientific models along with ‘a few figurings’ as one promising way forward for professional intervention in farm management. But this experience also confirms the value of using these tools in intervention processes that support managers’ subjective processes of sense-making and expectation formulation.

John Dillon (1979), p. 12) declared that he had thrown his lot with the systems paradigm of FSR: ‘at least until the next revolution occurs’. Discounting his characteristic hyperbole, this use of a complex science-based simulator to enable the acquisition of virtual management experience (Bakken et al. 1994; McCown 2005) is a paradigm change in intervention that appears to warrant a few assessments by farm management economists and farming systems scientists.

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