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MAPLE: A SCORING MODEL FOR FOREST RESEARCH PRIORITY SETTING

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INTRODUCTION

This note describes a scoring model designed to assist in setting forest research priorities. Research and development potential and capacity are evaluated, as is the ability and likelihood to actually capture benefits. Project evaluators are asked a specific set of questions and required to rank proposed projects relative to each other. The framework makes explicit, and focuses discussion around, concepts that should be considered when setting priorities. A spreadsheet has been created that automates many of the tasks required to analyze and visualize the data that would be generated in actual applications. Issues arising from a workshop where the model was applied in a hypothetical setting are briefly presented. A longer report and the Quattro Pro spreadsheet macros required to implement the model are available from the Canadian Forest Service, Great Lakes Forestry Centre.[4]

The design of a research portfolio must consider the enlarging role of forest management. Forestry is encompassing values from timber management to biodiversity conservation and recreation. Forest research no longer consists solely of projects aimed at increasing stand growth and yield or decreasing harvest costs. This broader scope of responsibilities requires research managers to examine more possible projects in an increasing number of areas. Deciding on a particular portfolio of research projects has become a more complex and interdisciplinary problem.

The determination of research priorities and the ranking of projects are complex tasks. Various models have been used, ranging from peer review and expert committees to more quantitative models, such as cost-benefit analysis, mathematical programs, and scoring models (Norton and Davis 1981). Although most of the literature on setting research priorities has focused on agriculture, these models are adaptable to forestry. Baker and Freeland (1975) suggest that the adoption of models could be improved if they were applied as decision aids, rather than as "decision models". Models are used to organize information and to aid, not make, decisions.

THE *MAPLE* SCORING MODEL

The *MAPLE* model has been adapted from a process used by Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), Division of Animal Health (Young 1993). In adapting the model an attempt was made to address some of the problems and issues in research prioritization in forestry, such as those currently facing the Canadian Forest Service. Many issues must be considered when appraising proposed research projects. The *MAPLE* scoring model leads users through a specific set of questions to produce a score for each project. Decision makers then use these scores together with other tools, expertise, knowledge, and outside pressures to make the final selection of a research portfolio.

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[4]Simkus, G.; Fox, G.; McKenney, D.W. 1995. MAPLE: A research scoring model for the Canadian Forest Service. Fall 1995 Prototype Workshop Manual. 22 p + append.

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The *MAPLE* model requires the research manager to consider information on agency priorities, detailed project proposals, research resources, technology transfer knowledge, market information, and relative values of market (priced) and nonmarket (unpriced) goods. This information will have an impact on the perceptions about four criteria that form the basis of the *MAPLE* model. Research capacity and research potential are assessed in the context of expected research results to derive a feasibility rating. Potential benefits and the ability to capture these are assessed in the context of expected research benefits and used to derive an attractiveness rating.

The rating of the four basic criteria leads to a score for each project under consideration. Participants answer several questions for each project by assigning a numerical ranking from 1 to 7, with the following values: 1 = the lowest rating, 2 = low, 3 = fair, 4 = moderate, 5 = good, 6 = high, and 7 = the highest rating. The rank obtained by one project reveals how it compares to others being rated. The list of sample work sheets developed for this project are provided in Appendix A. These questions are not meant to restrict the issues being considered, but to remind the user of issues that should be considered for each project. For each criterion there is one work sheet that provides a set of questions to be answered for each project. Averaging the ratings of this set of questions produces the criteria rating, a numerical value from 1 to 7.

The criteria ratings are converted to a project score in the following way: multiplying the ratings for research potential by the research capability gives a feasibility rating, which is a numerical value from 1 to 49; the rating for potential benefits is multiplied by the rating for the project's ability to capture benefits, giving a rating for the project's attractiveness, a numerical value from 1 to 49. The feasibility and attractiveness ratings are then multiplied, producing a research project score, a numerical value potentially ranging from 1 to 2 401. Figure 1 summarizes the process. Participants first complete work sheets for each criterion, then the data are entered into a spreadsheet for analysis and the results are generated. Scores can be used in their present form, or they can be ranked. Ranking may facilitate using or illustrating a project's merits, but the relative values between scores are not preserved.

Issues Arising from an Application of *MAPLE*

A workshop on a prototype version of the MAPLE scoring model was held on 22 November 1995 at the Canadian Forest Service's Great Lakes Forestry Centre. The purpose of the workshop was to introduce the model, its structure, output, and information needs, and to evaluate its potential value to forest research. Participants included both research and management personnel of the Canadian Forest Service. An exercise using hypothetical project profiles was used to evaluate the ease of use of the model and the types of results it could produce. Participants were asked to provide feedback throughout the workshop on all aspects of the model. Discussions ranged from general research issues to specific recommendations. This feedback was used to make

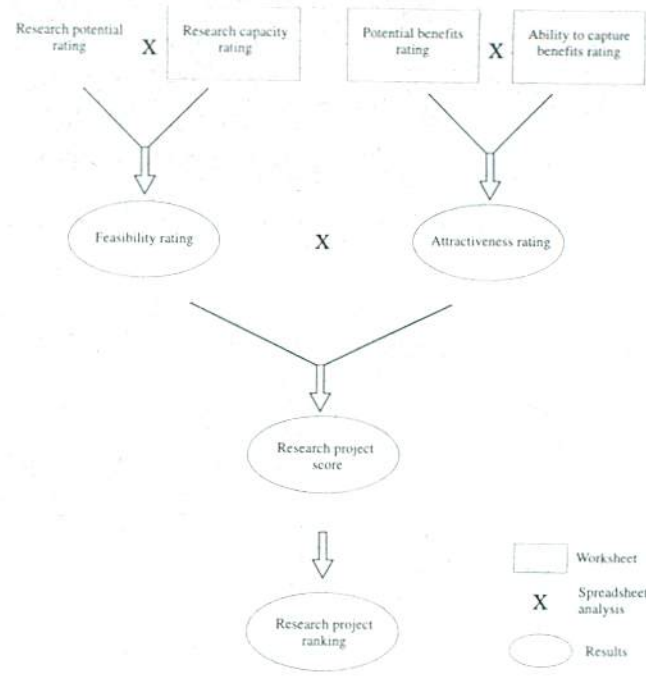

Figure 1. Calculating the research project score using Maple.

improvements to the MAPLE scoring model. Other organizations could follow the same general framework, but develop their own set of questions.

Classifying research

One general issue discussed at the workshop was the difficulty of comparing different types of research. Basic, applied, and developmental research all have different focuses, time lines, and assessment difficulties. A strategy to resolve this problem would be to sort research proposals into these categories. Each set of proposals could then be rated separately. Difficulties would arise, because many projects are complex and potentially encompass aspects of all three categories. For example, a herbicide research project might be aimed at developing diagnostic techniques, as well as determining metabolic pathways. Outcomes and benefits of basic and applied research do not necessarily have to be weighted equally; however, both tangible and intangible benefits are considered when rating each project.

Another way of classifying projects is by subject area. For example, silviculture projects could be distinguished from wildlife projects. In this case, groups of projects from different areas could be evaluated separately. This would allow different groups of assessors to be used and these could then be grouped by expertise. Those familiar with silviculture would evaluate silvicultural proposals and those familiar with wildlife would evaluate wildlife proposals. Although this may allow the selection of qualified assessors for each field, there is a drawback—there needs to be consistency across project assessments. If a group of projects are evaluated in isolation, inconsistent ratings may be a result. One group of assessors could rate their projects at a different level than another group. For this reason, all projects must be assessed in a consistent manner.

This is also the reason that assessors are directed to rate all projects on a relative basis. Each project should be ranked against all the other projects under consideration. Thus each project is being measured with the same yardstick. An alternative approach, such as normalization, recalibrates scores if consistency is a problem. Using a normalization approach, the scores of assessors that are consistently high or low can be adjusted to have the same mean value. Although this approach is possible to establish consistency, it would be better to instruct assessors on how to mark consistently. The rating instructions ask the assessors to use the whole range of ratings by assigning 1 to the lowest rated project and 7 to the highest.

Another issue is the need to ration budgets by the research category if pre-sorting of proposals into groups is used. The projects could be rated in groups, and the budget divided between the same groups and then distributed to individual projects.

Project level or strategic applications?

The *MAPLE* model questions were developed for use at the project level. The model is meant to be used to rank proposed research projects. The Australian model on which *MAPLE* is based was used on a much broader basis—to determine funding across different programs throughout Australia (e.g., forestry, agriculture, and other types of research). For example, to apply *MAPLE* to particular research networks within the Canadian Forest Service would likely require that the wording of the questions in the criteria work sheets be altered.

Criteria and questions

The criteria and questions received much attention during the workshop. There was concern that they needed to be general enough to apply to the different types of research, yet remain specific enough to be useful. Both criteria and questions are generic and attempt to capture the range of issues embedded in realizing benefits from research programs. Questions could be altered to suit the needs of different departments, but their basic nature should be maintained to ensure that all the issues are canvassed. Questions could also be weighted in a different fashion. For example, if research technicians with particular skills are very scarce, then the question on human resources could be given a higher weight. There are four questions used to evaluate research and development (R & D) capacity, so, for example, values of 0.2, 0.2, 0.2, and 0.4 could be multiplied by the question ratings. The human resources rating is thus multiplied by a higher weight of 0.4 (or 40 percent), and projects that make better use of human resources are favored.

Subjectivity

The *MAPLE* model does not attempt to eliminate all subjectivity. Instead, a balance is sought where experience, expertise, and explicitness are favored over bias, subjectivity, and implicitness. This model attempts to structure discussion of research priorities. Structuring will encourage a discussion of all pertinent issues required for proper ranking. Both tangible and intangible benefits and goals are included when deriving project scores. This is an advantage over models that do not consider changes in those benefits that are difficult to quantify or valuate. If information from cost-benefit analysis is available it could be considered by assessors. Thus, in principle both objective and subjective information can be incorporated in the assessments.

Prescreening

A triage process could be used to reject proposals that would likely be unsuitable for funding. This could assess the project's applicability to institutional goals. Information that would be required later in the evaluation process could also be gathered at that time. This additional step in the evaluation process could improve efficiency.

Background information sessions

Information sessions could also be of value in the evaluation process. These could be used to inform participants about specific projects or the general project areas. Assessors from various areas could thus increase their familiarity with issues pertinent to the evaluation process. By including this step, grouping projects by areas of specialty could be avoided. Not all the assessors will be equally familiar with all of the information and issues pertinent to the project assessments, and an information session prior to the assessment exercise could be used to disseminate or discuss them. Alternatively, information on these issues could be gathered and distributed to the assessors.

Iterative applications

Developing an iterative approach to project evaluations could be useful for increasing consensus and improving the quality of the evaluations. The initial individual ratings could be compiled and a summary of these results returned to the assessors. The initial scores could point out areas of disagreement, identify different interpretations, or provide information. Discussion of these items could help assessors reconsider their ratings before carrying out a second round of scoring. It is not necessary to achieve consensus, but the airing of pertinent issues would improve the process. Research outcomes are uncertain and disagreements between assessors will be inevitable, but structuring the evaluation process could be useful. If a similar process is used in subsequent evaluations, consensus and consistency may be easier to achieve.

Administration costs

The cost of administering this process would vary depending on how it was implemented. The work sheets and project proposals could be distributed to the assessors. Assessors could work independently and send their work sheets to a coordinator for compilation and analysis. Another approach would be for the assessors to meet and participate in information sessions, evaluation exercises, and discussions. Experience suggests this approach would increase the level of confidence in the process because of the opportunity for discussion. Generally, scoring models provide a method of

evaluation that can be less costly than other methods, such as cost-benefit analysis, especially when precise values for many of the benefits are difficult to determine.

LIMITATIONS OF SCORING MODELS

Although objective information may be considered when scoring projects, it is not directly used to determine ratings. This adds to the perception that the process is subjective and not repeatable. The process also requires time, and acceptance by participants before proceeding. The interaction of participants and the sharing of information and insights may be very useful in producing results and consensus, but this process clearly takes time. Background information and a pre-scoring filtering process may facilitate the method's applicability.

Rankings are ordinal, not cardinal. If the ranking of one project is 50 percent higher than another, this does not imply that the first project should receive 50 percent more funding. Typically, the highest ranked project would receive funding, then the next highest, and so on until the budget is exhausted.

Costs and time requirements related to administering and participating in the process should be considered when deciding between alternative models. The *MAPLE* model can be used in an iterative manner, in a workshop setting, or by correspondence. Each of these approaches has different cost implications. If the process is not well structured, costs will be higher.

Because the assessors provide the input for this model, their competency and approach to the process are critical to producing useful scoring results. Care should be taken in selecting assessors and in familiarizing them with the model. Training sessions and practice with the model should improve the participants' comfort level. They would also provide an opportunity for additional input, which may improve model questions and weightings. Ultimately, limitations should be considered in light of alternative priority setting frameworks.

CONCLUSIONS

There are no panaceas to the difficult task of setting research priorities and ranking projects. Although a scoring model may not produce a measure of economic surplus, economic principles can still be used throughout the process (Alston et al. 1995). The *MAPLE* model focuses on the concepts of attractiveness and feasibility. Attractiveness is a combination of a project's potential benefits and society's ability to capture these benefits. A project's feasibility is derived by combining a rating for the capability of performing the research, and the scientific or technical advances likely to flow from the project. Final rankings can be used with other decision support tools to create a research portfolio. The main advantage of this model is that it uses the experience and judgement of participants directly in an explicit process of project evaluation. The scoring model allows for the inclusion of both subjective and experience-based inputs. Such models provide research managers with a flexible tool that can make use of available information in a logical and systematic manner. Scoring models are simple but they do provide a structure to examine both qualitative and quantitative criteria (Beach and Fernandez-Cornejo 1993). Examining the results at each stage can help identify the strengths and weaknesses of individual projects.

This tool can be applied in a manner that is more open than are other decision making processes. Each step can be documented and the reasons for giving each rating can be examined later. The model's structure also makes it easier to provide feedback to researchers. This can help when they are designing project proposals. Making the model available to researchers will help them to determine information that should be included in project proposals; it also may help them decide on what research to pursue. The process forces people to think about the value of research, both within and beyond the laboratory or field site. Research managers are also under increasing pressure to defend their decisions. A scoring model helps make the decision process transparent. This allows stakeholders, whether funding agents, taxpayers, or researchers, to better understand funding decisions. However, with explicitness comes the risk that particular stakeholders will be unhappy enough to attempt to use political interference to influence the outcome.

This particular scoring model is only one of many tools that could be used to rank research projects. *MAPLE* uses information from a variety of sources to produce ratings and rankings for each project in a systematic and repeatable manner. The criteria and questions are generic, but can be adapted to suit institutional needs. Ultimately, the wording of the criteria and questions are of paramount importance and may take the most time to resolve in any application.

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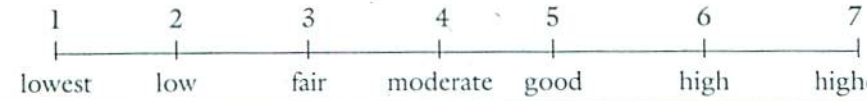
APPENDIX A. Sample work sheets.

R & D Potential Rating Work Sheet

R & D potential refers to the size of the innovative and useful research results anticipated from the proposed project.

Instructions: For each question check the rating which best indicates the level of merit for each project. The level of merit is **relative** to the other projects under consideration.

Rating Scale



Questions	Project name:	Rating 1	2	3	4	5	6	7
1. Evaluate the soundness of the proposed research approach. *Does the approach described in the proposal logically proceed from an understanding of current knowledge to significant enhancement of knowledge in the relevant field of inquiry?*	A							
	B							
	C							
	D							
	E							
2. Assess the level of creativity and innovation in the proposed approach? *Does the approach show significant potential to achieve new useful or innovative results?*	A							
	B							
	C							
	D							
	E							
3. How high are the prospects for development of new knowledge, techniques, or applications in this area of inquiry? *Is there a great deal more to be learned in the proposed area of inquiry? Is it possible to develop new technology or applications in this area of inquiry?*	A							
	B							
	C							
	D							
	E							

Assessor name:

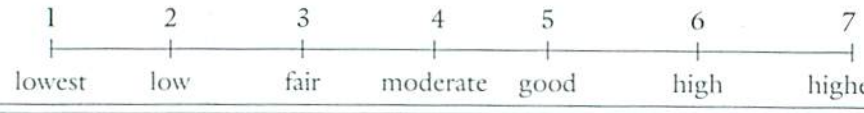
Assessor number:

R & D Capacity Rating Work Sheet

R & D capacity considers the extent to which adequate research and development resources are available, relative to those required by the project, to produce the proposed research results. Consider both the level of resources available and the efficiency with which they will be used in the proposed project.

Instructions: For each question check the rating which best indicates the level of merit for each project. The level of merit is **relative** to the other projects under consideration.

Rating Scale



Questions	Project name:	Rating 1	2	3	4	5	6	7
1. How high is the probability that the planned approach will produce the expected research results? *Consider whether the proposed plan could reasonably be expected to produce significant results. Consider factors that promote or impede the research process, such as linkages to other institutions and disciplines, state of basic knowledge, regulatory environment.*	A							
	B							
	C							
	D							
	E							
2. Evaluate whether the proposed project budget is adequate to cover the needs of the project. *Assign a 7 if the budget very adequate and 1 if very inadequate. Assign the other ratings relative to these scores.*	A							
	B							
	C							
	D							
	E							
3. Evaluate the human resource requirements proposed in the project relative to the availability of qualified personnel. *Consider the level of expertise that exists, the amount the plan requires, and the appropriateness of the planned use of staff. Are the personnel uses adequate for this project? Assign a 7 if very adequate and 1 if very inadequate.*	A							
	B							
	C							
	D							
	E							
4. Evaluate the proposed project's needs in terms of facilities and equipment. *Consider the quality and quantity of facilities and equipment, and whether the proposed uses are appropriate. Are the planned uses of facilities and equipment adequate for this project? Assign a 7 if very adequate and 1 if very inadequate.*	A							
	B							
	C							
	D							
	E							

Assessor name:

Assessor number:

Potential Benefits Rating Work Sheet

Potential benefits of research include net economic, environmental, and social advantages which may be realized in Canada as a direct result of the project.

Instructions: For each question check the rating which best indicates the level of merit for each project. The level of merit is **relative** to the other projects under consideration.

Rating Scale

1	2	3	4	5	6	7
lowest	low	fair	moderate	good	high	highest

Questions	Project name:	Rating 1	2	3	4	5	6	7
1. How important is the problem being addressed by the project? *Consider the size and significance of the problem. Is there a demand (existing or potential) for project results? How urgent is the problem? Are the results relevant to a wide range of problems or issues?*	A							
	B							
	C							
	D							
	E							
2. How great is the potential for tangible financial benefits going to Canadians? *Consider the size of financial benefits that will accrue to Canadians. These may include lower costs of production, greater market share, spillovers to other industries.*	A							
	B							
	C							
	D							
	E							
3. How high is the potential for intangible benefits accruing to Canadians? *Consider benefits that are not considered in question 2, such as the enhancement of expertise, health and safety, environmental quality, basic knowledge.*	A							
	B							
	C							
	D							
	E							

Assessor name:

Assessor number:

Ability to Capture Rating Work Sheet

Ability to capture benefits considers the extent that adequate opportunities exist so that research benefits may be realized within Canada. Consider the mechanisms for adoption or transfer of benefits and who is directly benefited by the research.

Instructions: For each question check the rating which best indicates the level of merit for each project. The level of merit is **relative** to the other projects under consideration.

Rating Scale

1	2	3	4	5	6	7
lowest	low	fair	moderate	good	high	highest

Questions	Project name:	Rating 1	2	3	4	5	6	7
1. Assess the opportunities for technology transfer. *Consider whether research results can be translated into results adoptable by potential users. Are technology transfer opportunities available or possible?*	A							
	B							
	C							
	D							
	E							
2. How high is the probability that Canadians will capture the benefits? *Consider factors that may promote or impede the adoption of project results, such as industry incentives, regulatory environment, and social factors. Do potential adopters exist in Canada or will benefits be exported?*	A							
	B							
	C							
	D							
	E							
3. What is the likelihood of results being adopted promptly? *The farther into the future that benefits occur, the more the value of these benefits will be reduced by discounting.*	A							
	B							
	C							
	D							
	E							

Assessor name:

Assessor number:

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