IMPROVEMENTS IN R, D & E ARE ON-GOING

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Summary. Improvements in R, D & E in agriculture have been on-going for most of the last 100 years. Periodically there have been movements to *evaluate* some smaller or larger part of these improvements and of the practices and procedures that underpin these improvements. One such movement, of about 10-15 years ago, was built around research productivity and related concepts. We are currently under the influence of a movement that is built around quality assurance and related concepts. The challenge for stakeholders is to extract the main contributions from this movement in order to maintain the on-going improvement in R, D & E in agriculture.

INTRODUCTION

Historically, the practices and processes that underpin R, D & E, have always included in-built and on-going internal and external self improvement. At times, these practices and processes have been low key and implicit; at other times explicit and high profile. The outcome has been improvement that has been slow and incremental, with occasional *revolutions*.

Quality assurance (QA) and related concepts are recent concepts that are making their contribution to this improvement. However, to maximize their contribution, we need to focus more on the intent of these concepts and less on the way they have been implemented in industry and in manufacturing. This focus is needed first, because of the special and even unique, but at least different, characteristics of R, D & E in agriculture, see for example (5). And second, because successful implementation of QA is usually highly context specific.

QUALITY ASSURANCE: A SYSTEM AND PROCESSES

Quality assurance is currently an issue not just in R, D & E in agriculture but for many work-places in many walks of life. The problems encountered, with QA, are in part caused both by the messiness (1) and by the complexity of the issues and of the decision support required (3, 4). Systems thinking has a long experience with complex issues. There are many systems methodologies that could be used in this context (6). One of the methodologies that places considerable attention on institutional and organizational aspects of systems, and is thus appropriate for QA in R, D & E in agriculture, is Systems Engineering Methodology (7, 8).

There are four main contributions of such a systems methodology:

• To provide a framework and a terminology distinct from the subject of analysis, in this case, QA. This is equivalent to saying that the framework and terminology are largely generic rather than largely context specific to QA. The need or reason to be largely generic is both to place QA in an appropriate historical perspective and to increase the clarity of the perception of the relative importance of the many short-term aspects of the issues related to QA. Specially given the need to focus more on the intent of QA and less on the way the concepts have been implemented in industry and in manufacturing.

• To approach QA, not in isolation, but rather that QA and related concepts be approached as a system. That is, that all components and aspects of QA and related concepts interact in a dynamic fashion with feedback.

• To increase awareness of the distinction between QA and related concepts as a system and the processes by which the system operates. Or in more practical and real world R, D & E in agriculture

terms, the distinction between the system and the processes by which stakeholders both operate within the system and react to changes in the system.

• To highlight the expectation that the system and the processes are likely to be highly context specific and interdependent.

There are several points about Systems Engineering Methodology which merit noting in special reference to QA in R, D & E in agriculture:

• Systems Engineering efforts are not processed in a sequenced linear way but rather as a process. In this context a process is the interaction of a method, or methodology, with human judgment, in which iteration plays a central part. Insights obtained from one part of the effort might lead to a revision of approaches taken earlier, making iteration and feedback necessary and very productive.

• The Systems Engineering Methodology is intended to be helpful as a guide, not as a restrictive format. Flexibility in the procedures and methods used is a central feature of Systems Engineering. It should be noted, however, that each of the steps (in the Systems Engineering Methodology), represents an important ingredient in a Systems Engineering effort, and omission or neglect of any step increases the risks of failure.

• Since Systems Engineering is a process in which people work together to realize the various steps of the effort, the selection of an appropriate combination of staff and other participants, is at least as important as adherence to the several steps of the Systems Engineering Methodology.

THE INTENT OF QUALITY ASSURANCE

The terms QA and the related concepts of total quality management, world best practice and bench-marking, among others, have largely been corrupted by abuse both in technical terms and in every day usage. This paper is based on the following conceptual framework: *Total quality management* is a philosophy aimed at making the best use of available resources. *Quality control* is the system used to achieve the best use of available resources. *Quality Assurance* is the documentation of how quality control is undertaken. *Quality audit* is the accreditation, usually by third parties, that the quality control as documented by QA is in place and operating. *World best practice* and *bench-marking* are two of many ways of comparing what your organization is doing, what others are doing and what is the best of what anybody is doing.

However, it is not the aim of this paper to discuss what is or what is not meant by any of these or other related concepts. Rather, to focus on some aspects of the intent of these concepts as related to the on-going improvement of R, D & E in agriculture. I will continue to use the term QA in a general sense because it is in fact the term often used by stakeholders, other than experts.

QA driven for transformation, innovation or for accountability

QA can be driven for, or by, different motives or objectives. Two of these are for transformation and innovation and for accountability. QA driven for transformation and innovation has been in place for many years in manufacturing industry. It is primarily output driven. It is well understood and relatively widespread. There are well developed procedures to estimate costs and returns, and for implementation. Output is usually physical (rather than a service), quality is relatively easy to define and to measure in agreed units (e.g. weight, number of units, delivery time) and is easily accepted by all stakeholders. An example of very successful QA driven for transformation and innovation, is the supply of air-conditioners for cars that do not contain greenhouse gases. Given this sort of experience in manufacturing industry efforts are now increasingly being made with some success, to extend QA (driven for transformation and innovation) to mainly service industries.

QA driven mainly for accountability is a relative newcomer. A good example is QA in universities, for example see (2). There are two aspects to accountability: accountability of funds (of inputs) and accountability of graduates (of outputs). Financial accountability of funds has been in place for many years via the Commonwealth and State Auditor Generals with varying degrees of success and of stakeholder support and confidence. In such financial accountability, funds are measured in the single widely agreed unit of Australian dollars. Such financial accountability ascertains that funds were used for agreed legitimate uses, as for example salaries, travel, building maintenance.

But QA driven mainly for accountability of outputs, as for example quality of graduates, does not have a single unit of measure. Rather in this context quality is very difficult to define and to measure and there is a wide range of views on the many aspects of quality and of QA among the many stakeholders. As output becomes less easy to measure and there is less agreement about what are appropriate units of measure the implementation of QA becomes more difficult. Thus to date, considerable effort has been allocated to seeking, documenting and validating measurable proxies for quality with only limited real success.

In the case of universities, the Commonwealth appears to be driving the QA agenda mainly to facilitate allocation of funds by using a relatively standard formula, and to maintain financial accountability. To date there have been significant difficulties in taking the successful experience of QA driven for transformation and innovation in manufacturing industry, and developing QA driven mainly for accountability in universities. It appears that similar difficulties apply to R, D & E in agriculture.

In systems terms the difference between QA driven for transformation and innovation and QA driven for accountability can be expressed as differences in value system (what are the objectives or what is important) and in system synthesis (what are potential alternatives). Experience to date suggests that the procedures for and implementation of QA are far more value system (objectives) and system synthesis (alternatives) dependent than has been generally acknowledged.

QA by reduction in areas of most waste over the total process

One aspect of the intent of QA is the focus on reduction of waste. Significant effort has been placed on reduction of waste in given sections within a total process with considerable success, as for example waste in transport of intermediate products in demand pull production in manufacturing. As QA is extended beyond manufacturing, there needs to be more focus on reduction in areas of most waste, over the total process, rather than just within one area. In other words, to focus more on the global optima and less on the local optima. For example, the recent trend in the preparation of research applications, in which there is a trend away from fewer more senior staff preparing applications on behalf of a team of people and towards a large number of more junior staff preparing their own applications. This trend considerably increases the overhead costs of doing research. A second aspect of the difference between local and global optima in reduction of waste is the case when two initiatives are at cross purposes. For example, the sacking of a staff member to save money (cash) against the loss, in non-cash terms, by staff morale and productivity in the staff that remain.

This is specially the case as QA is extended from the relatively low risk and low variability situation of manufacturing industry, to the higher risk and higher variability situation of service industry, and among these specifically to R, D & E in agriculture. In this context there needs to be a clear distinction between reduction in waste and appropriate steps to manage risk and variability. In Australia, management of risk and variability due to exchange rates, terms of trade, commodity prices, drought, trade wars etc are acquiring increased importance.

In systems terms, the reduction of waste is a question of systems synthesis (of identification of potential alternatives).

QA by expressing skills more as generic skills and less as context specific skills

The organizational environment in which QA is undertaken can range from stable to turbulent. As the turbulence increases so does the returns to individual retraining and organizational change. However, there is often a significant trade-off between private or organizational benefits or savings and public or social costs. In this context an increased ability to express individual and organizational skills more as generic skills and less as context specific skills, will be an asset.

In systems terms, the ability to express skills is a question of value system design (objective).

QA by an agreed management process and a visionary leadership

Attempts to extend the success of output driven QA in manufacturing industry to QA of processes in R, D & E in agriculture are more likely to be successful if focussed both on QA of an agreed management process to deliver agreed outcomes and QA of a visionary leadership to identify new outcomes and to facilitate improvements in the management process. The need for distinction between the two stems from the difference in their degree of dependence on individuals for success; their required skills and resources; their preferred organizational structure; and their preference for stable or turbulent times.

In systems terms, the difference between management and leadership is one of problem definition.

THE CHALLENGE

Given that R, D & E in agriculture usually has a relatively long lead time, the challenge, for stakeholders, in respect to incorporating the current movement built around QA into the on-going improvement in R, D & E in agriculture, would appear to be:

• First, and most importantly, to maintain the history of on-going improvement rather than loosing this perspective and getting overly side-tracked with short-term current issues;

• Second, to extract from these short-term current issues those few aspects that will in fact contribute to real long-term improvement rather than just make re-allocations in nominal terms between project and financial or calendar years;

• Third, to maintain environmental and organizational turbulence, while resolving these short term issues, within levels that are manageable both organizationally and in terms of staff morale;

• Fourth, to be proactive in maintaining the strengths, comparative advantages and core activities available due to expertise, location or resources;

• Fifth, to be entrepreneurial within these strengths and the improvements over time.

CONCLUSIONS

The outlook for the improvements in R, D & E in agriculture to be on-going would appear to be positive and guardedly optimistic. R, D & E in agriculture has come of age over the last 30 or so years. Current staff now have a large and varied range of skills and tools at their disposal. R, D & E is not a panacea. There are many problems which are still intractable. Furthermore, inappropriate use of current skills and tools is likely to end at best in disappointment and more likely in disaster. However, their appropriate and expert use will bring success. This success can often be expressed as the results or outcome of an individual R, D & E project becoming one of the very useful components in a wider process to provide support for farmer decision making, for local, State or Commonwealth policy recommendations or for further R, D & E.

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