Performance management and forest science in Ontario

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Introduction

There has been an historic issue of matching forest science to management problems as discussed by Baskerville (1994). A primary cause of a disconnection between forest managers and researchers is the lack of understanding about the role of research in the core business of the organization. Although this issue has been discussed and lamented by forest managers and scientists, it is not a situation unique to forest management or to resource management agencies in general or to the Ontario Ministry of Natural Resources (OMNR) that has an important science and transfer function. It is an issue that also plagues other research and development organizations and institutions. In a broad sense, this issue has much to do with how institutions manage research and development (R&D). By way of context, it is necessary to review how R&D management has evolved over the past century.

A Brief History of R&D Management

The management of research and development toward creating and marketing of new products has gone through three generations since the late 1800s and early 1900s and is now entering a fourth generation. When R&D was first employed by corporations, it was managed primarily by scientists who made decisions about which projects to undertake based on their judgement and professional interest. This generation ended in the 1940s and 1950s and was replaced by a second generation wherein companies realized that they needed to manage projects to meet their corporate needs. Sophisticated project management tools were developed to determine what projects were appropriate for the corporations' future marketing endeavours. This second generation can be characterized as managing discrete projects, monitoring progress, and conducting cost/benefit analysis. As R&D became more expensive accompanied by greater financial risks in the 1970s and 1980s, a third generation of management was developed (Roussel *et al*. 1991). This third generation developed more sophisticated strategic and tactical planning processes to determine priorities for research and technology development. These processes aligned research with corporate priorities by investing in a portfolio of projects that balanced high-risk undertakings that might pay off over the long term along with low-risk development type projects that would engender more immediate returns on investment (Roussel *et al*. 1991). Although third generation management processes enabled companies to accelerate product development aligned with corporate objectives it generally restricts innovation to continuous innovation[5] because the idea generation process is derived from client surveys that sample corporate experience but do not engender opportunities for creative discourse between researchers and users. It is the latter that has been shown to be pivotal to successful innovation.

During the 1990s, some companies began to realize that they needed to accelerate innovation to maintain a competitive edge. A new approach required engaging the user in the R&D planning and development phases of a project, optimizing multi-disciplinary and multi-sector partners (communities of practice), employing an iterative process of assessing competitive architecture and organizational capability (adaptive organizational management), and opening channels for knowledge exchange

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[5] "Continuous innovation is incremental and takes place within existing infrastructures. It builds on existing knowledge in existing markets without challenging underlying strategies or assumptions." (Miller and Morris 1999, page 4)

and interactive marketing. The principles inherent in these strategies are the basis of fourth generation R&D (Miller and Morris 1999). In contrast to third generation R&D management, fourth generation management can lead to discontinuous innovation[6] or major innovative leaps. This is because the communities of practice approach (researcher-marketer-user relationship) stimulates two-way exchange of tacit or latent knowledge that engages and focuses innovative thinking on new product opportunities beyond the experience of the R&D company and inconceivable to the user.

Government research organizations have, to varying degrees, adopted some of the R&D management processes of the private sector by progressing through similar generations of R&D management. Because government research organizations respond to a different set of social and economic drivers than private sector R&D organizations, there has not been an equivalent adoption of these management practices, particularly in the natural resource areas. However, government organizations have recognized, particularly over the past 10 years, that they need to adopt R&D management practices that align science activities with the priorities of government and public stakeholders. This transition can be characterized as moving from an organization whose main focus has been the development of intellectual capital to one that uses intellectual capital (Bowman 1999).

Until recently, research in OMNR was operating mostly in the first and second generation. There were some examples of individual R&D programs employing third generation (portfolio management), and even elements of fourth generation (communities of practice), principles. However, there was no formal management process that transcended these tentative steps into third and fourth generation processes. Beginning in 1997 a concerted effort was made to embrace the principles of third R&D and to develop a process that would ensure its use.

Forest Science R&D in OMNR

The past 10 years of forest research in OMNR has operated within a backdrop of phenomenal fiscal growth in R&D, radical organizational change, a major union strike, substantive downsizing, personal recovery, and transition into R&D support that depends heavily on external funding venues. This sequence of events coupled with stronger, more focused corporate accountability provided the impetus for improving science management and administration in OMNR.

Throughout the decade, several internal documents were prepared that focused attention on improving the science management and administration processes. A strategic plan for science in OMNR recommended a number of areas for improvement, including a better process for setting priorities, selection and evaluation of projects and programs. However, none of these were fully implemented and the provincial auditor's report in 1998 (Office of the Provincial Auditor 1998) identified these shortcomings in the science program.

Partly in response to the auditor's report and to provide a long-term comprehensive approach to forest science planning and evaluation, a forest science strategy was developed that incorporated third generation R&D principles as a cornerstone of the strategy. The Forest Science Strategy (Baker 2000) was completed in 2000 and was given full support for implementation by OMNR's senior executives. To ensure successful implementation of the strategy it was recognized that day-to-day decisions needed to be made in light of the direction and principles articulated in the strategy. It was also recognized that a performance management system was required to drive the strategy and to measure, over time, whether the goals and objectives were being achieved. More importantly, we wanted to ensure that the principles inherent in third and fourth generation R&D were employed to meet Ontario's commitment to forest sustainability. As described by Willick (2001) strong science, stakeholder understanding, and political will are three critical elements of Ontario's commitment to forest sustainability. Our ability to meet expectations of the stakeholder and to challenge the cutting edge of science demanded a departure from the old way of doing science business. Science activities must be strongly linked to corporate priorities that address stakeholders concerns in an active adaptive management approach to reducing uncertainties about sustainable forest management.

Performance Management in the Ontario Ministry of Natural Resources

After reviewing a number of performance management systems, the ProGrid® decision support tool (Bowman 1999) was chosen because it is designed to facilitate analysis of complex and extensive science-based information. Preparation for use of ProGrid® required development of a set of criteria that reflected the values of both science staff and resource managers for relevant and high quality R&D and knowledge transfer projects. These criteria are divided into three categories of relevance, quality, and impact. Our project performance system uses a set of 12 criteria (Table 1). Each criterion has a set of four statements called language ladders that provide a progressive ranking for each of the criteria. These statements range from acceptable to exceptional. Reviewers can quickly evaluate each project proposal using a consistent set of thresholds defined by the statements in the language ladder. Judging the merits of a proposal is always a case of attempting to be objective in what is essentially a subjective exercise in judging intangibles. This system provides a consistent method for making these judgements.

The development of the criteria and language ladder package in OMNR involved a broad mix of research, management and executive personnel across key sectors of policy, resource planning and field operations. This level of integration is critical to ensure that those responsible for corporate strategic direction, annual funding decisions, project implementation, and delivery are in agreement. The project performance management system ensures that corporate priorities and business objectives are embedded in the criteria and language ladder, and it provides a means to quickly array and evaluate all proposed projects (Fig. 1) so that decisions for selecting a portfolio of projects can be made. A similar procedure using the ProGrid® tool has recently been developed to evaluate research personnel for annual performance, to promote career development, and to assess readiness for advancement opportunities.

The OMNR Forest Science Program uses the performance management system for two fundamental purposes: a) to facilitate alignment of science activities with corporate prior-

[6] "Discontinuous innovation is characterized by lateral or divergent thinking by looking outside defined boundaries and by discovery of new knowledge related to both market needs and technological capability." (Miller and Morris 1999, page 6)

Table 1. Forest science project performance criteria

Relevance	Quality	Impact
Fit to OMNR Strategic Priorities	Project Design and Methodologies	Technology and Knowledge Transfer
Supporting Legal Obligations	Effective and Efficient Use of Resources	Building OMNR Capacity and Profile
Reducing Uncertainty in Resource Management Decisions	The Team	Building Sector Capacity
Advance on Prior Science and/or Technology Transfer	Partnerships and Collaboration	Ecological, Economic, and Social Impact

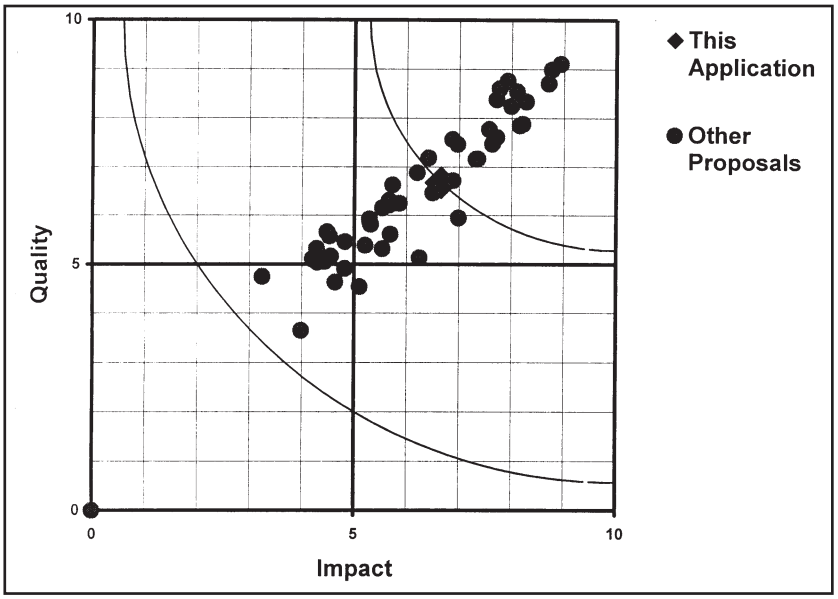

Fig. 1. Scores of all forest science proposals submitted for internal OMNR funding. A proposal can be identified (diamond) while it is considered by the budget committee.

ities and business plan objectives, and b) to enable managers to work with research staff to ensure scientist performance is documented and rewarded, and to assist scientists in working toward their career aspirations.

The Science Project Portfolio

The performance management system is employed to address the following R&D due diligence needs:

1. An efficient, effective and equitable means of selecting projects with the highest probability of achieving corporate priorities and business objectives,
2. Understanding priority needs and translating them into the selection of projects that best suits the short and long-term priorities.
3. Involving senior management in setting direction, verifying priorities, and approving relevant expenditures
4. Ensuring research results meet priorities and objectives by tracking progress toward deliverables.

Once decisions are made for funding projects, they are reviewed annually using a modified set of criteria that provide a means of judging how well each project is achieving its objectives. This system does not make decisions. It provides information that is based on independent reviews. The decisions defining the final project portfolio are made by science and client managers. Although ProGrid® results provide an objective guide to the best portfolio package, there are inevitably subjective decisions required to address intangibles. For example, a lower ranking project overall may be chosen over a higher ranking project because it is needed more urgently, or because the higher ranked project is too expensive and has not been adequately leveraged to fit within the budget.

Personnel Management and Career Development

The personnel performance management system is employed to address the following personal and professional needs:

1. Align work/effort with what's needed and rewarded by the OMNR and/or partners,
2. A simple process to evaluate and promote research science personnel, and
3. Improved clarity, focus and recognition for the array of activities and deliverables needed for professional advancement in OMNR.

A set of nine criteria is used that pertain to research, professional development and transfer (Table 2). Each criterion contains a six-statement language ladder used by a manager (annual appraisal) or a panel (promotions) to rank a candidate. These statements range from acceptable to exceptional. The value of this system is that it enables scientists and managers to work together in helping ensure that: a) scientist activities are recognized, b) direction is provided to guide the scientist toward optimal annual performance, and c) progression toward career advancement is on track.

The criteria were developed by science managers and research staff. They reflect the expectations that OMNR has of its scientists as it relates to a broad array of science activities. The criteria are aligned with those used in the project performance system to help ensure that there is continuity between scientist activities, project commitments, and funding allocation. The use of the personnel performance system as a tool for annual performance evaluation is extremely helpful in enabling a scientist to plan annual activities to address deficiencies that might hinder timely career advancement. Finally, the

Table 2. Scientist personnel assessment criteria.

Research	Professional Development	Transfer
Research Planning and Development	Productivity	The Transfer Plan
Relevance	Recognition	Transfer Effectiveness
Advance on Prior Science	Program Management	Transfer Impact

software simplifies the review process while allowing for more rigorous and equitable evaluation of what is typically a complex and diverse personal and professional portfolio.

Priority Science Areas in MNR

The strategic science framework used by OMNR in conjunction with project performance management is based on five major theme areas. Each theme area is further characterized by critical resource management needs that require a particular science focus. The themes and sub-tending science focus areas provide direction and context within which the scientist can discuss potential project options with partners and clients. These discussions reflect the principle of communities of practice advocated in fourth generation R&D. They promote an ongoing relationship that helps ensure that user needs are reflected in the project proposal, and that the experimental design and analysis strategy will deliver the desired result, whether information or a tool.

The theme and science focus areas are lead by senior managers from science, policy, resource planning and operations. This group of individuals also forms the Science Integration Committee. The committee is responsible for setting direction, reviewing and evaluating project submissions, making project approval decisions, adjusting project resourcing, and reviewing progress toward project deliverables. These activities enable senior management to remain actively involved in the science investment so that they are better positioned to make informed decisions concerning enhancements or constraints to the budget.

Performance Management System in Practice

The project performance management system is used to make decisions on allocation of funds within the science envelope of the Forest Management Business Plan. However, to ensure that all science activities, regardless of funding source, are aligned with business plan objectives all projects undertaken by the staff must be submitted for ProGrid® evaluation. This is an important aspect to the performance management system because permanent reductions and in-year constraints to science envelope funds have created an environment in which an increasing number of OMNR science staff rely heavily on funds acquired externally.

This funding situation is not unique to OMNR. However, it does raise concerns about the effect diverse partnership arrangements will have on the ability of OMNR science staff to deliver on explicit OMNR and stakeholder needs. Each partnership is different, but when a partner is a principal provider of dollars, their expectation is that they will receive value for dollar invested. Scientists adept at leveraging resources through partnerships (such as dollars, people and equipment) frequently require less than 25% funding from OMNR—in several cases less than 5%! How can OMNR be assured that the science staff on its payroll are providing OMNR with what it needs to meet forest business plan objectives?

This is where fourth generation R&D comes into play. Third generation R&D ensures that the "internal" science dollars are used to optimize a research, development and transfer portfolio of projects that is closely aligned with business plan objectives. Fourth generation R&D helps ensure that dollars derived from "external" sources (outside the science envelope but within or outside OMNR) engage all partners in a relationship that, a) optimizes the common benefit, and b) addresses the social, economic, political and environmental issues and opportunities critical to improving policy, resource planning decisions, and operational practices. It is the latter aspect that is akin to "product innovation" in the private sector. For OMNR, the principles inherent in fourth generation R&D help assure senior management that science staff activities, regardless of funding source, are serving corporate priorities.

Conclusions

Implementation of the performance management system will accelerate our ability to be more innovative in achieving high quality and relevant science that can make an impact in addressing outstanding problems and questions about forest sustainability. Implementation of the system is, however, not an end in itself. Rather it is a tool to link corporate responsibility and accountability for decisions about a portfolio of R&D projects that address forest sustainability.

Since we have only begun the implementation of the process there will need to be modifications and adjustments to the process and the tools as we learn what works and what does not work. We expect to improve our organizational practices that have benefited private organizations in moving to third and fourth generation R&D that are necessary to accelerate innovation. There remains a challenge to involve a wider set of clients and stakeholders in decisions about short- and long-term science activities. Our vision is to have an adaptive loop in knowledge creation, synthesis and transfer that will both enable and engage resource managers in guiding knowledge creation and uptake to improve forest management practices over both the short and long term.

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