Final Report

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Enabling Adaptive Forest Management

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Abstract

Adaptive Management (AM) is a rigorous approach for learning through deliberately designing and applying management actions as experiments. This study sought to gain insight on the factors enabling successful adaptive forest management, and how these factors differ between public and private entities. We employed three methods: literature review, written / telephone surveys of AM practitioners who implemented recent projects, and a workshop with a subset of survey respondents. We interviewed twenty respondents, representing AM projects led by thirteen public, six private, and one NGO forest management organizations. The projects were distributed across nine states and two provinces, plot to watershed scales, and a range of project costs from a few hundred to seven million dollars.

Most AM projects had positive outcomes. Fourteen of the twenty projects indicated that the AM initiative led to changes in policies or future management actions. While self-assigned grades for the level of AM success were generally higher in private-led than government-led AM projects, this could be due to the subjective nature of the grades, our small, non-random sample, and/or varying project complexity. Our literature review identified ten factors that could be either enabling or inhibiting to AM. In the survey, we found that each factor was enabling for some initiatives, and inhibiting for others. *Leadership* was consistently assessed as enabling, regardless of project outcome. Two factors distinguished projects receiving higher grades from those rated more poorly: *executive direction* and *the conduct of science*. The qualitative insights gained from the survey (e.g. lessons learned, advice, guidance) were even more valuable than the quantitative data.

Our workshop discussions were rich in insights. Participants concluded that the ten factors should be considered in a hierarchy. The *historical and current context* for the initiative is the top factor within the hierarchy; it motivates the need for AM. *Leadership, executive direction, problem definition, and communications / organization structure* are in the second tier, all required to get AM initiatives successfully started. Then AM leaders can artfully focus on the third tier (*community involvement, planning, funding, staff training and the conduct of science),* understanding the unique context of each project (e.g. corporate culture, stakeholder relationships, scale and focus of the project), and ensuring that any one factor does not become strongly inhibiting (tending the AM garden).

Workshop participants felt that there were not significant differences between public and private forest management entities in either how AM should be practiced, or in factors which enabling it. They perceived that public and private projects were converging with respect to the kinds of problems they're facing, both on the ground and within their institutions.

Despite the challenges of adaptive management, the results of the project survey and the workshop discussions show that adaptive management can be and is successful at a variety of scales for problems of differing complexity. The simple act of engaging in adaptive management may in itself be sufficient to create a shift in corporate culture that is more accepting of having to manage in the face of uncertainty.

Executive Summary

Introduction and Purpose

Adaptive Management (AM) is a rigorous approach for learning through deliberately designing and applying management actions as experiments. AM may be essential for achieving sustainable forestry, as it can help management to adapt to uncertainty and changes in environmental conditions, economic markets, scientific and experiential knowledge, technologies, and social values. Earlier work commissioned by the U.S. National Commission on Science for Sustainable Forestry (NCSSF) noted that complex conservation theories regarding biological diversity are difficult if not impossible to test through traditional experimental research, and recommended that adaptive management may be the best way to calibrate theories over time (Mitchell et al. 2004). Recent reviews of adaptive management in Pacific Northwest federal forests, however, indicate it is not working as intended (e.g. Stankey et al. 2003). The NCSSF wondered, "Can comparisons across ownerships show what factors enable adaptive management to work and what factors inhibit successful implementation?" The NCSSF commissioned ESSA Technologies Ltd. to develop a consensus paper on factors needed for successful adaptive management in the forest sector.

Methods

The study employed three methods:

1) a *review of recent literature* to develop hypotheses of what factors might enable or inhibit adaptive management;
2) a *written / telephone survey* of public and private led AM projects, to explore these hypotheses in the context of recent efforts at adaptive forest management, and
3) a *workshop* with a subset of the interview respondents and other knowledgeable experts, to gain further insights and practical examples of the relative importance of different enabling factors.

The definition of AM used in the study (modified from Stankey et al., 2003) was:

> *"Adaptive Management deliberately uses management actions as a source of learning with the intent to inform subsequent management policy or actions."*

We organized factors discussed in the literature into three dimensions: the *attitude / philosophy* of the people engaged in an adaptive management initiative, the *process* used to develop the initiative, and the *resources* available to support the initiative. Specifically, the following ten factors were identified as potentially enabling or inhibiting adaptive management:

- the historical context,
- leadership,
- executive direction,
- problem definition,
- organizational structure / communication,
- community involvement
- planning,

- funding,
- staff training, and
- the conduct of science.

We used both quantitative and qualitative approaches in the survey to explore a series of questions:

1. How did the perceived level of project success (a self-assigned grade of A, B, C or F) vary between public and private AM projects, and across different scales of projects?
2. Looking across projects, which factors did respondents consider most enabling to AM? Were some factors enabling for some projects and inhibiting for others?
3. Did the enabling factors differ between highly successful and less successful AM projects?
4. Which AM steps and elements (Table 3.1, page 8) were completed in each project and how enabling was each of the steps?
5. Did the AM steps and elements differ between highly successful and less successful AM projects?
6. Did the responses to questions 2-5 above differ between public and private AM projects?
7. How did respondents perceive the relative effectiveness of AM in the public and private sectors?
8. What observations did respondents have regarding project outcomes that would be valuable for others (e.g. changes in policies and procedures as a result of the project, lessons learned)?

At the workshop, we asked participants to provide their insights on both the survey results and their own experiences on enabling factors. In addition to soliciting general comments, we asked them to specifically consider three questions for each of the ten factors listed above:

1. When and why is the factor critical to AM?
2. How can you diagnose whether the factor will be enabling or inhibiting to AM for a given project?
3. What strategies can be implementing to create a successful, enabling environment for AM?

Results and Discussion

Twenty respondents were interviewed, representing a mix of private and public forest management organizations in Alaska, Arizona, California, Colorado, Oregon, Pennsylvania, South Carolina, Tennessee, Washington, British Columbia and Ontario. Almost all of the projects involved participants from more than one sector. Six of the initiatives were led by the private sector[1], thirteen by the public sector and one by a non-government organization (NGO). They reflected a spectrum of scales from plot/stand to watershed and cost from a few hundred to seven million dollars.

The perceived level of success was generally higher in private-led than government-led AM projects (i.e. a higher proportion of private-led projects were graded A or A-). However, the subjective nature of the grades, and the relatively small number of respondents for private-led projects leave us unable to determine if private-led projects really are more successful or if the results reflect other factors, such as the complexity and historical context of the project. As in figure skating, the assigned grade needs to be judged relative to the degree of difficulty of the attempted leaps into new knowledge. Confirming the degree of difficulty and true level of success of each project would require further investigation of

[1] An additional private project provided written survey responses, but too late to be included in our analysis.

project-specific written documentation. Nevertheless, most of the AM projects we surveyed had some positive outcomes. Nineteen of the twenty respondents interviewed in the survey indicated that some uncertainty was reduced, and fourteen indicated that the AM initiative led to changes in policies or future management actions.

Each of the factors explored were found to have been enabling for some initiatives, and inhibiting for others. Leadership was consistently assessed as being most enabling factor, however, this was true regardless of the outcome of the initiative. Historical context, lack of funding, community involvement, executive direction / mandate / legal and regulatory structure, and how science is conducted were the factors found to have the greatest potential to be most inhibiting.

Comparisons of how respondents rated the enabling/inhibiting nature of the factors with the self assessed project grades did not yield any clear associations between the factors and grades, although the factors ranked differently within the three grades assigned to the initiatives (Table 3.5, p.22). Projects receiving a higher grade tended to also consider executive direction and the conduct of science to be more enabling, as compared to projects receiving a lower grade. The message is that each factor can be either enabling or inhibiting and that success likely depends on a context specific mix of factors. What seems critical is that attention is paid to trying to ensure that any one factor does not become strongly inhibiting.

Due to the wealth of experience which the participants brought to the workshop, the discussions were rich in insight about how to enable adaptive management. These insights helped to refine our initial hypotheses about how to enable adaptive management, though it remains difficult to draw firm conclusions. Although this is due in part to the sample size of the survey portion of the study, it is due most importantly to the fact that there is not one right way to do adaptive management, or to enable it. Enabling adaptive management requires an understanding of the unique context for each project. While the study has not developed a single formula for enabling adaptive management, it has nevertheless provided valuable insights to help others enable future adaptive management initiatives.

Of the ten factors hypothesized to enable adaptive management, the workshop discussions concluded that they should be considered in a hierarchy. The hierarchy suggests that some of the factors may be more important than others, or at least that they need to be addressed very early on. It does not, however, mean that the other factors are not important. Each situation will be unique in terms of the corporate culture, corporate structure, relationships with other stakeholders, scale and focus of the initiative, and the potential importance each of the enabling factors needs to be carefully assessed in the specific context of an emerging adaptive management initiative.

The specific context for the initiative (historical and current) is the top enabling factor within the hierarchy (Figure 3.21, p. 42). Leadership, executive direction, problem definition, and communications / organization structure are the four enabling factors at the next level in the hierarchy. Each of these factors are essential for enabling adaptive management but none are in themselves sufficient to enable it alone. This group of factors reflect different elements of gaining and maintaining a broad level of support for the initiative, and gaining clarity about the focus of the initiative. The other factors (community involvement, planning, funding, staff training and the conduct of science) all reflect important elements needed to support adaptive management. The results of the workshop discussions regarding the ten factors is rich with insights, and well worth reading (see Section 3.3). Workshop participants felt that there were not significant differences between public and private forest management entities in either how AM should be practiced, or in the hierarchy of factors which enable (or inhibit) AM. They perceived that public and private projects were converging with respect to the kinds of problems they're facing, both on the ground and within their institutions.

Despite the challenges of adaptive management, the results of the project survey and the workshop discussions show that adaptive management can be and is successful at a variety of scales for problems of differing complexity. The simple act of engaging in adaptive management may in itself be sufficient to create a shift in corporate culture that is more accepting of having to manage in the face of uncertainty.

"One thing about adaptive management is that it is becoming an essential quality to living in a very complex world. … A lot of federal and state laws regarding forest policy are based on a regulated forest to achieve a sustained yield. … to minimize uncertainty and risk … [but] ecologists and social scientists now understand that [the forest ecosystem] is dynamic and can't be stabilized". Broad acceptance of AM requires openly acknowledging uncertainty and dealing with it directly. This requires people to accept the premise that forest ecosystems (including human socioeconomic systems) are constantly changing. Yet regulations are often fixed, as though these systems were stable. Regulatory risk aversion may make it infeasible in many regions to engage in active adaptive management on large landscape scales. In such regions, it may be more feasible to implement well-monitored *passive* adaptive management at a landscape scale to assess overall effectiveness, combined with more limited application of *active* adaptive management to assess cause-effect relationships at a smaller (safer and easier) scale such as stands.

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1. Introduction and Purpose

Adaptive Management (AM) is a rigorous approach for learning through deliberately designing and applying management actions as experiments. It was first developed under the name "Adaptive Environmental Assessment and Management" in the 1970s by Dr. C.S. Holling and Dr. C.J. Walters and associates at the University of British Columbia and the International Institute for Applies Systems Analysis in Vienna (Holling 1978). It has since been applied to a wide range of resource and ecosystem management problems throughout North America and elsewhere (ESSA 1982, MacDonald et. al 1997, Bouris 1998). AM is an approach to management that involves synthesizing existing knowledge, exploring alternative actions, making explicit predictions of their outcomes, selecting one or more actions to implement, monitoring to see if the actual outcomes match those predicted, and then using these results to learn and adjust future management plans and policy (Walters 1986, Taylor et. al 1997). This sequence of steps can be summarized in terms of a 6-step process (Figure 1.1).

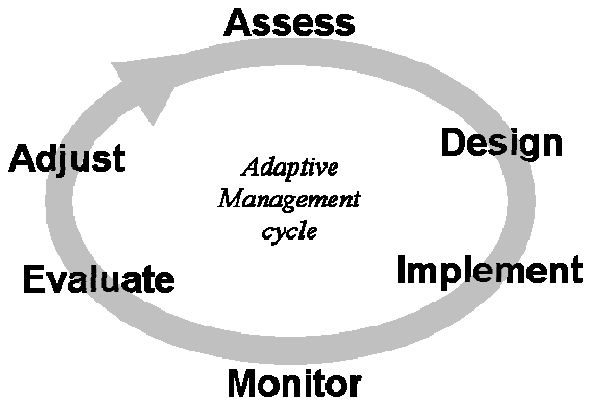

Figure 1.1. The adaptive management cycle.

Adaptive management requires dialogue and collaboration between managers and researchers, as it addresses the interests and objectives of both groups. Conventional management tends to focus on meeting management objectives, with little if any explicit intent to learn about the cause/effect relationships between management actions and outcomes, or to systematically learn if these actions are actually effective in achieving the desired outcomes. Basic research tends to focus on learning objectives, but often for areas, scales or topics that have little direct relevance to managers. Adaptive management combines the two, focusing both on management and learning objectives (Figure 1.2).

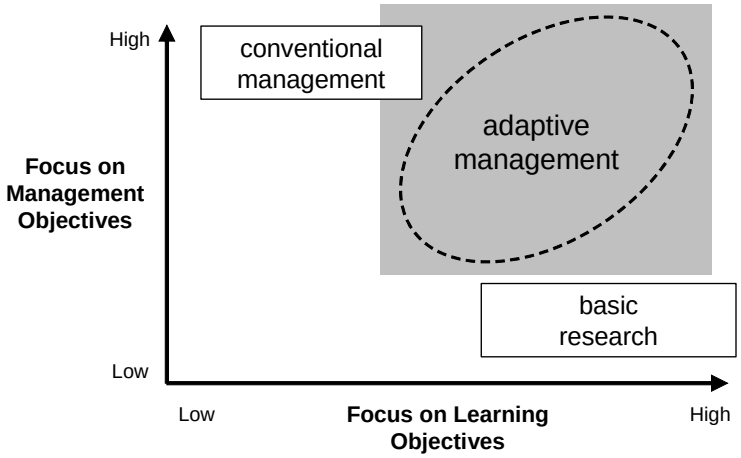

Figure 1.2. The relationship between adaptive management, conventional management and research.

Adaptive management may be essential for achieving sustainable forestry, as it can help management to adapt to changes in environmental conditions, economic markets, scientific and experiential knowledge, technologies, and social values. Earlier work commissioned by the U.S. National Commission on Science for Sustainable Forestry[2] (NCSSF) noted that complex conservation theories regarding biological diversity are difficult if not impossible to test through traditional experimental research and recommended that adaptive management may be the best way to calibrate theories over time (Mitchell et al. 2004). Monitoring is frequently cited as essential to continual improvement, the core concept in adaptive forest management. State forest management in Oregon features adaptive management as the key implementation strategy. Private forest owners and managers routinely practice varying levels of experimentation and continuous improvement in their programs.

Recent reviews of adaptive management in Pacific Northwest federal forests indicate it is not working as intended (e.g. Stankey et al. 2003). The NCSSF wondered, "Can comparisons across ownerships show what factors enable adaptive management to work and what factors inhibit successful implementation?". The NCSSF commissioned ESSA Technologies Ltd. to develop a consensus paper on factors needed for successful adaptive management in the forest sector. This report describes our methodology, results and conclusions.

[2] The NCSSF is a results oriented program that has a mandate to provide practical information and approaches that serve the needs of forest managers, practitioners and policymakers. The program's mission is to improve the scientific basis for the development, implementation, and evaluation of sustainable forestry in the United States. [Excerpted on March 3, 2006, from: ncseonline.org/NCSSF/cms.cfm?id=419.]

2. Observations Across Domains from the Literature

A review of some of the literature (see Appendix 1 for specific results) on efforts to implement adaptive management in a range of domains reveals a number of inhibiting and enabling factors, the latter of which are summarized below. It is important to keep in mind that this is a synthesis of observations and conclusions from several sources, and is not intended to imply that all of these factors will be enabling in all cases. The purpose of this section is to present an overview of enabling factors from a cross-section of experiences. The factors can be grouped into three broad categories:

1. Attitude/philosophy

This category includes characteristics about organizations that implement projects, as well as characteristics about individuals in the organization, particularly those in key or lead roles. For example, some enabling factors from the literature pertaining to organizations include: the ability of institutions to embrace uncertainty and take risks; an ability to adapt to change; having an organizational culture based on curiosity, innovation and learning (and in particular, encouraging learning from experience); having institutional patience (e.g. sufficient stability to measure long-term outcomes); having a desire to reduce conflict and crisis (including boldness about addressing controversial questions); valuing failures (or at least accepting that failures and mistakes are normal when dealing with uncertainty); and expecting surprises and capitalizing on crises. Several of the sources reviewed included the observation that AM must be institutionalized to be successful. Transition strategies that enable the transformation from a command-control system to one built upon learning, collaboration, and integrative management may be necessary.

Similarly, attitudes of individuals are important. Successful AM is enabled by leadership that asserts itself in supporting an adaptive approach, including establishing stable funding (which also relates to the third category below), promoting training and career development options, facilitating development of organizational competency and capability in adaptive management; creating learning organizations and partnerships; encouraging and supporting risk-taking; deliberately challenging itself to recognize change, adapting in innovative ways, taking calculated risks, and creating an organizational culture in which staff are expected to do the same. It is also enabled by managers and decision-makers recognizing that most management is really experimenting anyway, and caring about improving outcomes over biological time-scales. For AM to be successful, champions who embrace, use and demonstrate AM applications are needed.

2. Process

Many of the observations and conclusions from the literature pertain to process, or how AM and related activities are carried out. Some of the enabling factors were relate to who is involved. The following factors are considered important to the success of the AM *process*: multi-agency collaborative research, monitoring and evaluation efforts; extensive consultation with multiple stakeholders in developing and implementing plans; fostering and nurturing partnerships and teamwork; citizen involvement; engagement of regulatory agencies as active participants in management experiments; and involving all stakeholders in developing shared goals and objectives. A good collaborative process is seen as fundamental. This in turn requires transparency and trust among the lead organization, partners and stakeholders. It also requires good communication (including effective internal communication) about AM. This is not only important for building trust and commitment but also to build knowledge and inform the public; to identify and share values and goals; to reach agreement on complex questions; to dispel unrealistic

expectations; to share costs and benefits of uncertain decisions; to document program results; to communicate successes and failures; and to enhance accountability.

AM is enhanced in an environment with open decision-making processes that embody several attributes: uncertainty is accepted; scientifically based AM is an important element of policy development, implementation and evaluation; and alternate forms of knowledge are incorporated into the decision-making process.

Some of the enabling factors gleaned from the literature pertain to more technical issues. These include: identification of key information needs to guide AM program design; rigorous design and implementation of the management experiments; comparison of multiple pathways to increase the rate of learning; choosing proper indicators; deciding how data are to be analyzed before finalizing sampling methods; developing statistical methods for initial inventory and monitoring in concert with sampling design; and linking monitoring to hypothesis testing. It is important to look for efficiencies in monitoring, and to aim for breadth rather than depth (i.e. to try to monitor a few indicators well across a number of treatments and reference sites rather than intensively monitoring many ecosystem components in only a few locations). Clear documentation describing details of the experimentation process is also necessary for maximizing the potential for feedback and learning

It is enabling when the working environment is designed to encourage the development and application of quality science in support of policy, including continually expanding the knowledge base. One suggestion was to begin with a high-profile "crisis" issue of major concern, or an issue that can be investigated inexpensively and deliver a short-term payoff; this is consistent with other suggestions that an important enabling factor is the early demonstration of success.

What about outcomes? AM is enabled through consideration of the desire for fair and equitable treatment of tenure holders, other resource users, and communities (i.e. trying to ensure the costs and benefits of management experiments are borne equally); creative approaches to sharing the costs and benefits of AM; and compensation programs to mitigate losses associated with decisions based on AM. It can help to compare the real costs and benefits of traditional management (including the costs of litigation) versus the cost and benefits of an AM approach. Finally, there needs to be strong, explicit links between the results of management experiments and the use of those results to modify regulations and future practices—often referred to as "closing the loop."

3. Resources

It was no surprise that some of the enabling factors pertain to resources (funding, knowledge, experience, people, structure, tools). These include funding mechanisms designed to ensure that long-term studies and associated management programs are completed; contingency funds to manage natural resources in the face of unforeseen events; sufficient resources to measure ecosystem-scale behavior; sponsorship for the development and application of models at appropriate spatial and temporal scales for management; and sufficient (and usually considerable) initial investment to get the programs established.

AM is enabled through long-term planning and funding cycles that extend beyond annual budget allocation processes (e.g. long-term monitoring can be costly). Long time periods may be needed to evaluate success: a typical stand or landscape scale project could require 5 years to coordinate stakeholders, set goals, develop plans, design programs, and implement trials, and an additional 10 years to monitor, interpret, and translate results into changes in policy and planning procedures (whereas other projects might be considerably shorter depending on the questions being addressed).

The development and demonstration of AM tools and techniques is important, as is training for staff on techniques to plan for, and implement, AM. Enabling tools include integrated knowledge and databases to facilitate prediction of outcomes; management systems and structures that involve all participants in a team approach; and theory, models and field methods to estimate and infer ecosystem-scale behavior. The appropriate technical support must also be available (e.g. to help with statistical designs and decision designs).

A few additional enabling factors from the material we reviewed did not fit into these categories. These relate to things that are outside the control of most organizations that might consider implementing an AM approach. For example, there must be sufficient regulatory flexibility to allow testing of a range of alternatives; and the risk of "failure" must be acceptable—which may not be the case in some situations.

To learning more about the factors that enable adaptive forest management, we expanded these initial three categories, as explained in the next section.

3. Project Approach and Detailed Results

3.1 Project design and implementation

3.1.1 General approach

In this project, we wanted to learn about enabling factors from forest management practitioners who have been (or currently are) involved in projects that implemented the AM approach. We felt that the best way to do this would be through a two-stage process: 1) a survey that would ask a focused and consistent set of questions; and 2) a workshop with AM practioners to review the results of the survey in light of their own experience, and provide deeper insights into enabling factors.

We decided to implement the survey through individual telephone interviews, considering this to be the best way to both minimize the effort expected on the part of the respondents (being respectful of their time) and maximize the richness and depth of the information provided (e.g. probe further when needed, or explain questions that might not be clear for a given situation). Our survey design required each respondent to have a specific AM project in mind (i.e. a particular project[3] for which the adaptive management approach was used), and focused on three main areas: an assessment of the success of their project from an AM perspective, an assessment of factors that inhibited or enabled the implementation of the AM approach for that project, and the elements of AM that were included in the project. The full survey questionnaire is provided in Appendix 2.

Given the time available for this task, we set a target of sixteen survey responses: eight from public forest management organizations and eight from private forest management organizations. We then set about finding candidate projects—and people—to interview. This was an informal process, following leads provided by the NCSSF as well as from our own knowledge of where AM is being implemented in the forestry domain. We were looking for practitioners within public and private forestry organizations with hands-on experience in actually implementing AM—whether this ended up being successful or not. We wanted to learn from real experiences what factors were important to the success of specific projects that made a sincere effort to use an AM approach. This sample was drawn informally, rather than through a random selection of all possible AM projects in the forest sector. Therefore, results from this survey only reflect the patterns in these projects, and are not necessarily representative of the universe of all public and private AM projects. Indeed, it is likely that our method of finding cases (i.e. word of mouth referrals to projects which made sincere attempts to do AM) was biased towards finding more successful examples.

We used the following definition of AM, modified from Stankey et al. (2003):

> *"Adaptive Management deliberately uses management actions as a source of learning with the intent[4] to inform subsequent management policy or actions."*

[3] Some respondents had several candidate projects to choose from. We asked them to select the one that would be most informative regarding enabling factors, since that is the focus of our study.

[4] The word "intent" recognizes the fact that science is not the only influence on decisions regarding management policy or practices.

We also used the following four questions to screen candidate projects, to ensure that we were targeting those that aligned with what we considered to be the key elements of AM:

- Did you recognize that you were doing experimental management?
- Was the project started with a specific intent to learn?
- Was there some degree of monitoring done (or intended, if not there yet)?
- Were the results fed back to management (or intended, if not there yet)?

If the answer was "yes" to these questions, we asked who was the most knowledgeable person about this project (i.e. someone who could answer specific questions about various aspects of the project), and then tried to arrange an interview with that person.

3.1.2 Survey design

The survey design was based on hypotheses, developed from the literature review and our own experience, about factors that might serve to enable or inhibit AM, and elements within the AM cycle that are thought to be important to successful AM. The survey was broken down into five parts:

A. a brief introduction, characterizing the organization's involvement in AM, and the respondent's impression of the overall outcome and success of the project;

B. a qualitative evaluation of factors hypothesized to be important to enabling AM if strongly present, and inhibiting to AM if absent, plus some open-ended questions;

C. an assessment of which steps in the AM process were included in the project, and how the steps in the AM process were conducted (i.e. which elements of each step were included);

D. the respondent's perspective of the relative success of private vs. public AM; and

E. open-ended questions regarding the outcome of the project and lessons learned.

Based on Alverts et al. (2001) as well as other literature, we evaluated ten factors in part B: 1) historical context, 2) funding, 3) leadership, 4) definitions of problems/opportunities and potential management actions, 5) community involvement, 6) planning, 7) organizational structure and communications, 8) executive direction / mandate / legal and regulatory structure, 9) training of staff, and 10) how science and AM is conducted. To clarify these concepts, we provided an illustrative range of behaviors for each of these factors in part B of the survey.

The steps and elements for the AM cycle (part C of survey) are shown in Table 3.1.

Table 3.1. AM steps and associated elements explored in part C of the survey.

AM Steps	AM Elements within each Step
Step 1. Assess and define the problem	Clearly stated management goals and objectives
	Explore alternative actions
	ID measurable indicators
	ID spatial / temporal bounds
	ID key uncertainties
	Articulate hypotheses to be tested
	Build conceptual models
	Explicitly state assumptions
	Involve stakeholders
	Involve scientists
	Involve managers
	Reports describing this step
Step 2. Design	Active AM
	Contrast, replication, controls
	Statistical advice
	Predict outcomes
	Consider next steps under alternative outcomes
	Data management plan
	Monitoring plan
	Formal AM plan
	Peer review of design
	Multi-year budget commitments
	Involve stakeholders
Step 3. Monitoring	Contrasting treatments
	Implemented as designed
	Implementation monitoring
Step 4. Implementation	Implemented as designed
	Effectiveness monitoring
Step 5. Evaluation of results	Monitoring results compared against goals/objectives
	Monitoring results compared against assumptions, uncertainties, hypotheses
	Compare actual results against model predictions
	Receive statistical or analysis advice
	Data analysis keeps up with data generation from monitoring activities
Step 6. Adjustment / Revision of Hypotheses and Management	Meaningful learning occurred
	This was communicated to decision makers
	Actions or instruments changed based on learning

Our analysis of the survey's structured questions focused on the following questions (with their associated rationale). These are also questions which we will be addressing at the workshop.

1. *How did the perceived level of success (part A of the survey) vary between public and private AM projects, and across different scales of projects?* We didn't have any pre-conceived expectation regarding public vs. private projects, though the genesis of this project was partly from NCSSF's perception that private entities had greater flexibility to implement AM. We did expect that larger scale projects (watershed, landscape) would be more difficult to implement than smaller scale projects (plot, stand), simply because of the larger number of potentially affected stakeholders who would need to agree to allow the AM experiment to proceed.

2. *Which factors (section B) did respondents consider most enabling to AM? Were some factors enabling for some projects and inhibiting for others?* Based on our past experience, we expected that each of the ten factors could be either enabling or inhibiting.

3. *Did the enabling factors (part B) differ between highly successful and less successful AM projects? Which factors were strongly enabling in the most successful projects?* We anticipated that projects which had more enabling factors strongly present would have a greater likelihood of success. We were also curious to discover counter examples to our expectations (i.e. alternative paths to success). We recognized at the outset that our measures of success[5] were based on subjective information provided by respondents. Though we did ask for documentation, it was not possible within this project to verify the degree to which management policies and procedures really did change as a consequence of AM experiments.

4. *Which AM steps and elements (part C) were completed in each project and how enabling was each of the steps?* This question served to probe the degree to which AM was really implemented in each project, according to our definition provided in section 1 of this report. Our expectation was that all of the six steps would be enabling; we were curious to learn if that expectation would be shared amongst our respondents.

5. *Did the AM steps and elements differ between highly successful and less successful AM projects?* We expected that those projects which completed more of the AM steps and elements would tend to be more successful. An interesting issue (difficult to determine) is whether the enabling factors in section B or the AM steps and elements in section C are more critical to the success of AM projects.

6. *Did the responses to questions 2-5 above differ between public and private AM projects?* We were interested in elucidating public-private differences wherever possible. However, we recognized from the outset that our limited sample size of projects would make it difficult to address more complex questions convincingly, as there would be few projects in each of the four strata of interest (i.e. public AM successes, public AM failures, private AM successes, private AM failures). Furthermore, the distinction between success and failure is more of a continuum than a sharp boundary. Hence our analysis was intended to explore hypotheses and suggest new ones, rather than to rigorously test them.

7. *How did respondents perceive the relative effectiveness of AM in the public and private sectors (part D)?* We were interested to assess this perception, recognizing that respondents would be somewhat 'loyal' to their own sector.

Open-ended questions were included throughout the survey to give the respondents an opportunity to provide insights beyond the structured questions, and to pass on valuable guidance to others. In light of our relatively small sample (n=20), we looked for general patterns in the survey questions which generated quantitative results, but did not complete any statistical analyses. We consider the patterns elucidated from this process to be insights on the above questions that suggest possible avenues for further study, rather than as formal hypothesis tests.

[5] One measure of success was explicit in our survey: the grade that respondents gave their project. However, the survey questions also included two other less explicit measures of success: whether the project implemented all six of the steps in the AM cycle, and whether what was learned during the project ended up being used in making decisions about actions or policy.

3.1.3 The sample

We exceeded our target and successfully surveyed 20 people from a mix of private and public forest management organizations in Alaska, Arizona, California, Colorado, Oregon, Pennsylvania, South Carolina, Tennessee, and Washington State in the U.S., as well as from British Columbia and Ontario in Canada. Of these, 15 were interviewed by telephone (with an average interview duration of 1.5 hours) and five filled out a survey on their own and submitted it via email. Appendix 3 lists those who completed a survey (either on their own or through a telephone interview). However, we were only able to obtain six responses for projects led by the private sector. (A seventh survey from the private sector was received too late for the data to be included in these results.) Thirteen were led by government agencies and one was led by a non-governmental organization (NGO) (Table 3.2). Although we screened and obtained initial interest from two additional private sector companies, we were unsuccessful in booking an interview with them within the necessary timeframe.

Table 3.2. Number of projects surveyed, by lead sector.

		Lead Sector			
		Public	Private	NGO	Totals
Geographic Location	Pacific Northwest	7			7
	Elsewhere in USA	2	3	1	6
	Canada	4	3		7
	Totals	13	6	1	20

Responses to closed-ended questions (those asking for Yes/No answers or ratings) were coded into an MS Access database, and open-ended questions were entered into an MS Word file. Data were extracted from the database into MS Excel for graphing.

3.1.4 Workshop design

We convened a workshop in Portland, Oregon in early April 2006 to provide an opportunity to gain the insights of the participants regarding the results of the project, especially in regard to factors that enable adaptive management. We invited everyone who participated in the survey to attend the workshop (see Appendix 5 for a list of who attended). The workshop began with a brief presentation of and discussion of the findings of the survey, and then the rest of the time was spent discussing the factors that serve to enable adaptive management. To facilitate a systematic consideration of the factors, participants were asked, for each factor, to think about three key questions:

1) When and why is the factor critical?
    - Could there be situations when the factor was disabling rather than enabling?
    - In what sort of situations might it not be important?
2) How do you know whether this factor will be enabling for a given project?
    - Insights on how to diagnose whether a factor will be enabling or not.
3) What can be done to create an enabling situation?
    - Insights on strategies for success.

3.2 Survey results

3.2.1 Characteristics of our sample

The projects in our sample were primarily led by government or industry, with one led by a non-government organization. However, most involved broad participation. Five of the 20 projects surveyed had participation from the government, private, non-government and academic sectors, six projects had participation from three of these four sectors, and four projects involved two of these sectors. The remaining five projects all involved only one of the sectors, and for four of these it was the private sector. The details of our sample are presented in Table 3.3, and a brief narrative description of each project can be found in Appendix 4. (As noted in Appendix 4, two of these projects are different in nature from the others. However, they are included in the analyses presented in this section.)

The mixed participation in most of these projects is healthy—stakeholder collaboration can help to enable successful application of AM to forest resource management. However, this mixed participation makes it more difficult to formally test hypotheses regarding differences in how AM is practiced in public versus private forest management entities. The small number of privately led projects (six) also hinders our ability to assess variation *within* private entities across different factors (e.g. correlates of success). In addition, three projects coded as government-led were very close to a 50-50 split between government and private participation, and in such cases the line between government-led and private-led projects is less clear.

Our sample covered a wide range of projects sizes, as measured by total cost (Figure 3.1). The sample also covered a range of project scales, although most were at the stand level (Figure 3.2). More than half of these projects are (or were) at least 5 years in duration, and three were more than 10 years in duration. At least 8 of the projects are ongoing, and two have long timeframes (30 years or more).

Table 3.3. Details about the projects in our sample.

Title	Summary of Activities	Lead Agency Name	Lead Agency Type	Other Agencies	Location	Scale of Experiments					
						Area ('000 ha)	plot	stand	w-shed	Duration (yrs)	Cost ('000) USD
McCully Creek Watershed	alternative thinning and small entries	BC Ministry of Forests	G	P	BC	25			x	4	150
Forest Grassland Study	thinning to allow sustainable grasslands	Lignum	P		BC			x			
Adaptive Management of Pine-Lichen Woodlands (part of Omineca Northern Caribou Project)	thinning to minimize impacts to Caribou	Canfor	P	G	BC	1		x		6	188
Developing Sustainable Mixed Wood Practices in a Stand Level Adaptive Management Framework (SLAM)	partial harvesting to sustain mixed wood ecosystems	Ontario Ministry of Natural Resources	G	P,N	Ontario	0		x		7	1012
Tongass Wide Young Growth Studies	thinning to encourage deer forage	USDA Forest Service	G		Alaska			x		4	7000
Coast Forest Strategy	variable retention harvesting and landscape zoning to maintain biodiversity	Weyerhaeuser (Cascadia FP)	P	G,N,A	BC	800		x	x	6	3750
Riparian Function Study	maintenance of stream debris	Oregon Department of Forestry	G	P,N,A	Oregon		x	x		2	112
Genesys Landscape Planning System	forest land management system	International Paper	P		Tennessee	3,238		x		3	2500
Ponderosa Pine Forest Partnership	restoration of normal ecosystem	USDA Forest Service	G	P,A	Colorado	4		x		11	38
Blue River Landscape Study	emulation of natural disturbance patterns	USDI Bureau of Land Management	G	A	Oregon	23		x	x	12	1800
Five Rivers Landscape Management Project	maintain late successional stands, learning in NEPA	USDA Forest Service	G	N,A	Oregon	13		x	x	8	1500
Fort Valley Ecosystem Restoration Project	fire risk reduction and ecosystem restoration	Greater Flagstaff Forest Partnership	N	G,P,A	Arizona	3		x		7	1000
Pennsylvania Forest Resource Plan	more responsive forest management framework	Pennsylvania Bureau of Forestry	G	P,N,A	Pennsylvania	850		x		9	200
Donna Creek Adaptive Management Trial	snag maintenance and bird habitat	Peace Williston Fish & Wildlife Compensation Program	G (P)	P	BC	6		x		15	250
Ospika Mountain Goat Adaptive Management Trial	goat migration and cut blocks	Peace Williston Fish & Wildlife Compensation Program	G (P)	P,N	BC			x		7	1125
Almanor Forest Group Selection Harvesting	small openings and natural regeneration	Collins Pine	P		California	38		x			
Applegate Adaptive Management Area	many smaller projects, including reduction of bark beetle risk	USDI Bureau of Land Management	G	P,N,A	Oregon	202		x		9	1000
The Forests and Fish Report	reducing uncertainty in stream habitats	Washington Forest Protection Association	G (P)	P,N	Washington	3,237		x		8	
Commercial Thinning and Swiss Needle Cast	thinning and disease impact	Oregon Department of Forestry	G	A	Oregon			x		4	350
Leave Tree Harvesting System for Appalachian Hardwoods	partial harvesting and wildlife habitat	MeadWestvaco	P		Virginia	141,640		x		5	50

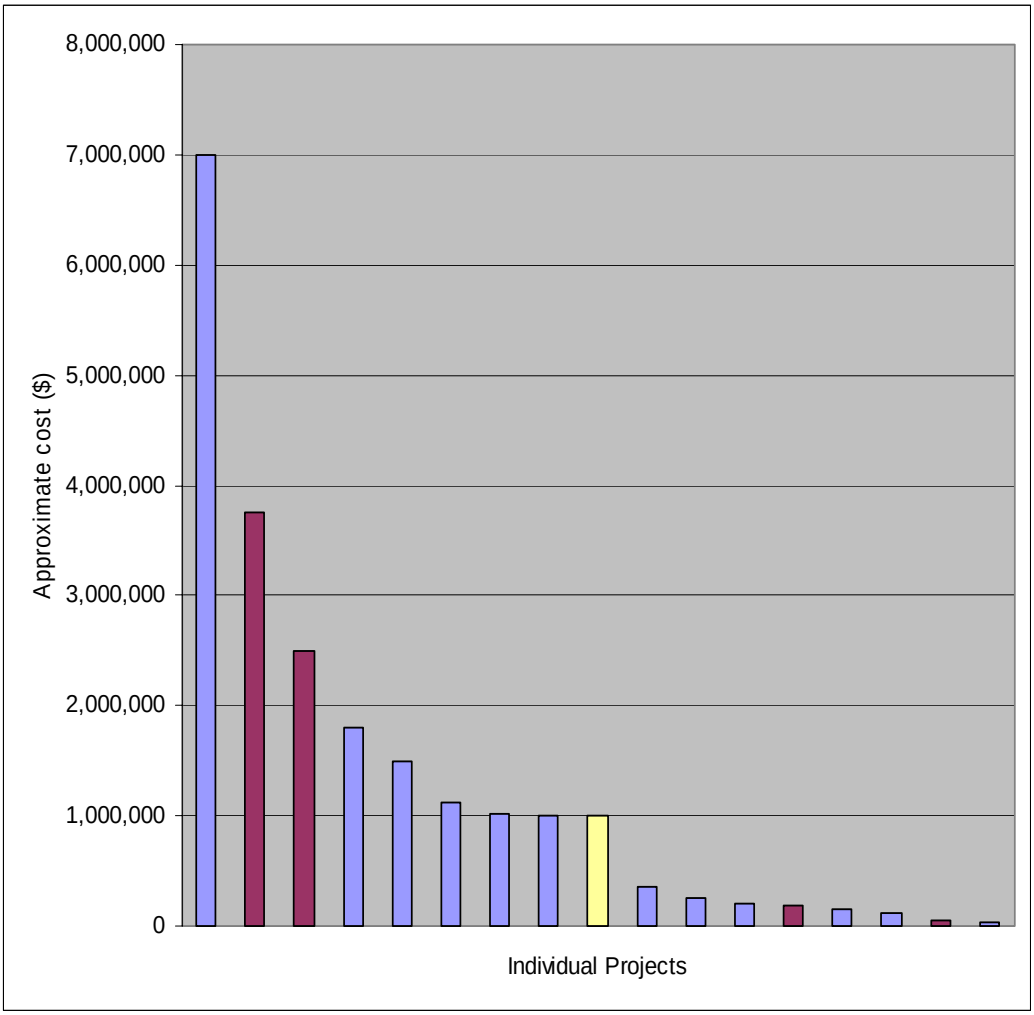

Figure 3.1. Approximate total cost (USD) of each project surveyed, arranged in descending order. (Blue bars represent government-led projects, purple represent private-led projects, and yellow represents the one NGO-led project. Cost figures were not provided for three of the 20 projects.)

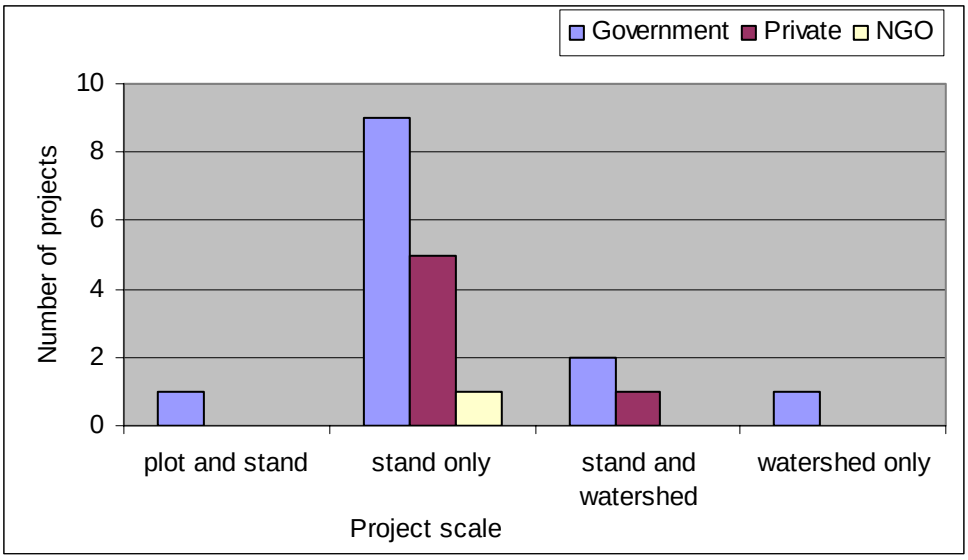

Figure 3.2. Scales of the projects surveyed.

Over half of the individuals surveyed described their role in these projects as a leadership role (project leader, research leader, scientific leader, director, principal investigator), a few cited multiple roles, and the rest served in an advisory, sponsorship, implementer, manager, coordinator or technical support role.

3.2.2 Overall "AM" success

Nineteen of the 20 projects were considered to demonstrate "successful AM" according to those who participated in the survey. All of the projects received an overall grade of C or better from an AM perspective by the survey respondents. Six projects received a grade of A or A-, and eleven projects received a grade of B, B+ or B-. Of those projects graded A (or A-), half were led by the private sector and half by the public sector (Figure 3.3). (As this was a subjective rating by the survey participants, there would be variation in their standards of evaluation.) We can't really assess whether success (as assessed by project grade) depended on scale (Figure 3.4), since virtually all of the projects were at the stand scale. Comparing project grade and cost, the six projects given a grade of A or A- included the four most expensive projects, as well the two least expensive (of the 17 projects for which cost estimates were offered) (Figure 3.5). Large budgets do not appear to be either a sufficient or a necessary condition for AM success.

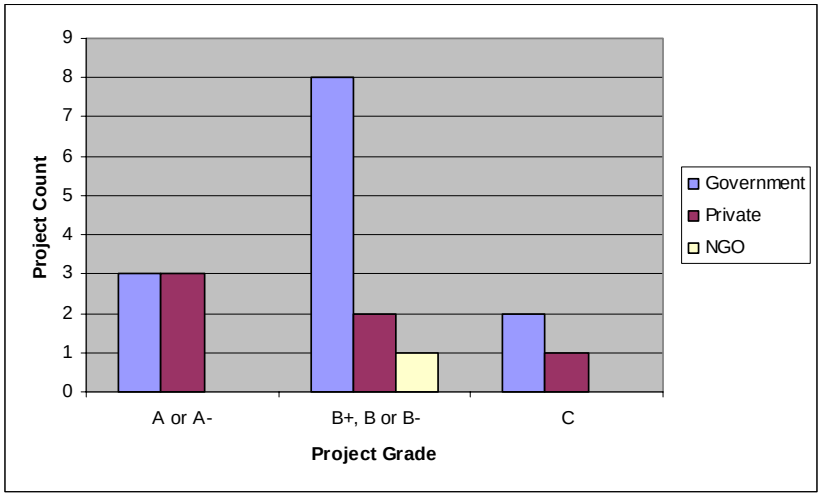

Figure 3.3 Distribution of project grades by the sector leading the project.

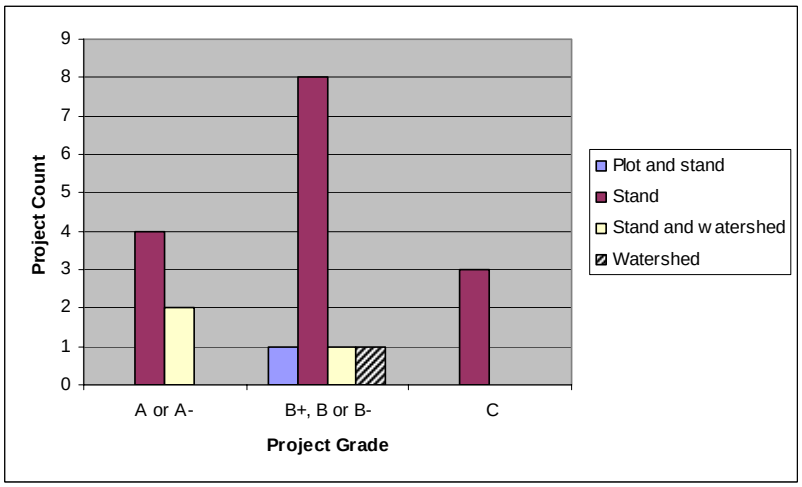

Figure 3.4. Distribution of project grades by the scale of the project.

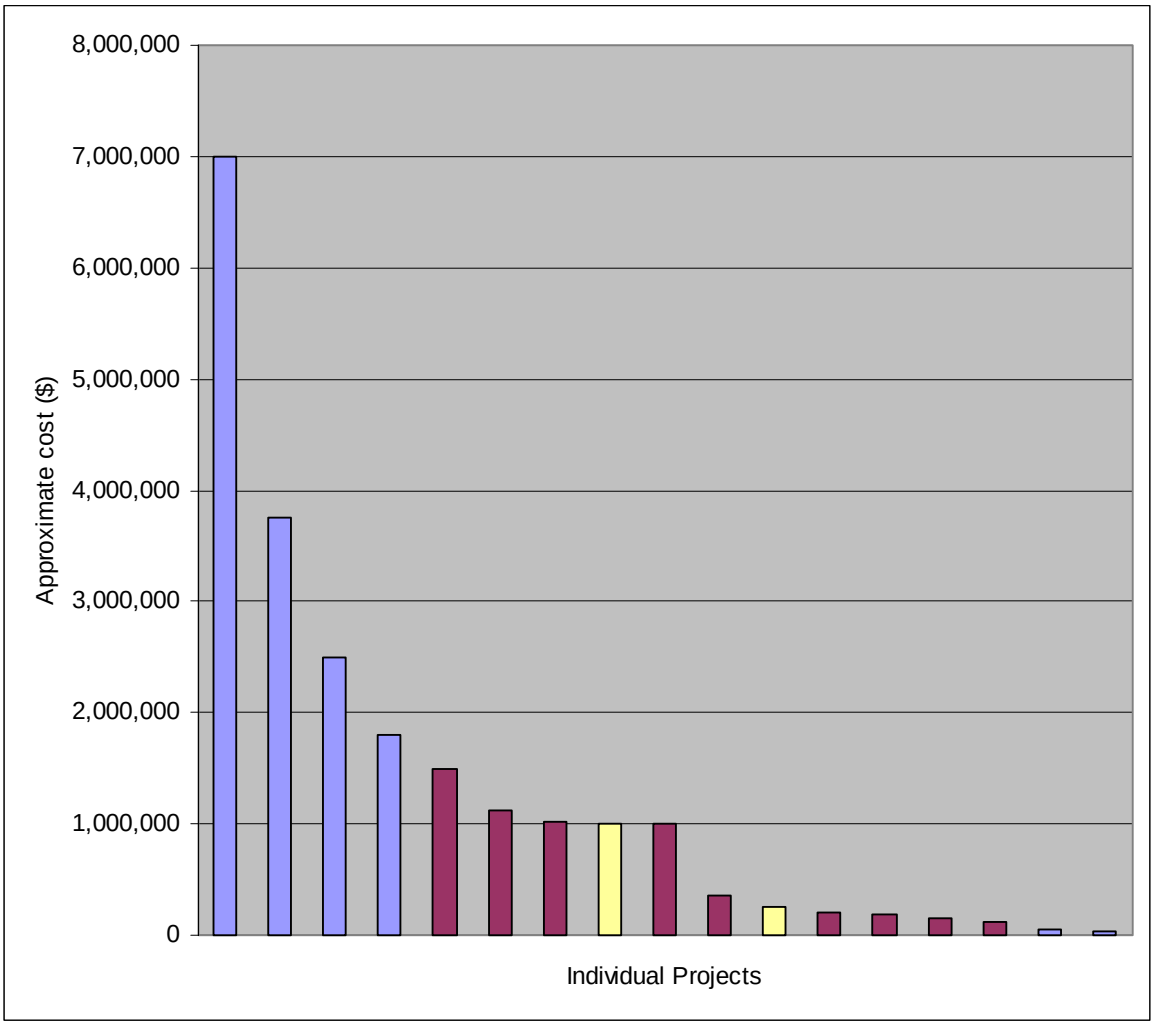

Figure 3.5. Distribution of project grades by the cost of the project.
(Blue bars represent projects with a grade of A or A-, purple bars represent projects with a grade of B, B+ or B-, and yellow bars represent projects with a grade of C. Cost figures were not provided for three of the 20 projects.)

Some uncertainties were reduced in all of the nineteen projects that were considered to demonstrate "successful AM". In seventeen of the projects, what was learned ended up being *used* in making decisions about actions or policy, and for the remaining three projects, survey respondents believe this will occur in the future. What was learned in fourteen of the projects let to *actual changes* in policy or practice (and in two other cases proposed policy changes are under review). This is a more objective standard of AM success, and provides corroborative support for the generally high subjective grades in Figure 3.4.

3.2.3 Factors that encourage or inhibit AM

Respondents were asked to rate each of 10 factors on a scale from +3 to -3. Positive values represented enabling effects (3=primary factor of success, 2=strongly enabling, 1= somewhat enabling); 0 = neutral or "don't know", and negative values represented inhibiting effects (-1=somewhat inhibiting, -2=strongly inhibiting, -3=primary factor of failure). When looking at the number of projects rating factors as strongly enabling or a primary factor of success (i.e. +2 or +3), leadership clearly stood out (17 projects;

Figure 3.6). Leadership is also the only factor that was not considered inhibiting in any of the projects surveyed; all other factors received at least one negative rating. Leadership also received the most (six) ratings of +3 (a primary factor for success), followed closely by funding which received five ratings of +3. Funding and planning were also frequently rated as strongly enabling or a primary factor of success (11 cases). Good leadership likely stimulates development of other enabling factors.

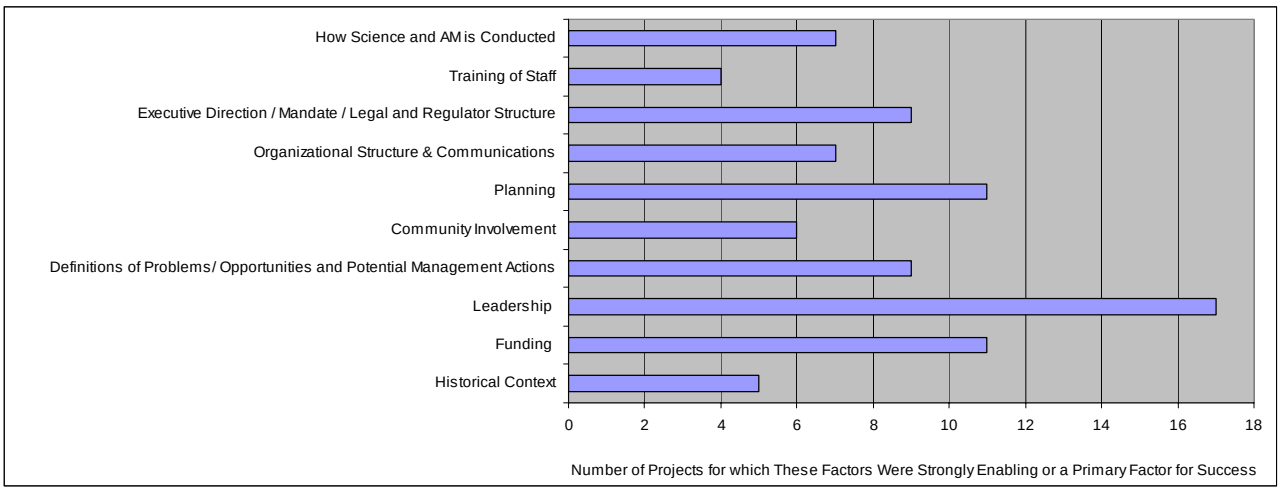

Figure 3.6. Number of projects rating each factor as strongly enabling or a primary factor of success.

Looking at only the six projects that were considered to be the *most successful* from an AM perspective (i.e. self-graded as A or A-), leadership again stands out as a primary factor for success in half of these projects, and as strongly enabling in the other half (Figure 3.7). The only other factor that was considered enabling in all six of these projects was executive direction/mandate/legal and regulatory structure. Clearly, many factors are thought to help enable AM. Of the ten factors, eight of them were considered enabling in at least half of these projects, and all of them were considered at least strongly enabling in at least one of these projects.

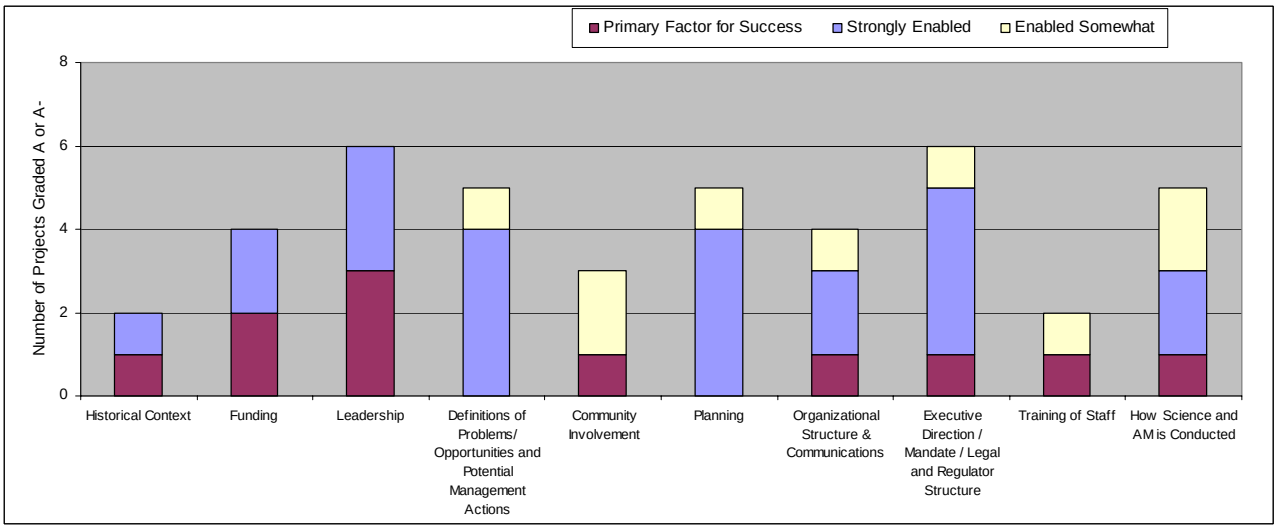

Figure 3.7. Importance of enabling factors across the six projects considered most successful from an AM perspective.

Most respondents felt that many factors *enabled* AM (median of 7 factors per project). However few factors were considered to *inhibit* AM (median of only 1 factor per project). Only one factor, how science and AM is conducted, was considered a primary factor for failure, and in only one project. The respondent reviewing that same project also rated two other factors as strongly inhibiting: funding, and community involvement. A different respondent rated executive direction/mandate/legal and regulatory structure as strongly inhibiting. Other factors were only considered to be somewhat or non-inhibiting.

In summary, respondents generally thought of their projects positively, and did not encounter many inhibiting factors. While this is a good thing, it also means that our sample has less contrast between AM successes and failures. We have however other sources of information on failures (and the inhibiting factors contributing to them) in other cases documented in the literature (see Appendix 1).

Figure 3.8 summarizes three dimensions: the factors; their perceived enabling/inhibiting quality; and the sector leading the project (private, public, NGO). The small number of NGO- and private-led projects makes it more difficult to delineate their distributions. In general, factors with distributions skewed to the right (e.g. leadership, problem definition, planning) were more enabling. Factors with distributions skewed to the left (e.g. historical context, training) were more frequently perceived as inhibiting. Those factors with uniform or bimodal distributions (e.g. funding, executive direction, legal and regulatory structure) could be either enabling or inhibiting. With the exception of planning, all of the other factors were considered a primary factor of success for at least one of the projects surveyed.

No dramatic differences are readily apparent between the project types (private, public, NGO), although the small sample sizes of private-led and NGO-led projects make it hard to detect such differences. Figure 3.8 suggests that community involvement may be more important for the success of AM in public sector organizations than in private sector organizations. Leadership may be slightly more important for the success of AM in the private sector than in the public sector (it was considered a strong or primary factor for 100% of the projects led by the private sector versus 77% of projects lead by government agencies).

There were several cases in which respondents felt that a specific factor could be considered both enabling and inhibiting *within* a project, and had difficulty in choosing one score. Some examples of this are provided in Table 3.6.

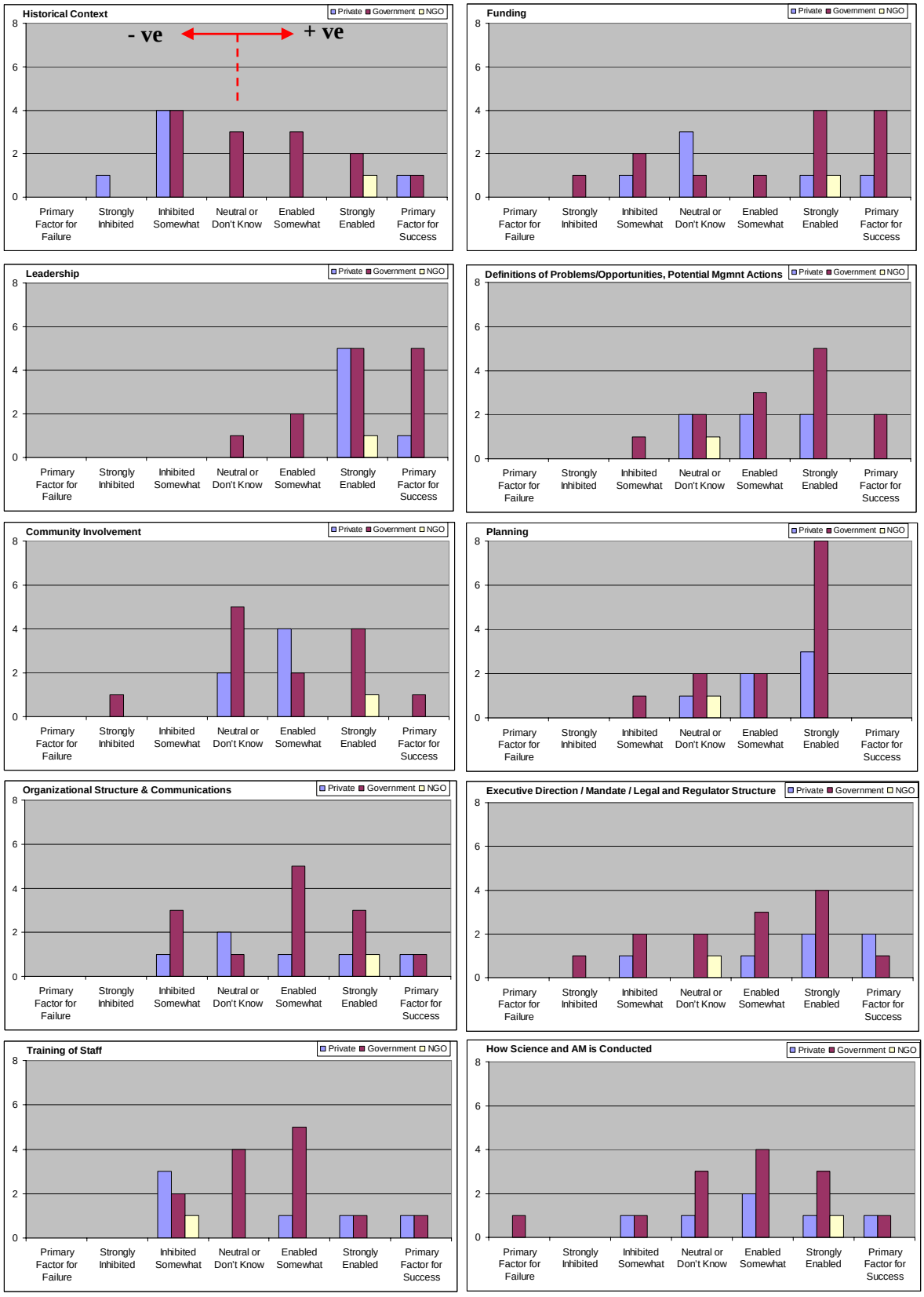

Figure 3.8. Enabling and inhibiting ratings by factor and lead sector.

We wondered how the scores assigned to the various hypothesized enabling factors might be correlated with the evaluation of the relative success of the projects. If the hypothesis that these factors enable Adaptive Management is correct, one would expect projects on which the enabling factors were judged to be more strongly enabling to be correlated with higher project grades. Table 3.4 shows the project grades together with the scores assigned to each enabling factor. The sum of the scores of the enabling factors is also shown for each project. Table 3.4 shows that projects assessed as being relatively more successful tend to have a larger number of the factors that were assessed as being more strongly enabling. Those projects scored in the A range (A+, A, A-) tend to have a sum of factor scores above 13, with two notable exceptions. Projects assessed as being in the B range tend to have a sum of factor scores in the range 10 to 16 with three notable exceptions; and projects assessed as being in the C range had a sum of factor scores less then 13. Given the qualitative nature of the scoring it is not surprising that there should be overlap between these ranges. The overlap may also be due to differences in un-stated criteria used to assess success. The overall pattern, however, appears consistent with the hypothesis in that the group sum of normalized factor scores declines with each project grade.

Table 3.4. Comparison between the scores assigned to the hypothesized enabling factors and the self-assessed project grades. Cells where a factor was scored as strongly enabling have bold text and are shaded light grey. Those scored as strongly inhibiting are shaded dark grey. Black shading in the project score column indicates projects which were led by private industry or a non-government organization. Projects were sorted first by project score and then in descending order by the sum of the enabling factor scores. The rows labeled FS (for factor score) show for each factor the sum of the scores for that factor normalized to the maximum possible outcome (e.g. 3 times the number of projects in the group); thus a factor that was assessed as being a primary factor for success (3) for all projects in a group would show here as +1, and one which was assessed as being a primary factor for failure (-3) for all projects would appear as (-1). The sum of these factor scores is also shown for each group (A, B, or C) of projects.

Project Grade	Sum of enabling factor scores	Historical Context	Funding	Leadership	Problem Definition Opportunity	Community Involvement	Planning	Organization Structure	Executive Direction / Legal	Staff training	Conduct of Science
A	20.5	3	2	3	2	0	2	3	2	0.5	3
A	15.5	2	2	3	0	0	2	2	2	1	1.5
A	13	-1	3	2	2	3	2	-1	1	0	2
A*	7	-1	0	2	1	0	1	1	3	-1	1
A	4	-2	0	2	2	1	0	-1	2	-1	1
A-	19	-1	3	3	2	1	2	2	2	3	2
FS	4.39	0.00	0.56	0.83	0.50	0.28	0.50	0.33	0.67	0.14	0.58
B+	13	-1	0	2	0	0	1	3	3	2	3
B	16	0	3	2	2	2	2	1	0	2	2
B	15	2	3	3	0	0	1	2	3	1	0
B	14	1	2	3	1	1	2	1	2	0	1
B*	12	-1	1	2	3	2	2	0	1	1	1
B	11	2	2	2	0	2	0	2	0	-1	2
B	10	3	2	2	1	1	2	0	1	-1	-1
B	5	1	0	1	-1	2	0	1	1	0	0
B	4	1	-1	0	1	0	1	1	0	1	0
B	0.5	-1	-1.5	2.5	3	1	2	-1	-2	-1	-1.5
B-	16	0	2	2	2	2	0	2	2	3	1
Sum	3.53	0.21	0.38	0.65	0.36	0.39	0.39	0.36	0.33	0.21	0.23
C	12.5	0	3	3	1	0	2	1	-1	1.5	2
C	3	-1	-1	2	0	1	2	0	-1	1	0
C	-9	-1	-2	1	2	-2	-1	-1	-1	-1	-3
Sum	0.72	-0.22	0.00	0.67	0.33	-0.11	0.33	0.00	-0.33	0.17	-0.11

Projects with an asterisk (*) beside their grade are projects which we feel did not actually conduct AM.

To get a sense for the relative importance of the enabling factors within each group (A, B, C), the normalized factor scores for each success group (FS row) were ranked (Table 3.5).

Table 3.5. Comparison of the relative importance of enabling factors and the relative success of the projects. Light shading indicates factors which were assessed consistently (within 1 rank) across the three groups, and rows with dark shading indicates factors that were assessed differently among the groups.

	Project Grade		
Enabling Factor	A	B	C
Leadership	1	1	1
Executive direction	2	7	10
Conduct of science	3	8	8
Funding	4	4	5
Problem definition	5	5	2
Planning	6	3	3
Organization Structure	7	6	6
Community involvement	8	2	7
Staff training	9	10	4
Historical context	10	9	9

Leadership was assessed as being the most strongly enabling factor across within each of the success groups, and historical context was assessed as being the least enabling. From the perspective of trying to understand whether any one factor is critical to success (at least in regard to the projects sampled) what is of interest are those factors which were enabling for A class projects but not for C. Most notable in this regard appear to be executive direction, and the conduct of science. Overall, given the pattern of enabling factor scores in Table 3.4, what may be important is having an environment in which a complex of the factors serve to enable success.

Table 3.6 provides some examples of comments from respondents on how different factors enabled or inhibited AM. Where a factor was both enabling and inhibiting (or intermediate), we've placed the comments across the two columns. Within each factor, each cell is a different respondent. These are some of the stories behind the numbers.

Table 3.6. Some comments from respondents on how different factors enabled or inhibited AM.

Enabling	Inhibiting
Historical Context	
Industry partners were innovative, took a long term view of things.	The long history of clear-cutting and very little experience with other harvesting approaches was a source of inertia.
This was an effective science-management partnership: involved Willamette NF and HJ Andrews Experimental Forest; positive and innovative attitudes; had full time research-management personnel in ranger district	Landowners were quite restricted in their management options, were resistant to changing anything
There was a good group to begin with; problems with institutional capacity	
Good collaborative environment; 30-40 years ago was strongly inhibiting but not now.	
Young, pro-active staff, open minded but not experienced in AM	
Somewhat inhibiting and somewhat enabling… *Inhibiting*: plan was outdated (>15yrs), they were stuck and there was inertia to overcome when changing to ecosystem based management. *Enabling*: now have gone through 5 iterations of planning, and everyone's used to continual planning.	
Funding	
Substantial funding from both the company and government programs was a key factor in the success of our AM program.	Lack of long term funding for operational activities
This was widely supported by the state and in the governor's office; development spanned an election year, which helped to achieve buy-in from all parties	Couldn't do full range of monitoring ($), had to scale back and try to maintain integrity of the plan
Ample funds. More than $US 7 million (all of Tongass National Forest budget).	Insufficient human resources at regional scale: national forest system funding is down 70% in last 12 years, therefore 70% fewer employees. Policy makers loath to fund AM experiments with uncertain outcomes.
Leadership	
Forest supervisor was a strong champion, very strong on importance of experimental design and value of research; all levels have bought into the program.	Job turnover, champions come and go; mixed levels of commitment
Corporate leadership (CEO level) created the opportunity for change; a team of committed AM champions in the company made it happen.	Risk aversion: AM not yet adopted as essential. Belief in "best practices" is opposite of AM; the incorrect habit of thinking that there is only one way to do management everywhere.
Fred Swanson and John Cissel were champions and a primary reason for success. There was a dedicated position for the project (John).	
Leadership helped to achieve clarity, internally and with the public.	
Defining Problems / Opportunities and Potential Management Actions	
We had strong industry partners willing to look at the big picture of management.	There was considerable resistance to the rigor of AM experiments.
Problems were clearly defined at the outset; potential management actions once "answers" are known is still under development.	
Scoped as a case study so that it would not be perceived as an excessively wide project.	
We had a clear focus on the key questions. Researchers see thousands of questions; AM has to be focused on key questions so that enough resources can be marshaled to answer them.	
Initial ideas gave clarity and strong direction, leading to a 12-year development and maturation period. Project challenged now because the study area was absorbed into another Ranger District.	

Enabling	Inhibiting
Community and Stakeholder Involvement	
Public advisory groups as part of Canadian Standards Association certification helped us build pubic support; engagement of NGOs was also a key component.	Some surveys within communities, but not a driving force. Current challenge: local interests don't want any trees >18" cut, so can't accelerate to old growth conditions.
Project now noted by NGOs like TNC; push for wide-scale application of treatments; 5th experiment now planned for riparian restoration; a better environment for collaboration among agencies; greater willingness to try AM	*Inhibiting:* although broad-based participation, some environmental groups against any thinning (16" max); this results in constrained and dueling science
Had advisory committees from many subject areas; 3 rounds of meetings spanning 5 years of initial planning, helped to identify issues and problems, build understanding and buy-in.	
Mixed. Early on there was a beneficial "advisory committee" involvement, but it eventually ended up in failure; environmental groups pulled the rug after 2 years. Public had little or no capacity for technical involvement.	
Information given out in newsletters, but community not actively involved.	
Planning	
A series of operational-scale experimental sites was planned as an "active" part of the AM program; 9 of 15 sites are established as of 2005.	
Started as –1, now a +1; mixed wood not traditionally a managed resource (unlike monoculture); planning and management has improved as learning takes place.	
Mixed effects. *Positive:* AM become institutionalized through the development of "learning objectives" in a legally binding, concise and powerful NEPA document, linking science with decisions. This facilitated AM, emphasizing evidence and learning objectives for each Purpose and Need section of the document. *Negative:* This planning was tedious, which inhibits AM.	
Organizational Structure & Communications	
Good communication among partners, site visits, lots of email flow and meetings	Difficult to get commitment from fire specialists (trained in suppression); hard to get acceptance from some other resource managers, e.g. wildlife, hydrology
Lots of collaboration among silviculture, wildlife and research people	Somewhat to strongly inhibiting; disciplinary teams worked together more than interdisciplinary teams, creating conflict. But learning objectives created better integration.
We set up working groups for decision making and communication.	
Mixed effects. *Inhibiting*: approaches were entrenched. *Enabling*: infrastructure was present, once the will to make changes was present.	
Executive Direction / Mandate / Legal and Regulatory Structure	
Government cooperation was very good; use of the "retention silvicultural system" required a change to government regulations, which was achieved in 9 months.	Didn't have organizational policy built in; discouraged AM
Collaborative organization with a cooperative agreement with the USFS (land owner); AM is made explicit in the agreement; new approaches are part of the mandate; mutual accountability; emphasis on learning and knowledge.	
There was a strong executive vision of what the system would do: met complex objectives; no turnover problem with staff	Lack of high level commitment. Legal structure (Endangered Species Act) had direct and indirect effects; worry about legal actions by NMFS and USFWS, who were not fully qualified to make key silvicultural decisions. Interpretation of laws inhibited: Rothstein decision halted all new projects for 2 years until environmental groups went to bat.
There was support from various divisions of one forest company, but in another company centralization gradually slowed progress on AM; this project could not be started today.	
Started as +1, now a 0; started strong in 1990s, now drifting toward inhibiting, but project is still going	
Positive: Local initiative was very good; Northwest Forest Plan (NWFP) created Adaptive Management Areas, some of which built nicely on existing initiatives. *Negative:* there were lots of problems/restrictions built into the NWFP due to the focus on endangered species.	

Enabling	Inhibiting
Training of Staff	
Over 250 foresters, managers, fallers, machine operators were given a 4-day training course covering everything from the scientific foundation of our program to worker safety.	Need leadership and training from boss to subordinates; co-workers were against AM project
Lots of training: ecologically based management, adaptive management, biodiversity. Needed open minds to embrace changes; needed to be receptive to new ideas (although this is not the same as being 'trained').	This was inhibiting because of lack of training for the NWFP. Managers were open-minded to science (e.g. random allocation was not natural to them, but they became convinced); multiple definitions of AM was confusing.
Did AM training modules at start. Industry people wanted to figure out what to do quickly, and then do it immediately; but they needed to learn to wait for research trials to be completed.	Source of inhibition: failure to recognize change issues; underestimating (corporate) cultural and training inertia
How Science and AM is Conducted	
High quality science: many replicates, published reports	Poor integration across disciplines *vs.* integration within disciplines. Scientists had problems with advocacy (e.g. Biscuit Fire: one group advocated massive harvest of burned trees; this invoked a vehement counter-reaction from another group. AM experiments could have helped to resolve this conflict.
An international scientific panel was set up to advise us on the scientific validity of the program.	
Reviews; academics were joint participants	AM takes too long (> 2yr minimum, and 5-10 yr actually required) for organization to support or pay for from the point of view of operations
	Project failed because of too much rigor and too high a cost, too long a time line for Active AM in an operational setting. Passive AM might succeed, with less monitoring. Work that was initiated is continuing as passive AM (vs. business as usual)

3.2.4 The elements of AM

Table 3.7 shows the project grade assessed to each project, and the steps in the AM cycle that were included in each project. To facilitate comparison, the order of the projects is the same as in Table 3.4.

In four cases, uncertain responses about the final steps in the process are due to the project not yet having reached these stages. While there may be intent to complete them, at this time the outcome is uncertain. One project with a grade of A did not explicitly include the design step, and the respondent for one of the B grade projects was also uncertain whether the project should be credited with an explicit design step. One of the A grade projects did not complete the final step in the AM cycle, suggesting that a further iteration of the cycle is not anticipated. One of the projects graded as C was terminated after second step in the cycle. In each case, the lack of evaluation of the results raises a question as to why the respondents would assign a grade of B or C, rather than F.

Table 3.7. Comparison between the assessed project grade and the steps in the AM life-cycle included in the project. Table entries for steps in the cycle that were included in the project (Y) are shaded light grey, and those that were not included (N) are shaded darkest grey. Uncertain responses (?) are shaded in medium grey. Black shading in the project grade column indicates a project for which the lead agency was either a private company or non-government organization.

Project Grade	Assess & Define Problem	Design Actions	Implement Actions	Monitor	Evaluate Results	Adjust & Revise
A	Y	Y	Y	Y	Y	Y
A	Y	Y	Y	Y	?	?
A	Y	Y	Y	Y	Y	N
A	Y	Y	Y	Y	Y	Y
A	Y	?	Y	Y	Y	Y
A-	Y	Y	Y	Y	Y	Y
B+	Y	Y	Y	Y	Y	Y
B	Y	Y	Y	Y	?	?
B	Y	Y	Y	Y	Y	Y
B	Y	Y	Y	Y	Y	Y
B	Y	?	Y	Y	Y	Y
B	Y	Y	Y	Y	Y	Y
B	Y	Y	Y	Y	Y	Y
B	Y	Y	Y	Y	Y	Y
B	Y	Y	Y	Y	?	?
B	Y	Y	Y	Y	?	?
B-	Y	Y	Y	Y	Y	Y
C	Y	Y	Y	Y	Y	Y
C	Y	Y	N	N	N	N
C	Y	Y	Y	Y	Y	Y

When looking at the overall number of projects for which any of these steps received a positive rating, all steps were considered enabling by 13 or more projects (Figure 3.9a). Steps 1 (assess) and 4 (monitor) rated the highest. Step 1 (assess), 3 (implement) and 5 (evaluate) each received the most (five) ratings of +3 (a primary factor of success). Steps 1, 3 and 4 appear to be slightly more enabling for government-led projects, and steps 4 and 5 slightly more enabling for projects led by the private sector (Figure 3.9b), but there are really no striking public-private differences.

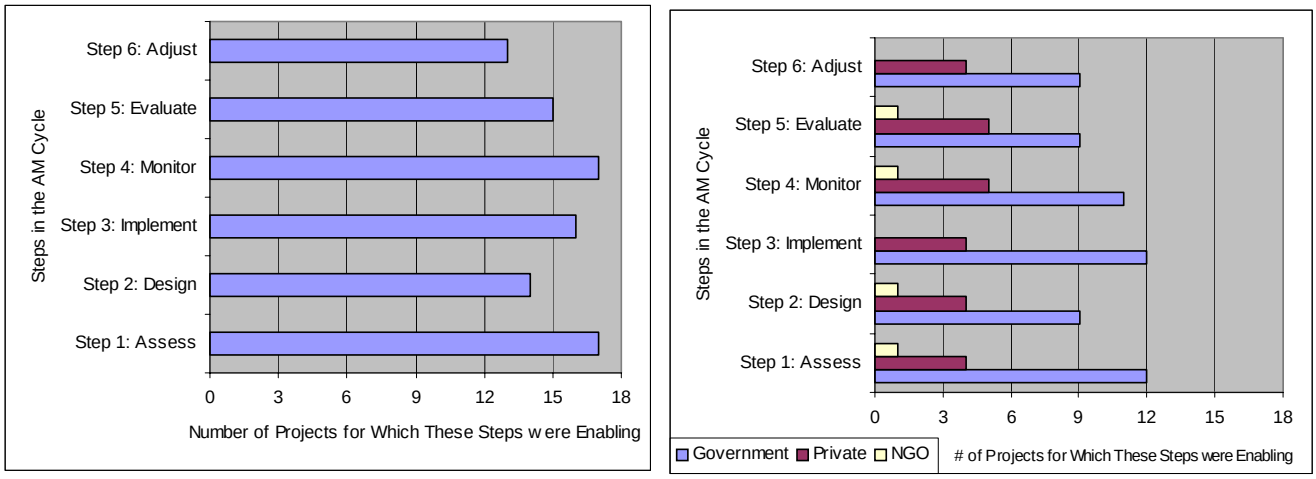

Figure 3.9. Number of projects rating each step as enabling: a) across sectors, and b) by lead sector.

Step 1 (assess) is the only factor that was not considered inhibiting by any of the projects surveyed; all other factors were considered somewhat inhibiting (rating of -1) by at least one project, and step 2 (design) was considered somewhat inhibiting for two projects.

Despite these few challenges with step 2, the overall results suggest that all of these steps are important. When looking at the number of projects for which any of these steps received a positive rating, all six steps were considered somewhat enabling, strongly enabling or a primary factor of success in more than two-thirds of the projects surveyed (Figure 3.10). Examining these results by sector (Figure 3.11) suggests that the latter part of the cycle (closing the loop) was considered more enabling in private sector projects (Figure 3.11).

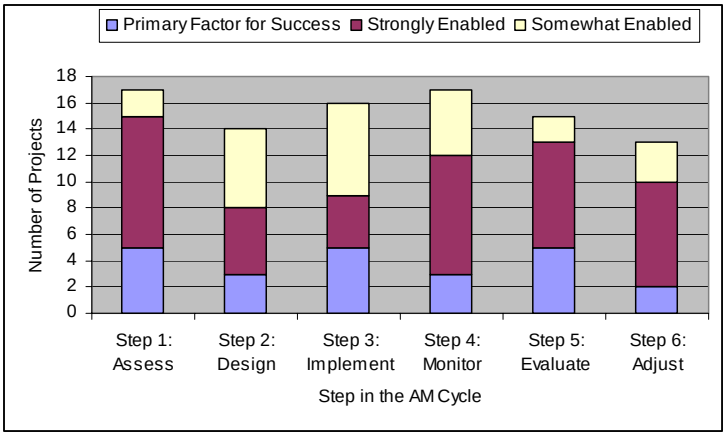

Figure 3.10. Importance of enabling steps across the projects surveyed.

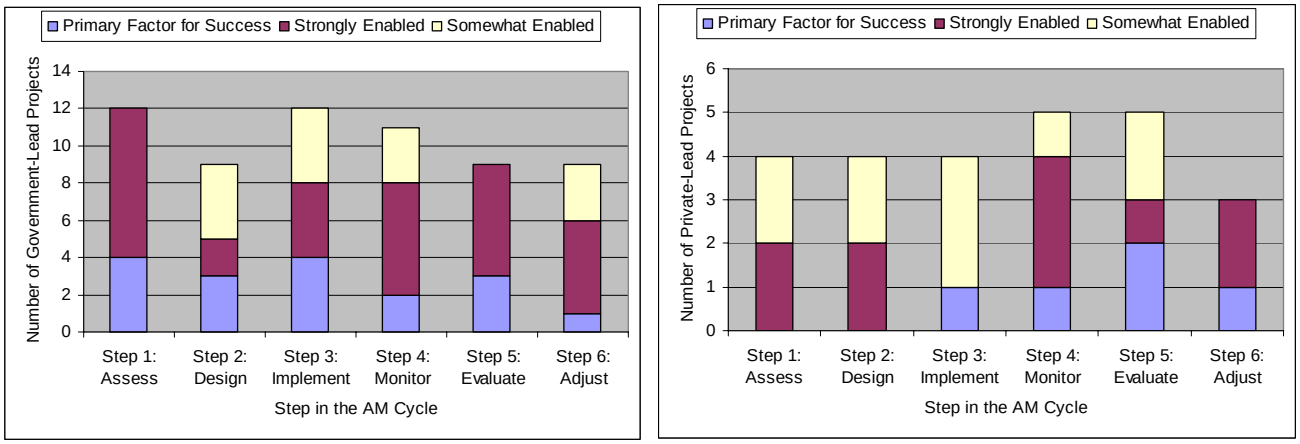

Figure 3.11. Importance of enabling steps across the projects surveyed for projects led by a) government and b) the private sector.

Figures 12 to 17 examine the specific elements of the AM process by lead sector. None of the projects in our sample included all elements in all six steps of the AM cycle. Table 3.8 shows, for each step, the distribution across lead sectors of the number of projects that do include all of the elements.

Table 3.8. The number and distribution across sectors of projects incorporating all elements of each step in the AM cycle.

Step	# of elements in each step	Number of projects incorporating all elements			
		Total	Government-led	Private-led	NGO-led
1: Assess	12	4	3	1	0
2: Design	11	0	0	0	0
3: Implement	3	13	9	3	1
4: Monitor	2	15	11	4	0
5: Evaluate	5	0	0	0	0
6: Adjust	3	13	7	5	1

Examination of the elements of step 1 (assess) that were included in the projects surveyed reveals that all of them had clearly-stated management goals/objectives and involved scientists, and almost all involved managers, identified spatial/temporal boundaries, and identified indicators (Figure 3.12). Identification of key uncertainties and articulation of key hypotheses to be tested were the least common elements across our sample, followed closely by exploring alternative actions and building conceptual models. The patterns are very similar when comparing government-led and private sector-led projects.

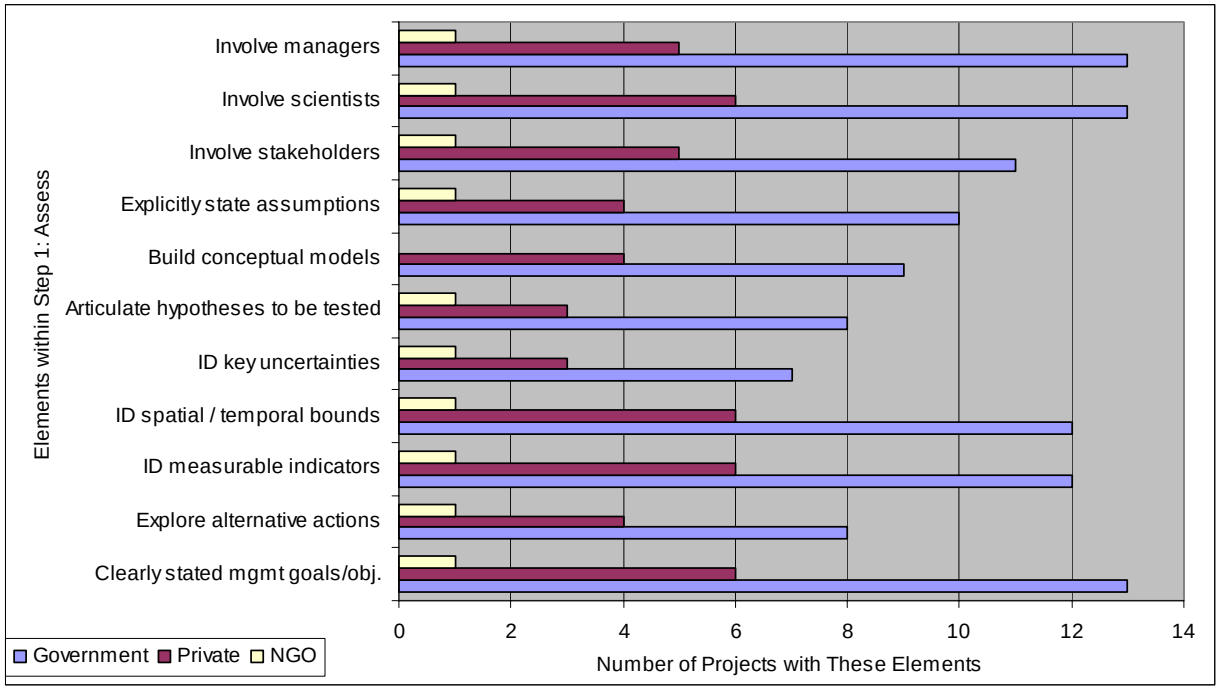

Figure 3.12. The frequency of Step 1 (Assess) elements across the projects surveyed, by lead sector.

Across all projects surveyed, having a monitoring plan was the most common element in step 2 (design) (Figure 3.13). While the prevalence of a monitoring plan was evident across sectors, least common among government-led projects was a consideration at this early stage in the AM cycle about what might be done if the outcomes of the management experiment were not those expected; and least common among projects led by the private sector were statistical advice and peer review.

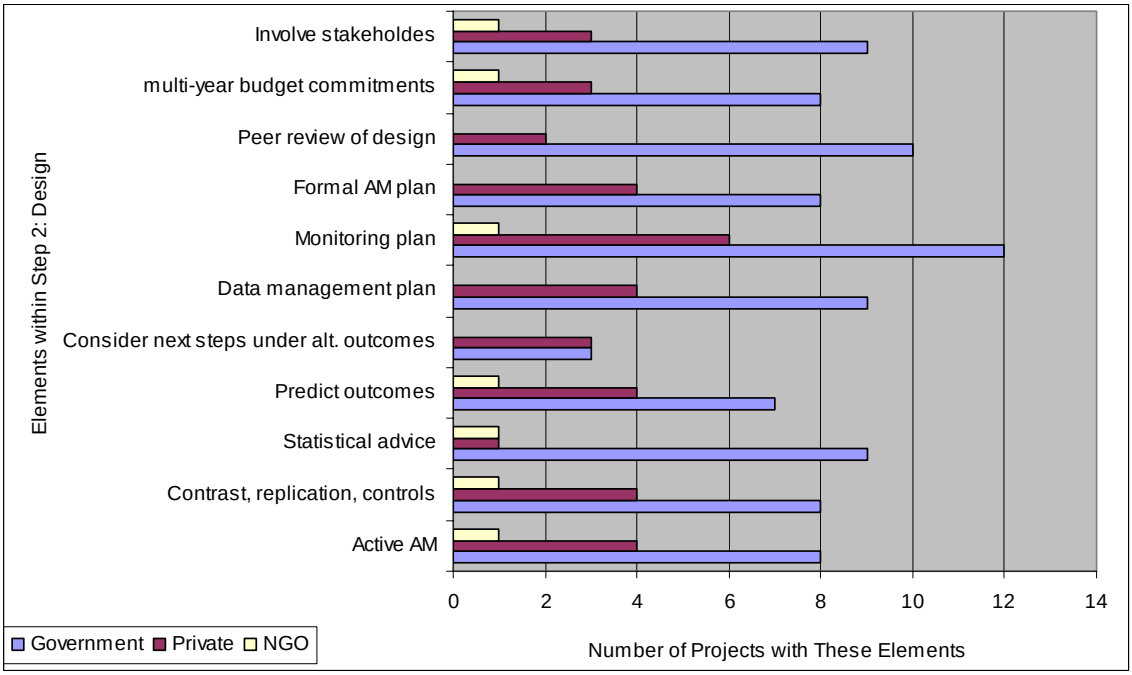

Figure 3.13. The frequency of Step 2 (Design) elements across the projects surveyed, by lead sector.

At least 84% of the nineteen projects in our sample that made it to steps 3 and 4 included all of the elements of these steps, with little difference between sectors (Figures 14 and 15).

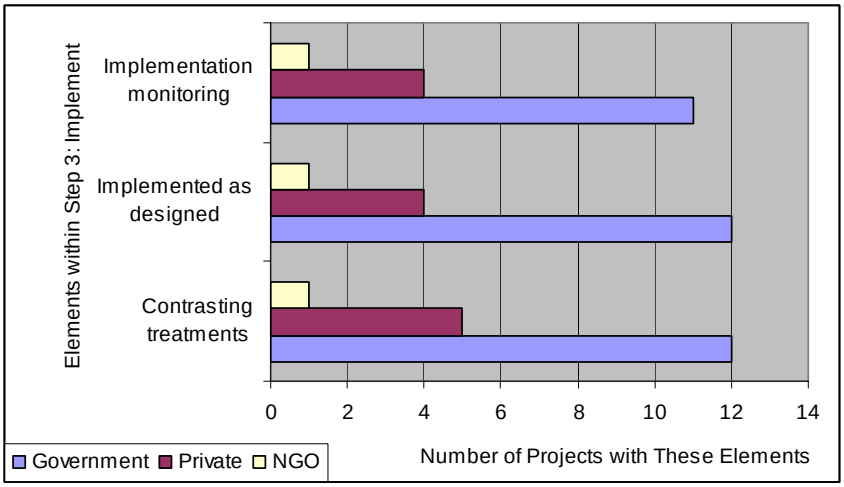

Figure 3.14. The frequency of Step 3 (Implement) elements across the projects surveyed, by lead sector.

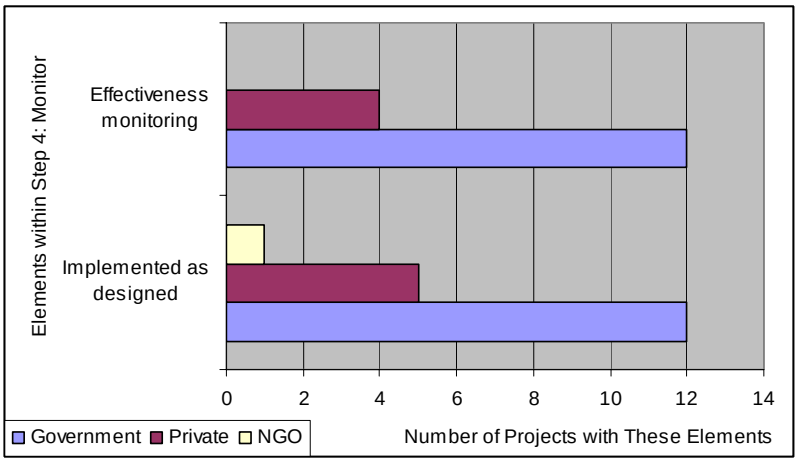

Figure 3.15. The frequency of Step 4 (Monitor) elements across the projects surveyed, by lead sector.

Of the fifteen projects that made it to step 5 (evaluate), all but one compared results against management goals/objectives (Figure 3.16), but few compared results against model predictions (likely reflecting the fact that fewer used conceptual models in step 1). The biggest difference between sectors is the relative frequency of statistical or analysis advice (less frequent in private-led projects).

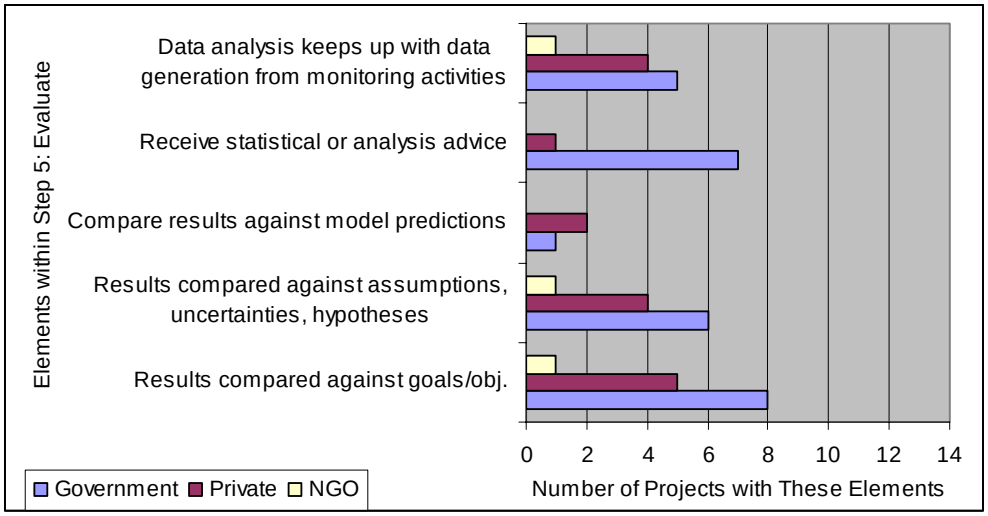

Figure 3.16. The frequency of Step 5 (Evaluate) elements across the projects surveyed, by lead sector.

Of the fourteen projects that made it through step 6 (adjust), thirteen included all three elements (Figure 3.17). Figure 3.17 shows more than this number, because of the six projects that were not considered to make it as far as this step in the AM cycle, the respondents for two still felt that learning occurred in their projects, and one of these also felt this was communicated to decision-makers. The frequency distributions were similar across sectors.

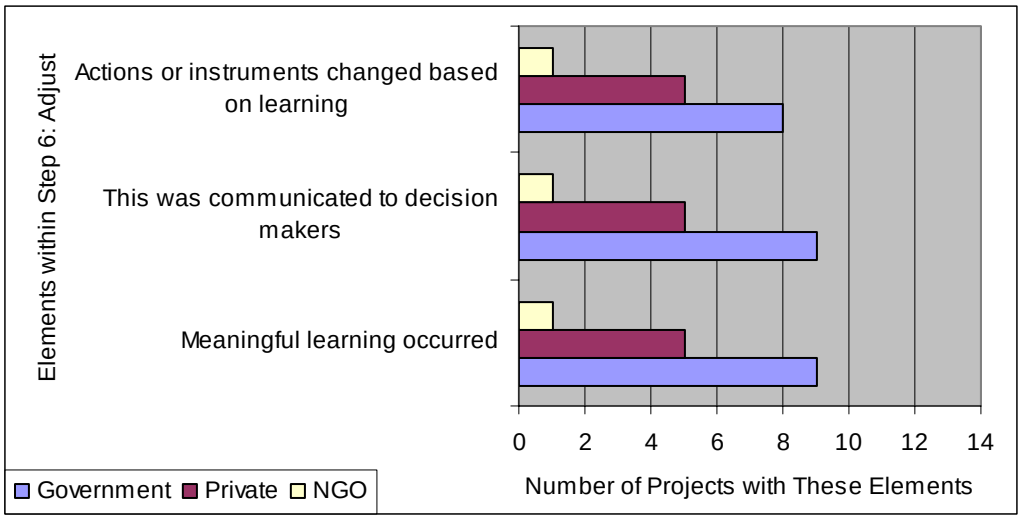

Figure 3.17. The frequency of Step 6 (Adjust) elements across the projects surveyed, by lead sector.

Figure 3.18 shows the elements included in each project in a slightly different way, by comparing the percent of government-led projects including elements within each step with the percent of private-led projects including the same elements. Differences between the two bars are most evident for:

Step 1: Assess

- A higher proportion of government-led projects involved managers and articulated hypotheses to be tested.

Step 2: Design

- A higher proportion of government-led projects involved stakeholders, multi-year budget commitments, peer review of design, and statistical advice, whereas
- A higher proportion of private-led projects predicted outcomes, and considered next steps under alternative outcomes.

Step 3: Implement

- A higher proportion of government-led projects implemented the project as designed in Step 2, and included implementation monitoring.

Step 4: Monitor

- A higher proportion of government-led projects included effectiveness monitoring.

Step 5: Evaluate

- A higher proportion of government-led projects received statistical and/or analytical advice, whereas
- A higher proportion of private-led projects had data analysis keep up with data generation from monitoring activities, compared results against model predictions, compared results against uncertainties, hypotheses and assumptions, and compared results against goals and objectives.

Step 6: Adjust

- A higher proportion of private-led projects lead to changes in actions or instruments based on what was learned.

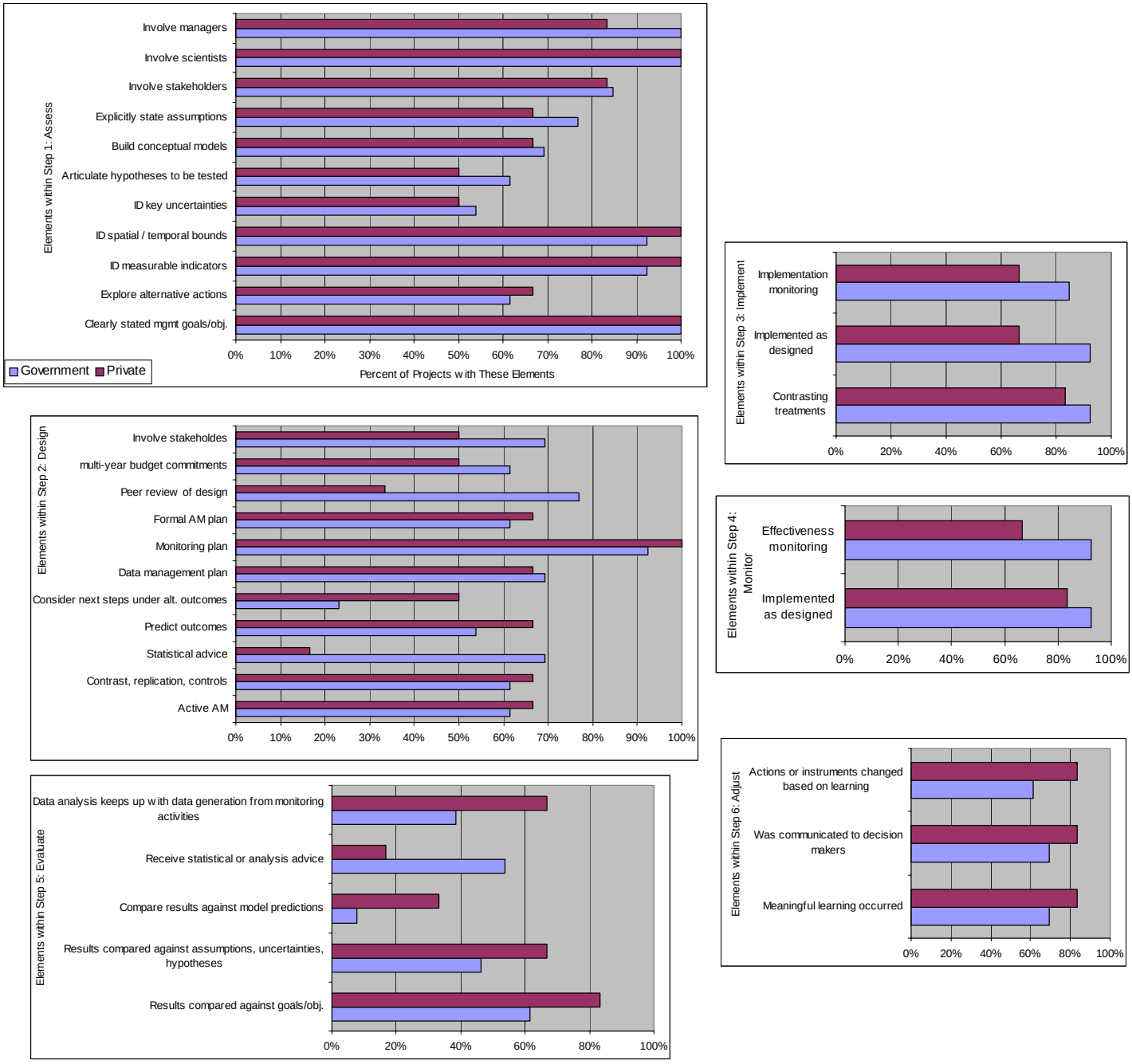

Figure 3.18. Comparison of elements included in each of the six steps between government-led and private-led projects.

One reason for including questions about the AM elements in the survey was to see if there was any correlation between overall success and any specific elements. We hoped this might provide another clue as to enabling factors. Figure 3.19 compares the percent of grade A projects (those graded A or A-) incorporating each element in each step with the percent of projects graded B or C (including B+ and B- grades) incorporating these elements. Differences between the two bars are most evident for:

Step 1: Assess

- A higher proportion of grade A or A- projects built conceptual models and explicitly stated assumptions, and a much higher proportion explored alternative actions; whereas
- A higher proportion of grades B and C projects identified spatial and temporal bounds, and a much higher proportion articulated hypotheses to be tested and involved stakeholders.

Step 2: Design –

- A higher proportion of grade A or A- projects included contrasts, replicates and controls, and a much higher proportion included a monitoring plan; whereas
- A higher proportion of grade B and C projects involved stakeholders, had multi-year budget commitments, included peer review of the project design, predicted outcomes, considered next steps under alternative outcomes, sought statistical advice, and involved active AM.

Step 5: Evaluate – a high proportion of successful projects compared monitoring results against assumptions, uncertainties, and hypotheses, and also against goals and objectives.

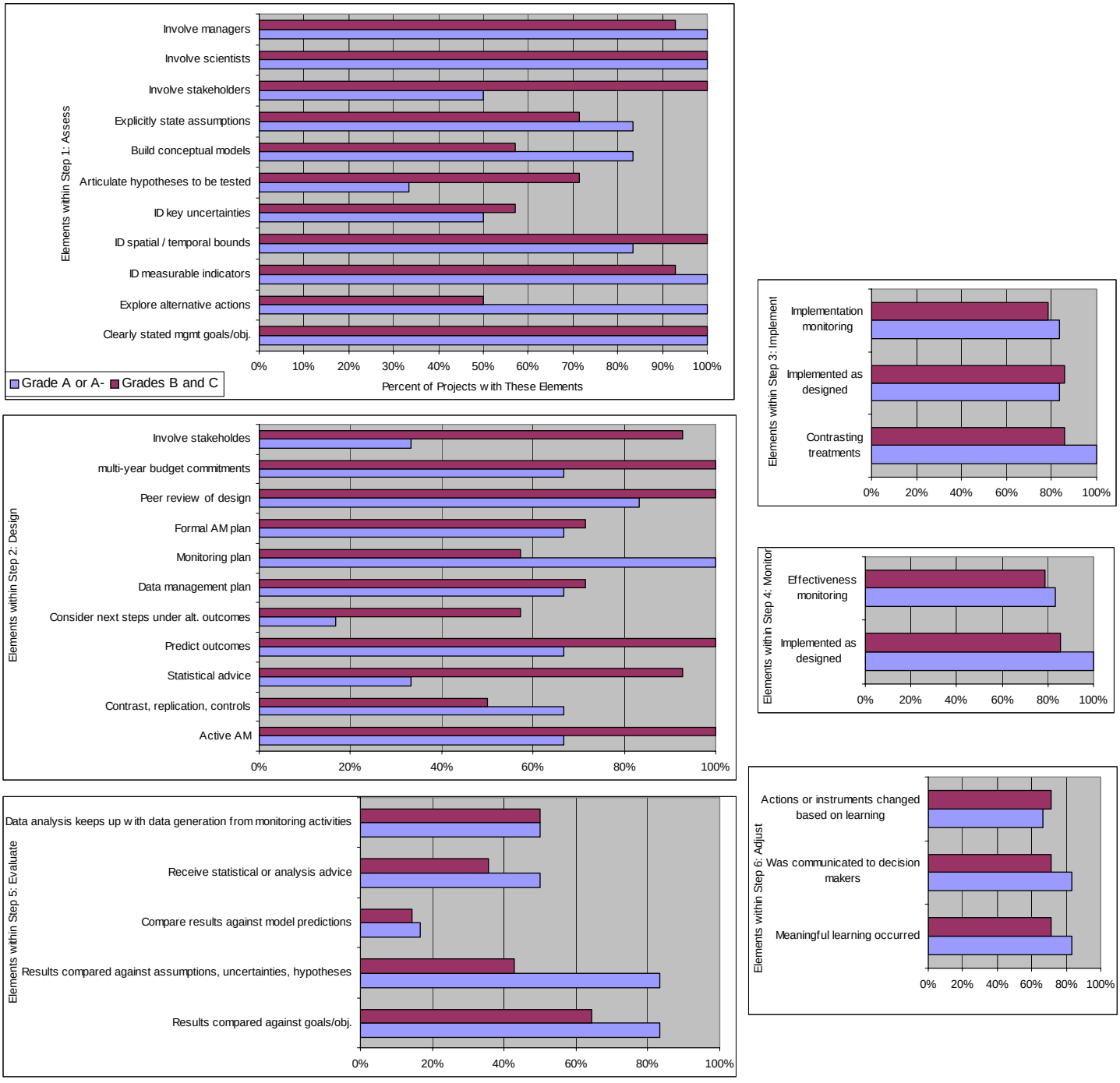

Figure 3.19. Comparison of elements included in each of the six steps between grade A projects and grades B and C projects.

Table 3.9 provides some comments from respondents on how about how management actions or policy changed as a result of AM experiments, which relates to step 6 in the AM cycle. Confirmation of such actions in project documentation is critical to objectively determining the outcomes of AM experiments, and independently corroborating respondents' subjective grades of their project's level of success. In this

project we did not however have sufficient resources or documentation to conduct a thorough corroboration of all projects, and relied on largely respondents' opinions.

Table 3.9. Selected survey responses about how management actions or policy changed as a result of AM experiments.

- We set a guideline of 0.25 ha for variable retention group size, with groups no more than 4 tree lengths apart. We implemented this approach for 3 years and monitored the results. We learned that there were potential drawbacks of this approach from both operational and biological perspectives (e.g. expensive and difficult cable yarding sites, safety concerns led to removal of snags which reduced cavity nesting habitat, other monitoring suggested beetles, amphibians and birds preferred larger patches). *Solution*: we modified our guidelines to allow "large patch retention" where groups must be at least 0.5 ha, but spatial distribution was more flexible.
- We set a target of 100% variable retention (VR), phased-in over 5 years at 20% per year. We learned that there were circumstances where our VR guidelines were not relevant or practical (e.g., land sales, hardwood management, catastrophic windthrow, near power lines). *Solution*: we modified our guidelines to allow exceptions to VR guidelines.
- Results of AM project now in a rule of the Oregon Forest Practices Act, sent to the Oregon Forest Policy Board for deliberation on small and medium fish-bearing streams; in use by other state agencies.
- Management *locally* was revised in significant ways, some regional plans were indirectly changed, and may still be evolving in response to this project (e.g. NW Forest Plan revised the riparian management plan based on "watershed analysis" from this project, but nothing was ever implemented. The *template* for the plan was based on the Blue River AM experience).
- (1) Pioneered emphasis on learning objectives in NEPA documents; (2) developed landscape scale EIS that was eventually applied in a couple of other cases, e.g. Biscuit Fire and set new direction in regional office; (3) Thinning in late successional reserves (wide spacing, 40/ac) was originally questioned by fish and wildlife departments and environmental groups, but they are now fully behind this practice.
- Increased use of prescribed fire after mechanical treatment; usage of smaller diameter trees; various treatments for fire behavior manipulation. Attempted to market woody biomass and small diameter trees (not however successful).

3.2.5 Perspectives on public and private sector AM

There were a wide range of answers when respondents were asked whether they agree or disagree with the statement that "AM is working better in private sector forest management than in public sector forest management" (Figure 3.20). Over half of the respondents were either neutral on the statement, or did not know, and these answers came from both private and public sector respondents. Three respondents, all from the government sector, disagreed with the statement. Two respondents, also from the government sector, agreed somewhat. Four respondents agreed strongly with the statement; three from the private sector, and one from an NGO. The results suggest (not surprisingly) that respondents who gave a non-neutral opinion were somewhat loyal to their own sector.

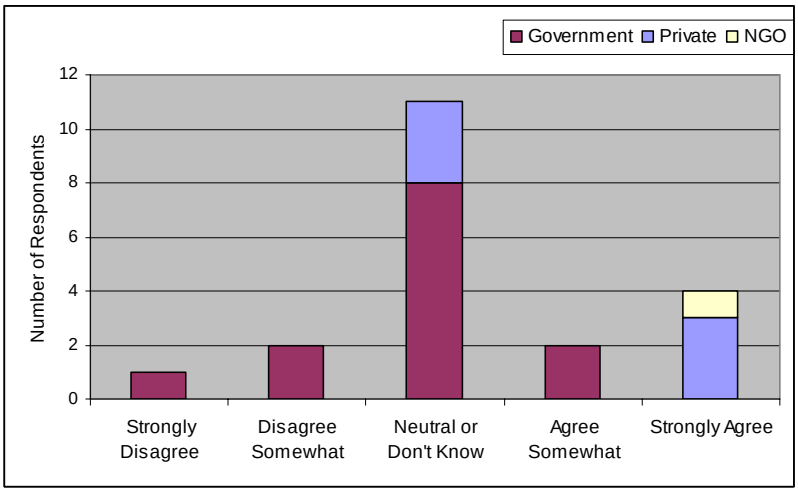

Figure 3.20. Perspectives on whether AM is working better in the private sector.

3.2.6 Additional insights

Tables 10, 11, 12 and 13 present insights offered by participants in response to some of the open-ended questions that provide the greatest opportunities to share wisdom regarding AM. We have tried to organize the comments into themes, shown in the first column of each table. The number in brackets after each comment corresponds to ID Code for each respondent, from Appendix 3. In most cases these are comments that were provided verbally during an interview, and while we attempted to capture what was as accurately as possible these should not be considered verbatim quotes.

Table 3.10. What guidance would you give to others undertaking an AM approach to forest management?[6]

Theme	Responses
Leadership	Find knowledgeable and committed champion; support from above for uncertainty and risk; plan for the entire AM cycle [1]
	Recognize the need for cultural change and adequately plan and provide resources for the process of cultural change; recognize the "people" side of change [8]
	Don't: revert to top-down decision making; become inflexible about planning [13]
	Be patient; organizational barriers are large; persistence is required; anything new is difficult [11]
	Get leadership to buy into to process; that will spur organizational buy-in; solicit from a wide range of interests; be afraid but don't be afraid (!); initial uncertainty about direction will sort itself out and movement forward will happen [13]
	Develop a clear vision of what the change will achieve and reach out to groups beyond forestry to build support. Identify and empower a "champion" to lead the project. [20]
Operational Relevance	Questions need to be important to operations, which operate at a 1-2 yr timeframe [2]
	Implementation isn't necessarily expensive; AM can often be achieved from Active Management with a small amount of additional effort. [5]
	Necessary to understand the management goals/objectives, since those drive the science goals/objectives (7)
	Learning about the other partners' needs are important. In this case it is the forest licensee, who has a planting and operations cycle that is not at first obvious to outsiders (biologists) [14]
	MOU is useful – put relationships, agreements in writing [15]

[6] Question B-14 in the survey.

Theme	Responses
Time Frame	Must focus on short-term goals [2]
	1: recognize the time frame required; 2: line up the funding required to implement and monitor; 3: line up the champions to support it [4]
Scope	Don't try to measure / monitor everything; it is better to do a few things well than a lot of things poorly. (6)
	Establish a formal AM process with monitoring and infrastructure, commitment to apply lessons; use existing models and programs as a guide; develop links for academic involvement (NAU, ERI), engineering (for wood utilization) [12]
	See primary factors (B8) science-management blend; politics/policy were an outside constraint; need flexibility to go outside the current BMP boundaries; having more stakeholders (eg NGOs) might have helped [10]
	Keep the science separate as free from policy influence as possible. Engage highly qualified people in the science and encourage technical debate on the design and outcome of any technical investigation. Force scientists to seek and respond to review. Engage skilled, knowledgeable policy people that can accurately judge scientific outcomes and lead their constituents to solutions. [18]
Buy In	Practitioners need to buy in to AM; plan needs to be flexible enough to withstand last minute changes; multi-year funding may cause unexpected costs (e.g. replace all goat collars in Mtn. Goat study, because of funding delay); response variables should be as fast as possible: 1-2 yrs; shift in questions: results come back and management wants to change instantly, forgetting what the questions were. [3]
	Reasons for success: 1) management buy-in at all levels; 2) collaboration between researchers and managers; 3) proper design of experiments, with contrasts [5]
	Operational staff must have sufficient "buy-in" to the approach (this will not happen immediately, so training and leadership are essential) [6]
	Partner with others. Seek outside advice and collaboration; no one can afford to go it alone [6]
	Importance of stakeholder involvement in review committees [7]
	Necessary to emphasize the certainties and uncertainties in the results [7]
	Understood, supported, accepted… the results [7]
	Find common larger goals, listen!; do on-ground demonstrations: e.g. timber sales, prescribed burns [9]
Others	Collect sufficient data on potential variables to minimize incorrect assumptions. Use photo-documentation! A picture tells a thousand words. Over time you create a volume [16]

Table 3.11. If you could start your AM project over again and change one thing to make it more successful, what would that be?[7]

Theme	Responses
Organizational	Official recognition from executive level, top level mandate to do AM; document properly and tell the story [1]
	Top management needs to make an informed decision about the need for active AM; they don't want to be involved at the level of detail at which it takes place, but they need to buy into the concept; performance measures that managers pay attention to must be consistent: they are currently focused on short term cost; there must be rewards for managers who do AM [2]
	Would do more to explain the importance of change management, why it is necessary [8]
	Should have started earlier with bringing fire people on board, encouraging buy in; same with wildlife [9]
	Formalize the AM plan [12]
	Ecosystem management and biodiversity are terms that have a negative connotation for some groups; would probably use the word 'sustainability' as a more neutral term [13]
	Establish an MOU at the beginning; design harvest timing and block location to improve the project design [15]
	Use a regimented step process to implement and track projects done in the AMA [17]
	Withhold funding and force the technical projects to compete for resources. Put more published and experienced scientists on the technical committee and encourage them to work together to develop better, more timely and efficient monitoring projects. The bucket of questions was too big and the pot of money was too large for a new organization without very top notch management in place to take on. The result is a lot of wasted money and time. Our negotiated policy solution should have been very much more specific as to the priority of technical investigation and the money should have been spent up front to hire the best natural resource science program manager that could be found. [18]
Implementation & Design	Probably would stress the Evaluate and Adjust more in the original design [3]
	Shortening the plan/design time frame would have helped to keep the momentum going [4]
	More fully integrate the silvicultural questions and monitoring into the AM program. The AM program was built around the biodiversity questions, and silviculture monitoring has proceeded alongside, but not fully integrated with, the AM program. [6[
	Improve the design: replication, randomization, reduced uncertainty [7]
	Would redesign the project with better spatial replication, more watersheds, treatments randomly within blocks. Missing pre- and post- harvest data [14]
	Tighter and more real time linkage between the monitoring and revision of prescriptions. [20]

[7] Question E-3 in the survey.

Table 3.12. What advice would you give to someone just starting to implement AM?[8]

Theme	Responses
Leadership	Top management needs to make an informed decision about the need for active AM; they don't want to be involved at the level of detail at which it takes place, but they need to buy into the concept; performance measures that managers pay attention to must be consistent: they are currently focused on short term cost; there must be rewards for managers who do AM [2]
	Expect to keep discovering; need to be committed for the long haul and involve all stakeholders [9]
	Requires flexibility, courage, acceptance of uncertainty [13]
Planning	Use AEAM approach from the very beginning, at scoping and design stage; need executive support for long enough to make the $ and personnel investment worthwhile [1]
	Need a bit more institutional structure; have managers involved in defining the questions; can cause problems taking ecology into the institution!; ecologists need to see management as integral to the ecosystem, not just an effect; decision process is critical to ecosystem processes [11]
	Assemble and do the necessary prep work to get policy people and the science people to trust each other to do their job in the best interest of their constituency. [18]
	Get an MOU; stand alone funding is a big benefit [15]
	Write the AM plan down on paper, have all stakeholders and implementers sign off on it [12]
	Have secure funding, clear questions, well-designed study [14]
	Train in the AM process, be systematic, and involve a scientist/researcher from the get go [17]
	Recognize and respect the economic consequence of an action and seek alternate technical solutions that are favorable to economic interests. Dire natural resource consequences will be recognized by economic interests and most often responsible parties will respond and adjust. But pushing science for the sake of science without as clear notion of why it is important to the resources will discredit the process. [18]
Communication	Forestry operations are expensive and changes to operational practices (as a result of AM) may not be considered when operations are conducted: good communication with operational staff is necessary to see that harvest operations are actually changed [3]
	Make the management objectives more clear [7]
	Plan and resource for change management; recognize the "people" side of the equations; they tried to push the technical team to do the project in 18 months when they had been told by them that it would take 24 months; need to listen better [8]
	Be clear where the important uncertainties lie and focus on the worst first. Don't try to satisfy every discipline with a crumb of the action unless there is a real question in an area that needs an answer. [18]
	Scientists can advocate for more detailed work in an area or direction that they are particularly concerned about, but then should not try to influence anticipated results by manipulating experiments. If there are multiple interests involved, be sure that the technical folks from each caucus can work together to produce science and that they will trust their policy counterparts to hold up their end. [18]

[8] Question E-4 in the survey.

Table 3.13. Did you learn anything about the AM process as a result of the project?[9]

Theme	Responses
Rigor	Challenge of passive AM: to give it sufficient rigor and documentation; otherwise it will just become anecdotal (and there is lots of anecdotal already) [2]
	Feedback and Adapt/Adjust could be improved; there is a difference between large scale projects and AM (i.e. the last step), otherwise it is just a large scale experiment [3]
	If AM proponents make it too rigorous it will kill it [2]
	Adjustments need to be adhered to (sub-cycles where plan is tweaked) [12]
	Have a good design [14]
Practicality	AM in operations: the context has to respect the needs of operations people (and their timeframe) or it won't fly [2]
	Important to be results-oriented for practical problems (not just abstract research) [5]
	Lots of on the job training (OJT) happened; AM is possible, requires broad participation from scientific and management communities; turnover of staff can be incorporated [10]
	"Need to get theory on the ground"; a physical model is much more important than a theoretical construct; need to have a manager/leader who is not averse to risk; pilot projects are good, but managers need to accept risk; need to find appropriate scale for leadership, including forest supervisor (champion), with buy-in from district ranger, and not the other way round. [11]
	Reinforced the value of operational scale projects (vs. small research plots that may not be applicable to real world forestry); AM accelerates learning at the large scale [4]
	This is the only way to do business today; change is too rapid for any other approach to resolve questions [13]
Communication	Have good communication with other partners (licensee) [14]
Others	There are few if any absolute scientific answers to the complex natural resource issues that we face today [18]
	Human endeavors have and are irrevocably changing the face of the earth in opposition to the tenets of conservation biology. The conflict is philosophical as much as it is scientific and keeping the science separated from the philosophy during research is very difficult. [18]

3.3 Workshop discussion of enabling factors

We convened a workshop in Portland, Oregon in early April 2006 to provide an opportunity to gain the insights of AM practitioners regarding the results of the project, especially in regard to factors that enable adaptive management. We invited everyone who participated in the survey to attend the workshop (a list of workshop participants is provided in Appendix 5). The workshop began with a brief presentation and discussion of the findings of the survey, and then the rest of the time was spent discussing the factors that serve to enable adaptive management. To facilitate a systematic consideration of the factors, participants were asked, for each of the ten factors addressed in our survey, to think about three key questions:

1) When and why is the factor critical?
    - Could there be situations in which the factor is disabling rather than enabling?
    - In what sort of situations might the factor not be important?
2) How do you know whether this factor will be enabling for a given project?
    - Insights on how to diagnose whether a factor will be enabling.
3) What can be done to create an enabling situation?
    - Insights on strategies for success.

[9] Question E-6 in the survey.

The discussion at the workshop affirmed the importance of each of the ten enabling factors explored in our study, and it was suggested that they be thought of in a hierarchical fashion (Figure 3.21).

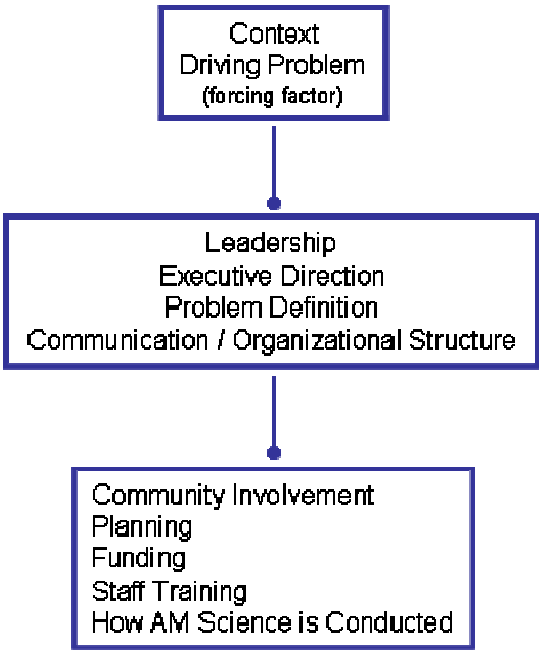

Figure 3.21. Hierarchy of factors that enable adaptive management.

The context, both historical and current, is key to providing the reason for an adaptive management initiative. It can also have important implications for the relationships between a management organization (government agency or private firm) and stakeholders concerned with the conduct of an adaptive management initiative. Once the need for an adaptive management approach is recognized, leadership, executive direction, the problem definition, and communication / organizational structure all play critical roles not only in the decision to proceed, but also in helping to sustain a project throughout the adaptive management lifecycle. The other factors: community involvement, planning, funding, staff training, and how AM science is conducted all play important roles in permitting AM to be successful. Below we summarize workshop discussions on each of these factors, including (in boxes) short statements from the participants that we found very helpful to drive home critical points.

3.3.1 Historical and current context

First, you need some problem or some driving force to get an AM project started.

Historical context is a critical dimension for several reasons. Firstly, it is typically what gives rise to the recognition that there is a problem that might be addressed through an adaptive management approach. In some instances, however, existing legislation can serve either to inhibit or prevent adaptive management altogether, especially if one or more stakeholders are opposed to the initiative, and if stakeholder relations are adversarial. In this regard the workshop discussion stressed the need to carefully assess the situation and to not assume that the context for the project will be enabling.

There would not have been a Forest Plan if there was not a spotted owl.

The context in which the project arises can cause it to develop in very different ways. For example, in the development of the NW Forest Plan, development of

the Applegate AMA was in some respects an artifact of the existing relationship among stakeholders. In this case the adaptive management approach was very much community-led, and the plan served essentially to federally codify what was already in place. The development of the adaptive management initiative in the Central Cascades developed somewhat differently in taking advantage of the relationship between the research community, and land managers. This relationship had been in place for years, with a high degree of trust and understanding of the respective worlds. Although the specific nature of the relationships which served to enable development of these initiatives was different, in either case what was important were the relationships between key stakeholders.

One needs to be thoughtful and respectful of past experience. It is as mindless to say 'we don't have any experience in this' as it is to say 'we can just use this approach blindly'.

This serves to illustrate a key aspect of historical context for those who need to diagnose other situations: it is very much about site specificity, taking into account social issues. Since the nature of the relationships that are in place will differ from case to case, it is important to pay special attention to understanding the nature of the relationships in place. Doing so will require a dispassionately honest appraisal—a clinical diagnosis.

It may be more enabling to have the social infrastructure than it is to be in the right place physically.

3.3.2 Leadership

Leadership is critical to gaining the support needed not only to begin an AM initiative but to sustain it over time. During the initial stages of developing an adaptive management initiative what is needed is for one person to become the advocate for the project, communicating the need to others and 'selling' it throughout the organization. An important element in this is the willingness to take risk. Securing long-term support for an AM initiative requires it to have legitimacy within an organization, and it is important that people understand why the initiative is needed.

Forest supervisors are important and extremely powerful; their involvement can make all the difference in the world.

Depending on the organizational structure and culture, the leadership role may be easier to fulfill at a higher or lower level, but regardless of where the need for the project is first recognized or first promoted, clear determined leadership will be important for gaining lasting support. The leadership role may change over time as an initiative moves through the AM cycle from initial concept to implementation, monitoring and evaluation. An initiative that is initially proposed at an executive level may end up being led in the longer term at a program level. Leadership is critical at the programmatic level (state forest program manager, community, or private forest manager) where issues are defined, and how they will be dealt with is determined. Leadership at the field level is also important.

In some cases projects that were initiated with top-down leadership—but did not have support at lower levels—did not work well in the field, suggesting that leadership at the local levels is important for success. This does not mean that top-down initiatives cannot be successful, but when AM projects are initiated from the top down, it is important to also create the conditions that will enable success by securing support at lower levels of the organization, e.g. by providing the necessary staffing and budgets. In this regard, it is also important to integrate the initiative in the organizations performance metrics. Is unfair to individuals to ask them to do undertake a project when their performance is based on other factors, and AM must be part of what is measured for performance at the field level. On the other hand, in organizations where hierarchy is important, an initiative may not

Support at senior levels is probably enough if you have leadership at the field level, as long as that is something that is measured in performance.

succeed despite strong leadership at lower levels if there is not support from higher levels. It is also important that leadership be sustained, and the organizational system support the replacement of key people, or the initiative will die when they leave.

Leadership is thus essential but not sufficient for success: a common theme in the workshop discussions was that support is important from all levels of an organization. Regardless of the level at which leadership for an AM initiative may be rooted within an organization, a key attribute of successful leadership is effective communication that gains broad support throughout the organization. In our survey of 20 AM projects, respondents consistently indicated that leadership strongly enabled AM, *regardless* of AM project grade, reinforcing the conclusion that leadership is necessary but not sufficient for good outcomes.

3.3.3 Executive direction (corporate culture)

Depending on the level within an organization at which the need for an adaptive management approach is recognized and promoted, executive engagement may arise as either executive direction or as executive support. Regardless of how it occurs, it must be clear that there is strong executive commitment to the success of the AM initiative. Experience has demonstrated the importance of this in both positive and negative contexts. In the development of the (BC) Coast Forest Strategy senior management initially provided clear direction that a new approach was needed, and which was subsequently defined as AM by managers at the project management level. The executive direction was critical in spurring the company to action. Following a later change in ownership, however, when the new executives did not reiterate clear support for the initiative, support from other levels of the organization began to erode, due to a lack of broad support within middle management. As with leadership, executive direction /support can erode over time as personnel change, and incorporating the goals of the AM initiative into the organization's performance measures may be an important means to help to maintain broad support.

Organizational buy-in indicates an agreement —and this is an ingredient that is fundamental to getting the results incorporated into closing the loop.

Current institutions are not designed to carry out AM. … I don't know a single organization that has AM built into its corporate culture.

In some cases, where there appears to be a legislative mandate for AM, it should not be assumed that it alone is sufficient. There is a big difference between executive direction from within versus direction from some rule. Clear executive direction is important in avoiding the traps associated with crisis management. In large measure, the critical need for clear executive direction is due to the fact that current institutions are not designed to carry out AM.

Transforming institutional culture to embrace the uncertainty within which management must be conducted, and to seek out ways to effectively manage in the face of uncertainty, will take time and it is important to start thinking about the implications for educational programs.

We get graduates with new ideas, but then we beat it out of them by the existing rules within industry or government. Young energetic people come out wanting to try these things, but we say "no, you can't do that" and they give up. We beat it out of them, and then it is gone.

3.3.4 Definition of problem

What we've learned is, pay now or pay later. Take the time to put the effort in up front, or you will need to do it later. If you don't do it, you are in trouble all the way through.

Because the problem definition used to frame an adaptive management initiative will establish the focus for subsequent work it is important to invest in getting it right. Failure to be clear about what the problem is will lead to later difficulties in maintaining an appropriate and effective focus.

An important part of getting the right focus is paying attention to how it is expressed. In one case, despite engaging stakeholders early on in developing the problem definition and agreeing on a set of top problems, it became clear later that lack of success with the initiative was due in part to some "problems" being expressed as methods, rather than their clearly reflecting the *underlying* problem. For example, a problem statement might focus on identifying attributes of leave strips, when the underlying issue is how to prevent fish mortality. In another case, the a forest management agency used an adaptive management approach to validate the underlying assumptions about how they manage the forest, but in retrospect it would have been more helpful if they had framed the problem for decision-makers differently; rather than focusing on validating just these assumptions, giving them more information on how it will help them make other decisions.

Looking back, often when things go south, it's because we weren't really focusing on the problem.

In fact, it may be better not to establish the focus as a "problem" at all, but instead to express it positively as a goal. In doing so it is important to think about the larger context and asking the question, "is this really the problem, or is it a manifestation of a larger problem?" If the "problem" does not capture the larger context but only reflects a piece of it, there is a danger that it will not be "*durable"* and the focus will be lost with a shift toward crisis management as other aspects of the real problem emerge over time. Figuring out what the *durable* questions are needs to be a responsibility of the organization and not left simply to research.

Risk aversion is alive and well. I try to get people to understand that there is no such thing as a "no action alternative". There will be consequences, and they may be disastrous.

Uncertainty opens the decision space, it does not close it.

In addition to helping to avoid a shift toward crisis management, expressing the focus as a goal is consistent with communicating to management that adaptive management is really a tool for helping managers to achieve management goals in the face of uncertainty. Coming to grips with uncertainty is a key feature of adaptive management, and an important element in the process of problem definition. In some cases the need for explicit recognition of uncertainty can lead to resistance to taking an adaptive management approach, but facing it head on is the only effective way to deal with it.

We need to openly acknowledge that it is OK to be worrying about uncertainty: it is not a perfect world, and we do not have all the answers. Adaptive management is a tool to help move into this uncertain world.

An important aspect of dealing with uncertainty and establishing the focus for adaptive management is making predictions about the expected outcome. The process of making predictions forces you to clearly think through just what is known and what is not known; to identify clear hypotheses that can be explored. Even though the initial model may be flawed, the time frame needed to resolve uncertainties can mean that it will be the best that can be done for now. A fundamental flaw of the Northwest Forest Plan (NWFP) 10-year monitoring program is that there were almost no quantitative expectations defined at the start, and they had to go back and generate them later in the process.

3.3.5 Communication / organizational structure

[Support] needs to be through all levels of an organization; not just the top of a hierarchy.

Effective, broad-based communication is necessary to gain the support needed within an organization for successful adaptive management. It is essential to keep in mind that the needed communication is two-way. It's not just about communicating the need for the initiative to others. In order to develop a successful AM initiative, it is important to develop a sound mutual understanding how the conduct and results of the initiative may impinge on the needs and interests of others. This can be a crucial aspect of work to define the problem / focus of the AM initiative.

Communication is always important, regardless of an organization's structure.

Organizational structures can serve to either aid or inhibit broad-based communication. It is usually successful if you can get to the right people, but in some circumstances organizational structure can make that difficult. One of the challenges is finding venues for the kind of interaction that is needed. In many organizations venues that support broad-based engagement are not well developed and it may be necessary to seek out or create new opportunities for communication that are not reflected in formal corporate communication channels. For example, creating opportunities for executives, managers and researchers to meet in a field setting has been found to be an effective mode of communication. It is also important to recognize that communication laterally is as important as communication vertically.

It is absolutely critical to get people out in the woods: the whole dynamic changes.

If you think you are over-communicating, keep doing it because you're probably not.

Some communications issues have to do with the languages of different disciplines; disciplines also may have different world views. For example, biologists may be trying to figure out how to work within a system, while engineers may see value in restructuring it. Scientists tend to be focused on what they don't know, while managers tend to focus on what they do know. Learning how to communicate effectively across disciplines can be like learning a foreign language. Structural issues that can hinder adaptive management are the barriers between research and managers, for example people keep telling the managers they are not allowed to do research, not allowed to learn. The appropriations law serves to reinforce this barrier. However, employing the AM initiative as a focus for technical transfer creates a legitimate approach for cooperatively engaging both management and research in the process of learning and adapting to new knowledge.

Things can break down when communication does not happen.

One mechanism that has been successful is to create a team environment—get a mind set that we are together on this thing and each brings something valuable to the table.

Given that in the modern setting it is not just about getting biologists to talk to foresters, but that we need to also engage the social sciences, communication is becoming more challenging. It is important to take the need for communication seriously and not assume that people understand what you are trying to do. There is no "one right way" to have effective communication; what works in one situation might not work in another, and different approaches can be successful in different situations.

If you can pin down the decision-maker on what the question is, they will be more likely to respond when you have learned something that helps them make the decision.

Effective communication is not just about getting support for a proposed initiative. It is important throughout the AM cycle to help maintain that support, but also especially important for "closing the loop" so

that useful outcomes get integrated into policy and future management initiatives. Closing the loop is not something that just comes at the end; it depends on how effective the communication and engagement was at the beginning, when the problem focus was being established. If you are having difficulty getting new knowledge incorporated in policy and future management actions, it may mean that the initial focus was not what was really needed. Adaptive management is not simply about research at a management scale, the focus has to be relevant to management decisions, and the relevance needs to be understood clearly from the start. The right strategy is to find out at the beginning what the key advice is that the decision makers need, and target their needs specifically. Another strategy is to ensure that results are communicated regularly by establishing formal channels for reporting the results within the organization. At the end of the process, an effective strategy is simply to get people using the results. Incorporating the results in guidelines can be an effective way to do this. If the operations people understand it and buy in, formal policy recognition is likely to follow.

Results are being fed back through management-level committees, and they feed that back up to the senior deputy minister level. It is boring and bureaucratic, but it works.

There are two keys to good communications. The first is to focus on learning the concerns of the people you are trying to communicate with. Maintain an active interest—be truly curious—about why others think the way they do, even if you do not agree with it. You open the doors to communication through true listening. The second is, be sensitive to how people are responding to your process. Are you getting good contributions from all sides? Observe people: are they engaged? You may need to adapt to different people's styles, e.g. some people need to go out into the field to see it and others can learn it in the boardroom.

The legacy of knowledge is so important in these projects; the important mechanism is to write it down!

3.3.6 Community involvement

If you want to close the loop, you are more likely to be successful if you have people involved, who will be influenced by the activity.

The need for community involvement depends on the context in which the AM initiative will be implemented. The community needs to be engaged whenever there is a clear public investment in the issues to be addressed. If an interested party can either stop, or assist an initiative, they should be involved. For example, local knowledge within the community can be a valuable resource in successful scoping and design of an AM initiative. Interested private land owners may also provide valuable opportunities for conducting or participating in work on their property, or for providing a reference site.

Community involvement will be essential whenever it is mandated by law or regulation. In other contexts, such as small corporate initiatives on a plot or stand scale, community involvement may not be necessary. However, it is important to recognize that involving people who could be affected by the outcome, if it is incorporated into future policy or management actions, can be important for enabling this to occur; for effectively "closing the loop". This is especially important if the outcome could have a large impact on them. It is also important to involve a community early, before decisions have been made, so that they can contribute to the process of defining the problem.

People may not get involved initially because they may not see how the process will affect their interests, or uses. So it can't be a one-time offer.

If a community does not want to be involved, it can mean either that they may not understand the importance of the initiative, or perhaps that there is some hidden resistance. Unwillingness to engage should not be simply dismissed as disinterest, but should be viewed with caution, as a possible signal that

other avenues may be employed to stop the initiative. On the other hand, if it does reflect a lack of understanding of the importance of the initiative to the community, it is important to keep the door open to their later involvement.

You need a facilitator to make sure it is done right. It can't be done ad hoc; without the necessary expertise you will have a high probability of failure.

In some situations community involvement can be inhibiting, and it is important to make conscious choices about engaging the public. In some cases whether to do it at all is a choice. In other cases, the choice is how to do it. It is important to go into it with your eyes open, and the right expertise. One problem that can arise is that people who leave the process can very easily be marginalized. Once way to try to prevent this is if you can engage the community as members of your team. To do this the goals have to be clear and common to the team. Get agreement on that early on, and the team will be likely to help defend the process if needed.

If they are there for political reasons and it is a technical problem, that is where we run into problems.

Successful public engagement also depends on being clear about what you are inviting them to do. Everyone who is brought in has to be clear on this. People from the community will make valuable contributions about values and acceptable alternatives, but may not engage well in the technical details. In BC's water use planning process[10], an approach that worked well was to have two parallel committees: a Consultative Committee and a Technical Committee. The Consultative Committee (stakeholder representatives) focused on values, management objectives, and the creation / evaluation of water management alternatives. The Technical Committee (experts and scientists) developed tools and performance measures to assess the consequences of each management alternative for each objective. The Consultative Committee iteratively evaluated the consequences of different alternatives until they found one which was generally acceptable, or a set of alternatives to be compared in sequential AM experiments. This does not mean keeping the public and technical people isolated, there can be real benefit in having them exchange views, but it does mean keeping the focus of discussions clear—not confusing discussions of values with those of technical issues.

It must also be recognized that engaging First Nations or Tribal Governments often requires a different venue and approach. At least in Canada, First Nations prefer to engage on a government-to-government basis and it is difficult to engage them in the same forum as other community members.

For smaller initiatives, public engagement may be less important or less complex. For larger initiatives, especially those that will affect the community, it is important to keep in mind that democratic ideals remain important. Since the problems we face encompass both values and technical issues, decisions can not be driven by just one group. In some respects, this is relevant not just to adaptive management, but also to how to develop better informed planning processes.

3.3.7 Planning

Both planning and action, and the ongoing interaction between them, is what AM is about.

Planning in relation to the adaptive management of forest resources can be thought of in two contexts. One context is that of planning an adaptive management initiative. The other context is that of the existing systems of planning forest management.

[10] http://www.bchydro.com/environment/wateruse/wateruse35655.html

AM really represents a fundamental, systemic reform about how we think about planning.

In the context of planning an adaptive management initiative, once clarity has been achieved about the problem / focus for the initiative (the Assessment step), planning should focus on designing and implementing the management intervention and monitoring program. A significant effort needs to be invested in this. It is also about considering up-front how you might want to use the results; how to incorporate them into the decision-making process. This can, and probably will, be adjusted later, but starting with some idea about how this might occur will help to define a successful initiative.

The planning should be more like a set of guidelines or a framework for how to pursue desired outcomes.

Adaptive management initiatives typically have to be carried out in the context of existing systems for forest management planning. Where the regulatory environment is highly risk-averse, existing planning systems can act as an impediment to taking an adaptive management approach. This is rooted in the un-stated assumption that acting on the basis of existing knowledge carries lower risk than conducting a management experiment to help to resolve uncertainty. Risk aversion and various other factors have resulted in existing planning systems that tend to be rule-based. This is antithetical to adaptive management initiatives which are designed to explore the consequences of alternative approaches. Consequently, implementation of adaptive management may require focused effort to explore how it can be done within the planning context. For example, in the United States the National Environmental Policy Act (NEPA), can be implemented in a mode that works either for or against AM. The Glen Canyon Dam is an example of the former, where AM was explicitly proposed in the Environmental Impact Statement.[11]. The flip side is when planners or proponents come up with a set of alternatives, pick one, and then select evidence to refute others. In many cases there are probably good parts to each alternative, and perhaps what should be done is choose multiple alternatives to evaluate within an adaptive management initiative. This rarely happens, though it can. NEPA is a learning paradigm, so there is no reason an adaptive management approach cannot be taken. Work may be needed, however, to sway people who are used to working within the planning paradigm in a mode that is counter to adaptive management.

At some point you need to quit planning and start doing. Some projects get so caught up in planning they never move out of that mode.

[forest management] plans are all about values.

We need to acknowledge that people will have different values, and the best we can do is help them understand the tradeoffs among those values.

Planning processes are increasingly about how to balance multiple values and objectives. At one time, planning was perceived as a scientific (technical) process, however the view of planning has shifted as more values have had to be considered. What is needed is ways to help the public and the planners understand the consequences and tradeoffs inherent in different choices. Adaptive management can help with the process of exploring the most effective ways of achieving multiple competing objectives in a climate of uncertainty, through well-monitored management experiments. Facilitation and mediation may be helpful for resolving disagreements over competing values (i.e. what you want); that effort is however beyond the scope of AM, which deals with the question of how to get what you want.

[11] The Glen Canyon Dam Environmental Impact Statement defined adaptive management as "a process whereby the effects of dam operations on downstream resources would be assessed and the results of those resource assessments would form the basis for future modifications of dam operations" (pg. 55; Commission on Geosciences, Environment and Resources 1999)

3.3.8 Funding

Having adequate funding to properly design an adaptive management initiative, to implement the needed management actions, and to monitor and evaluate the outcome is important to success, but not in itself sufficient to guarantee success. In many respects, having or not having the necessary funds is an indicator of the presence (or lack of) *executive support*. It must be recognized, however, that even with strong executive support, other constraints on the availability of funds can mean that funding will be limited. It is also important to keep in mind that the availability of funds cycles over time, and funds may become available in the future even if they aren't currently available.

The bad news: no budget this year. The good news: no budget this year. Why? Because we had to get creative; it can be very liberating.

If there is support for the initiative from outside the organization and one or more partners can generate grants or access other sources of funding, it opens opportunities and can help to buffer shortfalls in funding from within. Wise use of funds is important. Sometimes a lack of funding can serve as a stimulus for seeking out creative ways to get things done. It is also naive to assume that without funding you can do the work. Carl Walters said people think AM is something we can do simply and cheaply, but in fact the opposite is true.

3.3.9 Staff training

Staff training is relevant to adaptive management initiatives in three contexts. The first is training in the basic concepts of adaptive management, the broad goals and approach of an initiative. This is closely related to the earlier discussion of Organization structure / communication. In this regard, training in the basic concepts and goals is important for gaining the necessary support and engagement for successful adaptive management.

We asked "did you get any training?" Generally the answer was "no". So what level of commitment, and measure of importance does that imply? Not much.

AM has been elevated beyond the NWFP into a core element nation-wide. Nothing has changed culturally, so there is this blind belief that it will happen if it is in the regulations.

This sort of training can be especially important. Doing adaptive management means doing things differently from how they have been done before. Embracing adaptive management can require a shift in corporate culture, such as a shift from a risk averse / rule-based culture to one that acknowledges uncertainty and seeks to reduce it. This sort of training is not just for staff at lower levels in an organization—to fill them in on what is going on. It is important for all levels of management. This is not new, other important initiatives such as fire management often involve training at all levels of an organization. The absence of such training can convey a powerful message that the organization is not that serious about it.

It's crazy to think this will take off without training. How do you design an AM exercise? Neither scientists nor managers who have not been involved in the process before will know how to do this.

Our whole thing was about changing from clear-cutting, but nobody knew how to do anything else.

The second context is in regard to training in the necessary details of the initiative. This is especially important if the initiative will be done over a large area with many different people involved in applying the management prescription. As with any management initiative, such training is essential to consistent implementation. Most organizations may already have training systems and facilities to provide such training and this may be a fairly

straightforward task. Regardless of the existing resources, it should be kept in mind, that quality training means a two-way dialogue. It is important to involve staff in the design of the training program.

I contend that a well-run AM project does away with the need for tech transfer because it's an ongoing part of the process.

A powerful quality of the AM process is that if done right it is a process where there is mutual learning going on.

The third context is training staff in the knowledge gained through an adaptive management initiative that will be incorporated into policy and future management practice. Again, most organizations will already have systems in place to provide this kind of training. However, depending on the scale of the adaptive management initiative, some or all of this need may be provided already by the hands-on engagement of staff in the adaptive management initiative.

3.3.10 How AM science is conducted

Adaptive management combines science and management in order to learn from management experience. To enable adaptive management, both science and management have to combine in a way that transforms both. In doing so, management becomes more scientifically rigorous, and research becomes more policy relevant.

AM mimics the scientific method. And the rigor of the scientific method is a powerful tool.

We should not let science hang up the process; in thinking you can only do AM when you have teams of scientists.

It is naïve to think that large scale adaptive management can be as scientifically rigorous as small tightly controlled research experiments. There is a realistic trade-off that has to be recognized, and what is needed is a collaborative approach based on mutual understanding. On one hand, the rigor of the scientific methods is about allowing us to be clear about what we really know, and what is in doubt. Without scientific rigor initiatives billed as *adaptive management* may be little more than undisciplined trial and error, a poor paradigm for effective learning. On the other hand, trying to impose a high degree of scientific rigor can be seen as unnecessarily costly by managers, and serve as an impediment to taking an adaptive management approach. What is needed, especially in the early stages of experience with adaptive management within an organization is a reasonable balance, one that helps to assure true learning, and enable management acceptance. In situations with a high degree of public involvement, a relatively high degree of rigor (early in the process) can be important in building the mutual trust needed to enable adaptive management.

Ironically we're talking about working hard to make science more policy-relevant.

Rigor is important for overcoming lack of public trust – having scientists validate what we are trying to do

The adaptive management literature recognizes two broad approaches: passive adaptive management, and active adaptive management. With passive adaptive management a single 'best-bet' management alternative is employed together with carefully designed monitoring to evaluate its effectiveness. With active adaptive management more than one management alternative is used at different places and/or times, together with monitoring in order to learn from contrasting results. Active adaptive management, when carefully designed, offers a higher degree of rigor, and more rapid learning. Risk averse regulatory environments, concern by interest groups, and management concerns about cost, however, can each make pursuing active adaptive management more difficult than passive adaptive management, since the very nature of the active adaptive management makes your uncertainty about management entirely explicit.

In a company situation, if you don't have passive AM you will stymie the potential for learning about AM.

We're tying to produce powerful evidence about things that are important.

The passive and active approaches to adaptive management reflect two levels of scientific analysis, effectiveness monitoring/analysis, and cause-effect analysis. Although less rigorous, passive adaptive management can provide the dual benefit of learning, and experience with the adaptive management paradigm that can make later acceptance of active adaptive management easier if needed.

You need a combination of active and passive AM.

A key first step in deciding whether to follow a passive or active adaptive management approach is being clear about what is already known. It is important to engage scientists with management, early on (at the stage of problem definition), to clearly identify what is known, and what is needed. The key is to engage people with the necessary expertise to help provide a clear answer, for example biometricians to provide advice to managers. What might really be needed is the application of existing knowledge rather than an adaptive management initiative. Or, what might be most appropriate is a combination of active adaptive management at a smaller scale combined with passive adaptive management on a larger scale. Deciding which way to go, should not be the job of just researchers or just managers, but should be a collaborative effort.

Good science is more important as the magnitude of the project grows. The level of rigor needed is linked to the stakes of the outcome.

4. Insights and Conclusions

4.1 Insights and conclusions from the survey

4.1.1 Project success

The perceived level of success was generally higher in private-led than government-led AM projects (i.e. a higher proportion of private-led projects were graded A or A-). However, the subjective nature of the grades, and the relatively small number of private-led projects in our sample leave us unable to determine if private-led projects really are more successful or if the results reflect other factors. Survey respondents from the private sector may have been "easier markers", they may have looser definition of AM, or the private-led projects in our sample may have been easier to implement; and we are unable to distinguish among these possibilities from the results. If the level of success is indeed greater in private-led projects, it would be interesting to explore why. Do private-led projects have greater regulatory flexibility in implementing alternative forest management actions, or are the staff within private forest management entities less constrained by historical policies and procedures than public entities (i.e. freer to experiment with alternative treatments), or is this more a function of leadership? Greater certainty regarding a true difference between sectors (from both a larger sample size and closer scrutiny of documented outcomes) would be prudent before spending more effort generating hypotheses to explain the reasons.

Regardless of leading sector, a project using an AM approach is more likely to be successful if there is greater continuity of staff and vision/leadership; greater control over the project, fewer stakeholders, and fewer competing objectives that can inhibit experimentation; fewer constraints from historical policies; and a greater freedom to experiment with alternative management.

This raises an important question: **what is an objective measure of the success of an AM project?** We defined AM in this study as "using deliberate management actions as a source of learning with the intent to inform subsequent management policy or actions". Hence, a successful AM project must have three components:

1. a deliberate intent to learn (i.e. reduce some key uncertainty in management);
2. management actions which are designed to increase learning, amongst other objectives; and
3. an effort to monitor and evaluate these actions so as to inform management policy or actions.

In this study, we used two metrics to attempt to evaluate the success of AM projects:

Self-evaluation. The grades that respondents assigned to their projects are a helpful qualitative guide that integrates all of the above three components. However, this method is totally subjective. As with teachers, there are easier markers and harder markers. It seemed to our interviewer that the respondents discussing public projects tended to be tougher in evaluating their projects, with a style of response that emphasized weaknesses or "things we should have done better", whereas the respondents discussing private projects tended to emphasize project strengths. Thus the evaluations may partly reflect cultural differences in how public and private scientists and managers assess their own organizations (i.e. the dispassionate civil servant vs. the loyal company employee). We also did not know the true degree of difficulty of each AM project. It's easier to successfully complete a controlled plot or stand level AM project without public involvement (and get an "A" grade), than to achieve success in a landscape level public project with multiple stakeholders and a long history of

conflict. Future work on enabling factors should attempt to diagnose the 'degree of difficulty' of each project, and use that measure to put project outcomes in the context of the challenges faced by the implementers. Figure skating judges take the degree of difficulty into account in assessing the overall success of a performance (e.g. quadruple vs. triple jumps), and so should research on enabling factors.

Steps of the AM cycle completed. We asked respondents which steps they completed partly to check on whether projects really did do AM (i.e. included the three components listed above), and also to find out how important these steps were. We wanted to determine if learning was just 'trial and error', or whether there was a deliberate attempt to learn. A project which ended after its design (step 2) or implementation (step 3) would not be as successful as one which continued through steps 4 and 5 (monitoring and evaluation), or one which moved to step 6 and attempted to revise management policy and actions. A project which actually did revise management policy and actions based on the results of an AM project would be the highest level of success. We recognize however that political factors beyond the control of the AM team affect the ability to close the learning feedback loop. In using the steps of the AM cycle completed as a metric of success, we were careful to recognize that some projects may be only partially completed due to lack of time, rather than lack of commitment. We asked respondents for documents describing what they did; a more rigorous evaluation (beyond the scope of this project but perhaps ideal for an M.Sc. student) would be to comb through these documents in detail and determine to what degree the written documentation matched the oral summary. Some private organizations may not have the need to document their projects in as much detail as public projects with multi-stakeholder participation.

(Learning can also occur opportunistically, for example taking advantage of an unexpectedly large fire or windstorm to learn about disturbance regimes. We would argue that in this case that the six steps of the AM cycle would still apply, though monitoring and evaluation is designed around natural events rather than deliberately implemented management actions.)

We tend to view AM quite rigorously, otherwise the methodology becomes diluted and the tool loses power and value. While the screening questions presented in the methodology were intended to help focus the sample, two projects (as noted in Appendix 4) are somewhat different from the others and fall outside of what we would typically consider to be an application of AM. It would be interesting to re-run the analysis of results after removing these two projects from the sample (and to add in the 7th private sector survey that was received too late to be included) to learn if any of the observations and conclusions from the survey results would be strengthened or change.

4.1.2 Enabling factors

Leadership was consistently found to be strongly enabling, *regardless* of AM project grade, meaning that leadership is necessary but <u>not</u> sufficient. Leadership was also not blamed for lack of success in projects graded as less successful—it was the only factor that was not considered inhibiting by any of the projects, even those graded B or C.

Executive direction and how science and AM is conducted are more enabling in successful projects. This is likely because having an explicit AM mandate or a legal requirement for AM ensures project persistence through challenges, until through positive experiences AM is engrained in the corporate culture of multiple participating entities.

Historical context is more often inhibiting than other factors, perhaps because AM projects often grow from conflicts over management and values, where a lack of trust has developed. Community involvement was greater and more enabling in projects graded "B" than in projects graded "A" or "C". AM success may simply be harder if many stakeholders involved, though it is critical to do so.

The most and least expensive projects were graded as "A", indicating that (like leadership) funding is necessary but not sufficient for success. Certainly, *large* budgets do not appear to be a necessary condition for AM success, though the required budget will obviously depend on the scale and complexity of the problem. Although we often hear lack of funding touted as a common reason for AM failure, our results suggest that it is only one of many important factors, neither the most inhibiting in cases of failure, nor the most enabling in successes. As indicated above (section 3.3.8), funding may be more of a symptom of the level of executive support.

Our final conclusion from the survey results regarding enabling factors is that **most factors can be enabling or inhibiting,** and **there is no magic bullet**. No major differences were found between government-led and private-led projects, possibly due to our sample size. More private-led projects would be needed to conclude whether there are (or are not) any real differences across sectors.

4.1.3 AM steps and elements within the steps

Completion of six steps in the AM cycle was not related to project grade, suggesting that actually completing the cycle may be less critical than other factors. **All of the steps were considered enabling**, but the Assessment step was more enabling in public than private projects, perhaps because rigor might be more critical for stakeholder buy-in. The Evaluation and Adjustment steps were more enabling for private-led projects, perhaps because of a greater focus on continuous improvement and closing the loop. A higher proportion of the private-led projects led to changes in actions or instruments based on what was learned, as compared to government-led projects.

Looking more closely at the elements within Step 1 – Assessment, more successful projects build conceptual models, and explore alternative actions. Only approximately half of the public-led and private-led projects articulated testable hypotheses and identified key uncertainties, raising questions about the level of rigor of management the experiments.

Among the elements of Step 2 – Design, more successful projects had a monitoring plan, and used contrasts, replication and controls. What is interesting about this step is that many of the elements were more prevalent in less successful projects, including involvement of stakeholders and consideration of next steps under alternative outcomes. This may be partly differences among respondents in grading (discussed above in section 4.1.1). However, it could be that some projects were simply harder to do. The implementers might have completed more of the "required elements" (to continue the figure skating analogy), but still had less success than others due to the historical context or other factors. Or perhaps what matters is not whether these elements are included but how they are included that determine the level of success.

Looking at the elements from a sectoral perspective, few private projects had peer review of the design, and sought statistical advice (in the design or the later evaluation step); both of which are very valuable elements for gaining public trust (i.e. likely more important in government-led AM projects). This again raises the question of the level of rigor, particularly in private-led projects. Were they less rigorous are than government-led AM experiments, or in a continuous improvement context in which the trajectory may continuously change, are statistics foregone for results that seem self-evident? Does this affect the degree of perceived success? In other words, could this be one of the reasons why a greater proportion of private-led projects received a higher grade?

Among the elements of Step 5 – Evaluate, more successful projects compared results against assumptions, uncertainties and hypotheses. All elements except one (obtaining statistical or analytical advice,

mentioned above) were included in a higher proportion of private-led projects than government-led projects. This latter pattern was true for all of the elements in Step 6 – Adjust, which would be expected given that a higher proportion of private-led projects were considered successful.

4.2 Insights and conclusions from the workshop

Due to the wealth of experience which the participants brought to the workshop, the discussions were rich in insight about how to enable adaptive management. These insights helped to refine our initial hypotheses about how to enable adaptive management, though it remains difficult to draw firm conclusions. Although this is due in part to the sample size of the survey portion of the study, it is due most importantly to the fact that there is not one right way to do adaptive management, or to enable it. Enabling adaptive management requires an understanding of the unique history, problem and institutional context for each project. While the study has not developed a single formula for enabling adaptive management, it has nevertheless provided valuable insights to help others enable future adaptive management initiatives.

Of the ten factors hypothesized to enable adaptive management, the workshop discussions concluded that they should be considered in a hierarchy. The hierarchy suggests that some of the factors may be more important than others, or at least that they need to be addressed very early on. It does not, however, mean that the other factors are not important. Each situation will be unique in terms of the corporate culture, corporate structure, relationships with other stakeholders, scale and focus of the initiative, and the potential importance each of the enabling factors needs to be carefully assessed in the specific context of an emerging adaptive management initiative.

The specific context for the initiative (historical and current) is the top enabling factor within the hierarchy (Figure 3.21). Leadership, executive direction, problem definition, and communications / organization structure are the four enabling factors at the next level in the hierarchy. Each of these factors are essential for enabling adaptive management but none are in themselves sufficient to enable it alone. This group of factors reflect different elements of gaining and maintaining a broad level of support for the initiative, and gaining clarity about the focus of the initiative. The other factors, community involvement, planning, funding, staff training and the conduct of science all reflect important elements needed to support adaptive management. Depending on the context, each factor can be crucial, however, those in the top two levels of the hierarchy are always critical to success. Determining which of the factors at the lower level of the hierarchy are most important, is a process of trying to assess whether relative inattention to a factor could result in a situation that could effectively inhibit the project. In some cases, the importance of a factor will be related to the scale of the initiative. For example, the scale of leadership must grow with scale of project; and it must exist at multiple levels (ranging from “on the ground” to the corporate level), though it can start at any level.. Scientific rigor is critical in highly scrutinized projects (be they public or private), but may be considered unnecessary in some smaller scale private sector projects which do not involve high stakes (i.e. if decision makers are convinced to adjust policies and procedures by the people who implemented the AM experiment, and the data they generated). If it is not clear that a factor is relatively unimportant in a specific context, the prudent strategy is to assume that it is important.

Workshop participants felt that there were not significant differences between public and private forest management entities in either how AM should be practiced, or in the hierarchy of factors which enable (or inhibit) AM. They perceived that public and private projects were converging with respect to the kinds of problems they’re facing, both on the ground and within their institutions.

Doing high quality adaptive management is about doing good science to enable learning from management experience. Enabling adaptive management is about working with people to understand their concerns, to develop a common understanding, and an environment of trust that will allow the work to proceed. A key requirement is a clear and *"durable"* focus / problem statement. The focus needs to be relevant to making management decisions, and to be durable it needs to be established in the decision making context. Key to defining a durable focus is asking the question, why is this a problem; what underlies it? A properly specified focus can be valuable in helping to prevent the organization from slipping into a crisis management mode of operation, where it is constantly shifting focus to newly emerging symptoms of a larger underlying problem.

An additional factor that may be currently inhibiting adaptive management is a lack of instruction in how to do it. Workshop participants felt that adaptive management is not currently being taught in either academic institutions or in most public and private forest management entities. Managers and scientists who recognize the need for it, have to make their own way, gradually learning from experience. At the present time, there are no organizations whose corporate culture is designed to support adaptive management. Consequently, in their efforts to pursue adaptive management, managers and scientists can find themselves immersed in an effort to shift corporate culture without actually realizing it. Education is an important asset for dealing with this situation.

Despite the challenges, the results of the project survey and the workshop discussions show that adaptive management can be and is successful at a variety of scales for a variety of problems of differing complexity. Nineteen of the twenty respondents interviewed in the survey indicated that some uncertainty was reduced, but more importantly fourteen indicated that the initiative led to change in policy or future management action. The simple act of engaging in adaptive management may in itself be sufficient to create some shift in corporate culture.

"One thing about adaptive management is that it is becoming an essential quality to living in a very complex world. … A lot of federal and state laws regarding forest policy are based on a regulated forest to achieve a sustained yield. … to minimize uncertainty and risk … [but] ecologists and social scientists now understand that [the forest ecosystem] is dynamic and can't be stabilized". Broad acceptance of AM requires openly acknowledging uncertainty and dealing with it directly. This requires people to accept the premise that forest ecosystems (including human socioeconomic systems) are constantly changing. Yet regulations are often fixed, as though these systems were stable. Regulatory risk aversion may make it infeasible in many regions to engage in active adaptive management on large landscape scales. In such regions, it may be more feasible to implement well-monitored *passive* adaptive management at a landscape scale to assess overall effectiveness, combined with more limited application of *active* adaptive management to assess cause-effect relationships at a smaller (safer) scale such as stands.

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Appendix 1: Literature Review

We conducted a literature review, focusing on papers and reports that analyzed the success of multiple adaptive management projects (through their own extensive literature reviews, interviews with experts, and/or workshops), believing this was the most efficient way to cast a wide net and filter the information down to key messages regarding enabling factors. This appendix summarizes the relevant information from the references we reviewed: their definition of AM, the methodology they used, and observations or conclusions they provided about inhibiting or enabling factors. The summaries are arranged in chronological order, from least to most recent. Three of the sources (numbers 3, 4 and 9) were specific to the forestry sector.

1. ESSA Environmental and Social Systems Analysts Ltd. 1982. Review and Evaluation of Adaptive Environmental Assessment and Management. Prepared for Environment Canada, Vancouver, B.C., 116 pp.

Definition

- Adaptive Environmental Assessment and Management (AEAM) is a collection of concepts, techniques, and procedures for the design of creative and effective resource management and policy alternatives.

Methodology

- workshop with AM practitioners, AM users, and senior policy designers; 29 case study evaluations; and a synoptic analysis of AM procedures, the literature and the cast studies
- Evaluated success of AM against 7 objectives:
    - Identification of issues and unknowns
    - Identification of impacts
    - Communication
    - Information synthesis
    - Research planning
    - Policy analysis
    - Project management

Results

- User evaluations across all objectives revealed general consensus that AEAM was successful with some moderate successes, some highly successful applications, a few ineffective ones, and one evaluation as destructive for one objective in one application
- Success or failure of AEAM depends in part on the scale of the problems and issues being addressed. When applied to specific, narrowly-focused management problems, it may have a greater chance of failure because many of the possible sources of surprise lie outside the system being considered, and these may not be captured if the timescale is too short.

Inhibiting Factors

- Cites as reasons for failure in 50% of projects:
    - Institutional inertia (inability of institutions to adapt to change as quickly as society's problems develop)
    - Model inadequacies

  - Data inadequacies
  - Misunderstanding of AM concept or procedures
- Cited in 25-30%:
  - Lack of policy people
  - Lack of "wise person" – an individual with professional understanding who has an intuitive knowledge that the process will help, and knows the institutional environment well enough to nurse the process through to completion.
  - Inadequate planning before and after the project

Enabling Factors
- Institutional support
- Longer timescales that increase the chance that sources of surprise are within the system

2. Lee, K.N. 1993. Compass and Gyroscope. Integrating Science and Politics for the Environment. Island Press, Washington D.C.

Definition
- Adaptive Management is a synthesis of science and policy that treats policies as large-scale experiments.

Methodology
- Analysis and conclusions about adaptive management within the context of the pursuit of sustainable development, based on lessons from attempts to balance management to produce hydroelectric power while maintaining habitat suitable for salmon in the Columbia River Basin.

Inhibiting Factors
- Risk of failure. Doing any experiments at all is a challenge, as failures in projects that manipulate large parts of ecosystems are likely to carry real costs, particularly for those in charge.
- Corruption. Not deliberately or overtly, but inadvertently through cutting design and methodological corners in order to get around some of the other challenges (e.g. time, cost).
- Challenges in randomization and establishing controls in ecosystems that are complex and unique.
- Delay and cost. Experimentation is a form of study, and study is a form of delay. The information needs of an experimental approach are high. AM requires a large down-payment to start with, to amass enough of a baseline to comprehend the outdoor "laboratory" in which the experiments will take place, and this can be slow and expensive.
- Limitations to institutional learning and responsiveness:
  - Reliance on operating agency staff,
  - The disruptive capability of policy changes,
  - Vulnerability to political change, and
  - The requirement that the adaptive manager be an able negotiator as much as a visionary scientist.

Enabling Factors
- Institutional conditions favoring adaptive management:
  - A mandate to take action in the face of uncertainty,
  - Decision-makers are aware that they are experimenting anyway,
  - Decision-makers care about improving outcomes over biological time-scales,

- Preservation of a pristine environment is no longer an option, and human intervention cannot produce desired outcomes predictably,
- Resources are sufficient to measure ecosystem-scale behavior,
- Theory, models and field methods are available to estimate and infer ecosystem-scale behavior,
- Hypotheses can be formulated,
- Organizational culture encourages learning from experience, and
- There is sufficient stability to measure long-term outcomes, institutional patience is essential.

3. *MacDonald, G.B., R. Arnup and R.K. Jones. 1997. Adaptive Forest Management in Ontario: A Literature Review and Strategic Analysis. Forest Research Information Paper No. 139.*

Definition

- Adaptive management is a formal process for continually improving management policies and practices by learning from their outcomes (Taylor et al. 1996).

Methodology

- On-line library database searches and reviews of relevant literature, and
- Interviews with planners, policy-makers, operations staff, and scientists in government, universities, Model Forests and several sectors of the forest industry.

Inhibiting Factors

- Technical challenges
  - It is difficult to design powerful experiments and effective monitoring strategies for large-scale phenomena characterized by high variability and long response times.
  - There may be inadequate information to assess baseline conditions and to predict responses; a large investment in data collection may be required prior to the application of any treatments.
  - There needs to be a reliable system to forecast future conditions in response to disturbances, implying the need for access to high quality computer-based models linked to GIS, but it is difficult to obtain compatible data for GIS applications because they are often collected from multiple sources and for different purposes.
- Economic challenges
  - Maintaining continuity of staff and resources is one of the biggest challenges facing long-term AM studies.
  - The human and financial resources needed for effective field layout, monitoring programs, and data management and analysis are scarce in most resource management agencies.
  - The prescriptions being tested bay reduce short-term revenues, and some of the benefits are usually delayed.
  - Costs and benefits may not be borne evenly.
  - Additional costs may result if some of the alternatives tested have negative outcomes.
  - There may be pressure to implement experiments that are less expensive, even if these are less reliable in the long term.
- Ecological challenges
  - Sub-optimal treatments may be required to accelerate learning, but these may risk causing irreversible damage to the ecosystem. Therefore AM may not be feasible in

scarce or endangered ecosystems where managers or the public are unwilling to accept the risk.

- Institutional and sociological challenges
    - Agencies may be unwilling to publicly admit that they are uncertain about the results of some of their actions.
    - Large-scale experiments designed according to ecological boundaries often cross administrative boundaries, requiring agreement among agencies on objectives and on long-term collaboration.
    - When a problem needing collaboration moves into the public arena, stakeholders tend to become frozen in polarized positions.
    - Formal planning processes are linear, in contrast to the cyclical nature of AM.
    - The rules, procedures and routines in many resource management organizations act as barriers to learning.

Enabling Factors

- The following elements were common to all successful examples of adaptive management in North America reviewed for this analysis:
    - A desire to reduce conflict and crisis,
    - Extensive consultation with multiple stakeholders in developing and implementing plans,
    - Identification of key information needs to guide research program design,
    - Development of an integrated knowledge and inventory database to facilitate prediction of outcomes,
    - Multi-agency collaborative research efforts,
    - Considerable initial investment to get the programs established,
    - Long time periods to evaluate success: approximately 5 years to coordinate stakeholders, set goals, develop plans, design programs, and implement trials, and an additional 10 years to monitor, interpret, and translate results into changes in policy and planning procedures, and
    - Acceptance that adaptive management should not be applied in all situations, especially where the risk of failure on large-scale experiments is unacceptable.

4. Taylor, B., L. Kremsater and R. Ellis.1997. Adaptive Forest Management in British Columbia. B.C. Ministry of Forests, Victoria, B.C., 93 pp.

Definition

- Adaptive Management is a formal process for continually improving management policies and practices by learning from their outcomes.

Methodology

- From a review of literature on adaptive management, examination of 13 case studies that illustrate certain elements of adaptive management, a 3-day workshop, and discussions with those knowledgeable about adaptive management.

Inhibiting Factors

- Reluctance of professional managers to admit uncertainty and to risk the less than optimal outcomes that my result from innovative management alternatives
- Lack of skill, expertise, and time to learn adaptive management approaches
- Issues of traditional mandates, roles and approaches (where there is multi-agency participation)

Enabling Factors

- Commitment to continuity of funding, monitoring, and involvement of key people over the time frames necessary to detect ecosystem responses to management activities
- Rigorous design and implementation
- Consideration of the desire for fair and equitable treatment of tenure holders, other resource users, and communities (i.e. trying to ensure the costs and benefits of management experiments are borne equally)
- Regulatory flexibility to allow testing of a range of alternatives
- A management system and structure that involves all participants in a team approach
- Strong, explicit links between the results of management experiments and the use of those results to modify regulations and future forest practices

5. ***Walters, C. 1997. Challenges in Adaptive Management of Riparian and Coastal Ecosystems. Conservation Ecology [online] 1(2):1.***

Definition

- AM is a structured process of learning by doing that involves more than simply better ecological monitoring and response to unexpected management impacts. It should begin with a concerted effort to integrate existing interdisciplinary experience and scientific information into dynamic models that attempt to make predictions about the impacts of alternative policies.

Methodology

- An assessment of reasons for low success rates in implementing policies of AM, based on the extensive case-based experience of the author.

Results

- Of the 25 planning exercises for AM of riparian and coastal ecosystems that the author has participated in over the last 20 years, only seven resulted in relatively large-scale management experiments, and only two of these would be considered well planned in terms of statistical design (i.e. adequate controls and replication). In two other cases, participants were unable to identify experimental policies that might be practical to implement. The rest either disappeared with no apparent product, or are trapped in endless processes of model development and refinement.

Inhibiting Factors

- Barriers to modeling for reliable assessment of best use policies—the presumption that detailed modeling can be substituted for field experimentation to define "best use" policies (i.e. supplanting modeling for AM planning by ongoing modeling exercises).
    - A presumption, in such exercises, that best use policies can be corrected in the future by "passively adaptive" use of improved monitoring information.
    - Cross-scale modeling problems
    - Non-additivity of parameter and data effects in population dynamics analysis
    - Difficult and emergent processes
    - Confounding of factor effects in historical validation data
- Costs and risks of large-scale management experiments—the perception that effective experiments in AM are excessively expensive and/or ecologically risky, compared to best use baseline options (and the false presumption that some sound baseline option can be found in the first place).
    - Direct costs to riparian economic interests
    - Short-term pain for long-term gain

  - High monitoring costs
  - Risk to sensitive species
  - Misunderstandings about experimental design options and opportunities
- Self-interest in research and management organizations—strong opposition to experimental policies by people protecting various self-interests in management bureaucracies.
  - Belief that single best judgments are necessary to maintain credibility.
  - Belief that AM is a threat to process research interests.
  - Bureaucratic and political inaction as a rational choice.
- Fundamental conflicts in ecological values (very deep value conflicts within the community of ecological and environmental management interests.)

Enabling Factors
- Creative thinking about how to make management experimentation an irresistible opportunity, rather than a threat to various established interests.
- Demonstration that AM can create win-win outcomes for scientists, bureaucratic administrators, politicians and resource/environment interest groups.

6. ***MacDonald, G.B., J. Fraser and P. Gray. 1998. Adaptive Management Forum: Linking Management and Science to Achieve Ecological Sustainability. Proceedings of the 1998 Provincial Science Forum. Ontario Ministry of Natural Resources, Peterborough, Ontario, 58 pp.***

Definition
- AM is a systematic process for addressing the uncertainties of resource management policies by implementing the policies experimentally and documenting the results.

Methodology
- A 4-day forum of 108 participants from across North America to share experiences, through presentations and participatory breakout groups.

Inhibiting Factors
- Institutional barriers
  - The perception on the part of resource management agencies that uncertainty leads to lower credibility.
  - The unwillingness of managers (and politicians) to take risks, usually because of the lack of rewards for risk taking.
  - The lack of effective communication between scientists and managers. Scientists often do not transfer their knowledge well, and managers have inadequate insights into science.
  - Inadequate staff training and competence.
  - Lack of senior management endorsement of active AM.
  - Conflicting resource management objectives and mandates in legislation.
  - Competition for control within or among agencies, hidden agendas, and pressure among scientists to publish – which can all lead to data hoarding.
- Social
  - The public's lack of understanding of the statistics and indicators used in AM.
- Economic
  - The perceived high cost of AM.
  - Allocation of funds and staff for research are not sufficient.
  - Lack of long-term planning to accommodate AM initiatives.
  - Short-term, politically-based funding cycles.

    - Unwillingness to deliver economic bad news to resource users.
- Technical
    - Inadequate statistical techniques
    - Knowledge gaps that impede model development
    - The tendency to expect all models be predictive tools

Enabling Factors

- Successful implementation of AM relies on strategic and tactical support at all levels in the organization. Common themes: communication, scale, partners.
    - Political/Legal
        - an open decision-making process where uncertainty is an accepted factor
        - Managers who are champions of an AM process
        - A process that entrenches scientifically based AM as an important element of policy development, implementation and evaluation
        - A working environment designed to encourage development and application of quality science in support of policy
        - Funding mechanisms designed to ensure that long-term studies and associated management programs are completed
    - Institutional
        - eliminate conflicting objectives and mandates within and among agencies by establishing a strategy with reasonable and attainable goals, clearly identified roles and responsibilities, and an emphasis on the concept of uncertainty and learning
        - bottom-up process for policy development and refinement
        - managers embrace, use and demonstrate AM applications
        - fostering and nurturing partnerships and teamwork
        - institutional culture based on innovation and learning; supporting managers and staff as they work adaptively, and adjusting job specifications and performance appraisals to recognize AM responsibilities and associated risks
        - effective internal communication about AM
        - development and demonstration of AM tools and techniques
        - training for staff on techniques to plan for and implement AM
    - Economic
        - comprehensive procedures to examine the real costs and benefits of traditional management (including the risks of litigation) versus the cost and benefits of an AM approach
        - compensation programs to mitigate losses associated with decisions based on AM
        - contingency funds to manage natural resources in the face of unforeseen events
        - creative approaches to sharing the costs and benefits of AM
        - long-term planning and funding cycles, extending beyond annual budget allocation processes (e.g. long-term monitoring can be costly)
        - adequate human and fiscal resources to design and implement new programs
    - Public/Social
        - transparency and trust among the lead organization, partners and stakeholders
        - good communication (for a more knowledgeable and informed public; to identify and share values and goals; to reach agreement on complex questions; to build trust and commitment; to dispel unrealistic expectations; to share costs and benefits of uncertain decisions; to document program results; to communicate successes and failures; and to enhance accountability)
    - Technical
        - creating the right teams

- ensure the appropriate technical support is available (e.g. statistical designs, decision designs)
- commitment to continually and consistently expand the knowledge base
- support for, and sponsorship for completion of, complex experiments
- commitment to identify and address key and often controversial questions
- sponsorship for the development and application of models at appropriate spatial and temporal scales for management

7. Alverts, R., J.M Calhoun and R.L. Lee. 2001. Organizational Learning: Adaptive Management for Salmon Conservation Conference Proceedings. University of Washington, Olympic Natural Resources Centre, Forks, WA, 59 pp.

Definition

- Adaptive management is a six-step process: determine management objectives, design experiments, apply the management actions as intended to achieve the objectives, measure key variables, compare responses with objectives, and repeat the process, seeking continued improvement in achieving the management objectives.

Methodology

- Presentations made at a December 2000 conference which included sessions on organizational learning and on what adaptive management requires organizations to do, and
- A post-conference workshop (27 participants) to identify characteristics/principles of organizations that learn and adapt.

Enabling and Inhibiting Factors

- Listed below are characteristics of organizations that do, and do not, learn and adapt. Those in bold are the qualities considered most important to an organization's ability to learn.

Characteristics of organizations that fail to learn and adapt	*Characteristics / principles of organizations that successfully learn and adapt*
HISTORICAL CONTEXT	
H1. Management done the same way for a very long period of time, creating inertia	H1. Frequent re-examination of management (actions, products, delivery mechanisms) prevents institutional inertia from being established.
FUNDING SETTING	
F1. Entities providing funding (e.g. legislature) do not want to see $ spent on experimental management. Funders expect positive results in return for $ invested, and consider evidence that some management actions didn't work as 'failures', waste of $.	F1. Funders recognize uncertainty and are involved in designing intelligent management experiments with 'safe fail' outcomes. Funders buy into learning approach and agree to a contract regarding experimentation so that surprises aren't judged as failures.
F2. Insufficient human resources and funding to carry out AM experiments.	F2. Sufficient human resources and finances provided to carry out AM experiments.
F3. Policy makers want scientists to provide answers without having to do AM experiments that acknowledge ignorance, and may be risky.	F3. High-level political support provided for AM experiments. Uncertainty accepted publicly.
LEADERSHIP	
L1. Leaders resist change, discourage risk taking and innovation, and repeat past actions. Create organizational culture in which staff are expected to do the same.	L1. Leaders deliberately challenge themselves to recognize change, innovatively adapt to current challenges and take calculated risks. Create organizational culture in which staff are expected to do the same.
L2. Staff who show existing actions aren't working are criticized, and evidence suppressed.	L2. Staff rewarded for generating information that demonstrates existing actions aren't working. Celebrate failure and learning.
L3. Leaders cautious and defensive to public;	L3. Leaders are self-confident, willing to explain or defend AM approaches.
L4. Leaders treat unexpected events as aberrant outcomes that don't negate traditional approaches.	L4. Leaders treat unexpected events as catalysts to rethink approaches.

Characteristics of organizations that fail to learn and adapt	*Characteristics / principles of organizations that successfully learn and adapt*
L5. Leadership frequently changing, lack of continuity.	L5. Leadership maintained for longer periods.
L6. Inconsistent political leadership, and wavering support.	L6. Consistent political support.
DEFINITION OF PROBLEMS AND POTENTIAL MANAGEMENT ACTIONS	
D1. See problems as linear and break them down into small pieces. Focus on details of the parts over short time horizons and restricted spatial scales.	D1. See both ecosystems and institutions as non-linear systems that respond dynamically to disturbances. Focus on dynamics of the whole system over long time horizons and large spatial scales.
D2. Rely on engineering technology not designed for dynamic ecological systems.	D2. Rely on management actions that emulate natural disturbances, rather than technological fixes.
COMMUNITY INVOLVEMENT PROCESSES	
C1. Institutions isolated from public, or very limited consultation at random intervals. Frequent court cases, advocacy, arbitration.	C1. Collaborative inputs to decision making over sustained period, generating buy-in and trust, allowing stakeholders to move from positions to interests, clarifying areas of agreement and disagreement.
C2. Agency decides what actions should be implemented at local level. Monitoring done by agency if funds available.	C2. Explain goals, and then delegate to local level (e.g. watershed) the task of working out how to achieve them, encouraging experimentation within a framework of consistent monitoring and guidance.
C3. Staff science and data predominant.	C3. Citizen science, traditional knowledge incorporated into decision making.
PLANNING	
P1. Plan based on past experience, practices, procedures established by senior staff.	P1. Recognize critical uncertainties and plan experiments to test alternative hypotheses / actions.
P2. Collected information stored, but most not analyzed due to lack of incentives and resources to take a critical look at outcomes of actions.	P2. Use information to produce cognitive change in formulation of issues, maintaining critical reflection over policy-relevant time frames (e.g. > 10 years)
ORGANIZATIONAL STRUCTURE AND COMMUNICATIONS	
O1. Poor internal communication between departments with different mandates, between disciplinary specialists. Difficult to access required information. 'File merge' approach to synthesis.	O1. Collaborative, interdisciplinary working environment with free-flowing communication and easy access to well-synthesized information. Focus on interdisciplinary problem solving, exploration of cumulative effects and dynamics.
O2. Focus on management and emergency response rather than learning.	O2. Use management teams to help create time, resources, opportunities for learning teams, whose main job is learning.
O3. No institutional memory.	O3. Institutional memory is important.
O4. Hidden decision processes.	O4. Clarity of decision processes.
TRAINING OF STAFF	
T1. Staff not trained to accept change, to deal with surprises or to focus on learning.	T1. Staff trained to embrace change, to focus on learning.
T2. Staff not trained to design and implement AM.	T2. Staff well trained to design and implement AM.
HOW SCIENCE AND AM IS CONDUCTED	
S1. Advocacy science to support agency's position (selective evidence). Data kept internal; insist on single, dogmatic agency position regarding data analysis.	S1. Stress on high quality science at appropriate scale, with independent review panels. Data made available; different interpretations of data welcomed, used to postulate alternative hypotheses and design management experiments. Wide publishing of scientific findings.
S2. Agency scientists do work largely independently from public and other institutions.	S2. Agency scientists interact in 'learning teams' and/or 'transboundary issue networks' with scientists from NGOs, academia and stakeholder groups (incorporating traditional knowledge). Involvement in data collection encouraged to build confidence and trust.
S3. Goals of AM experiments not well defined or linked to decisions; alternative hypotheses not defined for key uncertainties; experimental design at wrong spatial/temporal scale or inadequate to provide required insights; and/or poor documentation.	S3. Clearly defined, measurable goals of AM experiments, linked to decisions; alternative hypotheses defined for key uncertainties; experiments designed at appropriate spatial/temporal scale; thorough documentation; results fed back into revised decisions.
S4. Avoid/ignore cumulative effects due to difficulties of drawing scientifically defensible conclusions.	S4. Consider cumulative outcomes even if scientifically defensible conclusions not possible.

8. ***Salafsky, N., R. Margoluis and K. Redford. 2001. Adaptive Management: A Tool for Conservation Practitioners. World Wildlife Fund, Washington D.C., 100 pp..***

Definition

- Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management and monitoring to systematically test assumptions in order to adapt and learn.

Methodology

- Based on a survey of adaptive approaches from different fields and conservation projects, through literature review and field visits.

Enabling Factors

- These are presented in this report as a set of principles:
    - Do adaptive management yourself
        - Involve regular project staff members
        - Help people learn about adaptive management
    - Promote institutional curiosity and innovation
        - Innovate to survive in a changing world
        - Start with managers at the top
    - Value failures
        - Learn from your mistakes
        - Create a safe-fail environment
    - Expect surprise and capitalize on crisis
        - Use surprises to point to flaws in your understanding
        - Use crises as opportunities for action
    - Encourage personal growth
        - Hire people who are committed to learning
        - Invest in helping staff develop skills and experiences
    - Create learning organizations and partnerships
        - Promote organizational learning
        - Build teams of project partners
    - Contribute to global learning
        - Encourage everybody to do good science
        - Get the word out to help other people find you
    - Practice the art of adaptive management
        - Treat adaptive management as a craft
        - Pay attention to your intuition
        - Practice

9. Stankey, G.H., B.T. Bormann, C. Ryan, B. Shindler, V. Sturtevant, R.N. Clark, and C. Philpot. 2003. Adaptive Management and the Northwest Forest Plan: Rhetoric and Reality. Journal of Forestry, Vol. 101, No. 1, January/February 2003.

Definition

- Adaptive management treats actions and policies as experiments that yield learning (it mimics the scientific method: specifies hypotheses, highlights uncertainties, structures actions to expose hypotheses to field tests, processes and evaluates results, and adjusts subsequent actions in light

of those results), and embraces risk and uncertainty as opportunities for building understanding that might ultimately reduce their occurrence. It produces new understanding, based on systematic assessment of feedback from management actions, incorporates that knowledge into subsequent actions, and creates venues in which this new understanding can be communicated

Methodology

- An extensive literature review in the fields of adaptive management, learning theory and decision-making; 50 interviews with regulatory and management agency personnel involved with the implementation of the Northwest Forest Plan; and a review of organizational plans and reports.

Inhibiting Factors

- Failure to implement a rigorous, experimental-based model of adaptive management, relying instead on an approach to decision-making that is informal and incremental but nonetheless widely accepted as what an adaptive approach involves. This has resulted in an inability to test and validate many of the underlying assumptions on which the Northwest Forest Plan is based, and it has similarly limited development of alternatives to the Plan's precautionary direction.

Enabling Factors

- Leadership that asserts itself in supporting an adaptive approach throughout the management and research organizations. This includes establishing stable funding, promoting training and career development options, facilitating development of organizational competency and capability in adaptive management, and encouraging and supporting risk-taking.
- Organizational recognition that adaptive management represents a significant change in how work is done. Such changes must permeate the agency, and the transition to a new way of doing business will require patience and skill, as it involves changes in deeply rooted beliefs, norms, and behaviors.
- Engagement of regulatory agencies as active participants in management experiments, particularly those that focus on questions critical to threatened and endangered species survival and habitat restoration programs.
- Mutual trust among key stakeholders: agencies, citizens, politicians, and the court.
- Sufficient definition, coordination, and communication of activities that foster learning, both within and among agencies and key external interests.

10. Murray, C. and D. Marmorek. 2003. Adaptive Management and Ecological Restoration. Chapter 24, in: Freiderici, P. (ed.). 2003. Ecological Restoration of Southwestern Ponderosa Pine Forests. Island Press (Washington, Covelo CA, London), pp. 417-428.

Definition

- AM is a rigorous approach for learning through deliberately designing and applying management actions as experiments.

Methodology

- A review of case studies of the use of adaptive management in forest management in the U.S. Pacific Northwest and British Columbia, in restoration of Wisconsin pine and oak barrens, and in the management of Glen Canyon Dam on the Colorado River, specifically searching for lessons that can be learned from successes and failures.

Enabling Factors

- Lessons for ecosystem managers from the successes and failures of past adaptive management efforts:
    - Embrace uncertainty and take risks.
        - Build support for AM initiatives by committing to use them as an opportunity to learn. Look for small victories and early successes.
        - Start with problems and pilot projects that can provide new data and insights within one to two years to demonstrate an approach and its value, then tackle larger-scale issues that may take decades to resolve.
    - Think of AM as an innovative alternative to ever-tightening regulation.
        - Use it to rigorously assess the necessity and sufficiency of standards and guidelines, and to foster creative solutions to local problems.
    - Comparisons of multiple pathways speed learning.
        - Accept that more than one management pathway can likely achieve management goals and then compare different pathways by rearranging practices across the landscape.
    - AM must be institutionalized to be successful.
        - Add learning objectives to environmental decision documents.
        - Educate and train resource managers at multiple levels in the organizational hierarchy about AM concepts and processes.
        - Take advantage of the energy, drive, and imagination of innovators at the field level, while supporting them from above. Lead rather than command, and pull staff along by enthusiasm and example.
        - Demonstrate how to do it, for various issues and at various scales; not all AM needs to be large-scale and long-term.
        - Be patient – build understanding and use of AM into the organization slowly, on generational time scales.
    - The roles of both management and science in AM must be clear.
        - Managers are best positioned to learn by doing, and should take the lead; they can rely on other experts for technical assistance with experimental design, data analysis, and so on.
    - Begin with a high-profile “crisis” issue of major concern, or an issue that can be investigated inexpensively and deliver a short-term payoff.
    - Do not limit the time horizon up front. Assume that AM will be undertaken for as long as it takes to achieve goals.
- Lessons regarding participation:
    - Citizen involvement is essential, as society no longer accepts expert-based learning and decision-making. New citizen-manager-scientist partnerships are needed.
    - Involve all stakeholders in developing shared goals and objectives. A good collaborative process is fundamental.
        - AM experiments are a good way to test alternative management actions that arise from different hypotheses and are supported by different stakeholder groups.
        - If necessary, employ conflict resolution to have stakeholders admit uncertainties, and focus constructively on reducing them. Creative solutions are often possible.
- Technical lessons:
    - Choosing proper indicators is critical. Link monitoring to hypothesis testing.
    - Monitor a few indicators well across a number of treatments and reference sites rather than to intensively monitoring many ecosystem components in only a few locations.
    - Look for efficiencies in monitoring.

    - Decide how data are to be analyzed before finalizing sampling methods. Develop statistical methods for initial inventory and monitoring in concert with sampling design.

11. Stankey, G.H., R.N. Clark and B.T. Bormann. 2005. Adaptive Management of Natural Resources: Theory, Concepts, and Management Institutions. Gen. Tech. Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 pp.

Definition

- This reference explores the concept of adaptive management through time and across multiple sources. In summary, it is "learning by doing" with the addition of an explicit, deliberate and formal dimension to framing questions and problems, undertaking experimentation and testing, critically processing results, and reassessing the policy context that originally triggered investigation in light of the newly acquired knowledge. The concept of learning is central to adaptive management. It is a process to accelerate and enhance learning based on the results of policy implementation that mimics the scientific method: experimentation is the core of adaptive management, involving hypotheses, controls and replication. It is also irreducibly sociopolitical in nature.

Methodology

- Review of the extensive and growing literature on the concept and application of adaptive management, from a diverse range of fields including social learning, risk and uncertainty, and institutional analysis.

Inhibiting Factors

- Legal and political constraints (e.g. Endangered Species Act)
- Socio-psychological barriers (e.g. risk aversion)
- Technical-scientific constraints (e.g. lack of adequate knowledge bases or appropriate monitoring protocols)

Enabling Factors

- An institutional atmosphere that is open, participatory, and inclusive, integrative, collaborative, risk-tolerant, and flexible
- Organizational leadership and political support, coupled with skilled advocates and champions at the field level
    - Leadership and ongoing capacity-building efforts by organizations, at all levels
- Transition strategies that enable the transformation from a command-control system to one built upon learning, collaboration, and integrative management; an acceptance that traditional ways of operating have changed.
- Acknowledgement that mistakes and failures are normal when working in uncertain situations.
- Processes and structures that enable alternate forms of knowledge to be obtained and incorporated into the decision-making process.
- Recognition and acceptance of risk and uncertainty.
    - Explicit acknowledgement and acceptance of the limits of understanding and the risks that accompany decisions undertaken in the face of uncertainty.
- Clear documentation describing details of the experimentation process, maximizing the potential for feedback and learning.
- Involvement and support of the full set of partners and stakeholders.

Appendix 2: The Survey Questions

Enabling Adaptive Forest Management

A Introduction (5 minutes)

We are working on a project funded by the US National Commission on Science for Sustainable Forestry, to identify the key factors that enable successful adaptive forest management in public and private sector institutions/organizations. Part of this study involves a survey of AM practitioners within public and private forestry organizations. We are interested in talking to those with hands-on experience in actually leading the implementation of AM. We want to learn from their experiences the factors that were important to the success (or failure) of specific projects that made a sincere effort to use an AM approach. The results of this survey will be discussed at a workshop of selected experts to be held in February 2006, and will be reported and synthesized in the publications that are planned as part of the knowledge transfer stage of the project. Unless we explicitly ask for and receive your permission to quote or identify you, all the information we collect will be presented in summary form only. The interview notes, subsequent analyses and interviews will become the property of the NCSSF.

A-1. Your name, and your and organization's name

A-2. Project Name (could be part of a Program) If you have more than one project, please for this interview use the one that received the greatest effort.

	Question	Gov't	Private	NGO	Academia
A-3	What type of organization provided overall leadership (check one only if possible)				
A-4	What types of organizations participated in the project (check all that apply)				

A-5. Your role in the project and for how long

A-6. Project Duration

A-7. Area Extent of Project (plot, stand, watershed, landscape; hectares)

A-8. Approximate cost of Project (as dollars or FTE-years or both)

A-9. What was the problem or opportunity being assessed? – This could be in your own words or could be a reference to a report or document produced as part of the project.

We define AM this way – "Adaptive Management uses deliberate management actions as a source of learning with the intent to inform subsequent management policy or actions."

	Question	Yes	No
A-10	By this definition, do you think the project demonstrates "successful AM"?		
A-11	Were some uncertainties reduced?		
A-12	Did what was learned during your project end up being used in making decisions about actions or policy?		
	a) If so, can you give some specific examples about what changed?		
A-13	From an AM perspective, what kind of overall ABCF grade would you give the project, with A being a textbook example of successful AM, and F being a complete failure.	A B C F	

B Factors that Encourage or Inhibit AM (20 minutes)

As you reflect upon the successes or difficulties encountered during the project, try to evaluate the factors that enabled / inhibited the overall success / failure of implementing the AM approach.

In the following table, please evaluate the importance of these factors to the success or failure of applying AM to the project. The 2 pages following this table describe and provide examples for each of these factors.

	Factor	Effect on AM						
		Primary Factor for Failure	Strongly Inhibited	Inhibited Somewhat	Neutral or Don't Know	Enabled Somewhat	Strongly Enabled	Primary Factor for Success
B-1	Historical Context							
B-2	Funding							
B-3	Leadership							
B-4	Definitions of Problems/Opportunities and Potential Management Actions							
B-5	Community Involvement							
B-6	Planning							
B-7	Organizational Structure & Communications							
B-8	Executive Direction / Mandate / Legal and Regulator Structure							
B-9	Training of Staff							
B-10	How Science and AM is Conducted							

B-11. Are there important factors that are not on this list?

Open Ended Questions

B-12. Please expand a bit on any factors that you thought were especially encouraging or inhibiting. What attributes of these factors were particularly important?

B-13. What were the circumstances that caused a shift to the AM approach? (either for this project, or for the program that this project falls within. For example: arguments that couldn't be resolved, or where a dramatic demonstration was required to resolve uncertainty)

B-14. What guidance would you give to others undertaking an AM approach to forest management?

Context for Evaluating the Table of Factors

These are descriptive terms for each of the Factors, expressed as general characteristics of the project, the team, or the larger organization within which the project is being undertaken. Examples are provided with both inhibiting and enabling statements, and are provided to help clarify any questions about what the factors mean.

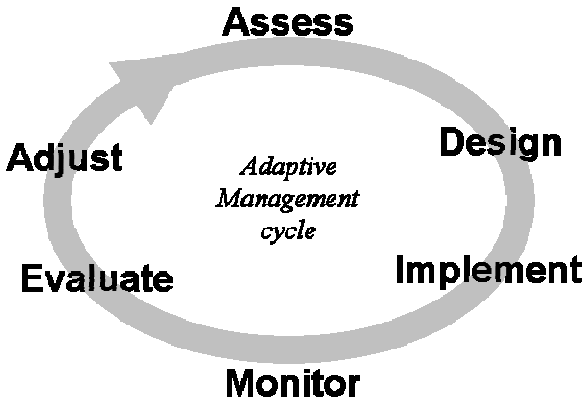
POTENTIAL INHIBITING FACTORS	*POTENTIAL ENABLING FACTORS*
Historical Context	
• Management in the organization has been done the same way for a very long period of time, creating inertia	• There is frequent re-examination of management (actions, products, delivery mechanisms) which prevents institutional inertia from being established.
Funding	
• Entities providing funding (*e.g.* legislature) do not want to see $ spent on experimental management. Funders expect positive results in return for $ invested, and consider evidence that some management actions didn't work as wasted $. • Insufficient human resources and funding to carry out AM experiments. • Policy makers want scientists to provide answers without having to do AM experiments that acknowledge ignorance, and may be risky (and therefore may not get funded).	• Funders recognize uncertainty and are involved in designing intelligent management experiments with 'safe fail' outcomes. Funders buy into learning approach and agree to a contract regarding experimentation so that surprises aren't judged as failures. • *Sufficient human resources and finances provided to carry out AM experiments.* • *High-level political support provided for AM experiments. Uncertainty accepted publicly.*
Leadership	
• Leaders resist change, discourage risk taking and innovation, and repeat past actions. This creates an organizational culture in which staff are expected to do the same. • Staff who show that existing actions aren't working are criticized, and evidence suppressed. • Leaders cautious and defensive to public. • Leaders treat unexpected events as aberrant outcomes that don't negate traditional approaches. • Leadership frequently changing, lack of continuity. • Inconsistent political leadership, and wavering support. • The project has no "AM champion"	• Leaders deliberately challenge themselves to recognize change, innovatively adapt to current challenges and take calculated risks. Create organizational culture in which staff are expected to do the same. • Staff rewarded for generating information that demonstrates existing actions aren't working; failure and learning both celebrated. • Leaders are self-confident, willing to explain or defend AM approaches • Leaders treat unexpected events as catalysts to rethink approaches. • Leadership maintained for longer periods. • Consistent political support. • The project has an "AM champion"
Definition of Problems and Potential Management Actions	
• See problems as linear and break them down into small pieces. Focus on details of the parts over short time horizons and restricted spatial scales. • Rely on engineering technology not designed for dynamic ecological systems.	• See both ecosystems and institutions as non-linear systems that respond dynamically to disturbances. Focus on dynamics of the whole system over long time horizons and large spatial scales. • Rely on management actions that emulate natural

POTENTIAL INHIBITING FACTORS	*POTENTIAL ENABLING FACTORS*
	disturbances, rather than technological fixes.
Community Involvement Processes	
• Institutions isolated from public, or very limited consultation at random intervals. Frequent court cases, advocacy, arbitration. • Agency decides what actions should be implemented at local level. Monitoring done by agency if funds available. • Internally generated "staff" science and data predominant	• See both ecosystems and institutions as non-linear systems that respond dynamically to disturbances. Focus on dynamics of the whole system over long time horizons and large spatial scales. Collaborative inputs to decision making over sustained period, generating buy-in and trust, allowing stakeholders to move from positions to interests, clarifying areas of agreement and disagreement. • Explain goals, and then delegate to local level (e.g. watershed) the task of working out how to achieve them, encouraging experimentation within a framework of consistent monitoring and guidance. • Citizen science, traditional knowledge incorporated into decision-making.
Planning	
• Plan based on past experience, practices, procedures established by senior staff. • Collected information stored, but most not analyzed due to lack of incentives and resources to take a critical look at outcomes of actions.	• Recognize critical uncertainties and plan experiments to test alternative hypotheses / actions. • Use information to produce cognitive change in formulation of issues, maintaining critical reflection over policy-relevant time frames (e.g. > 10 years)
Organizational Structure and Communications	
• Poor internal communication between departments with different mandates, between disciplinary specialists. Difficult to access required information. 'File merge' approach to synthesis. • Focus on management and emergency response rather than learning. • No institutional memory. • Hidden decision processes.	• Collaborative, interdisciplinary working environment with free-flowing communication and easy access to well-synthesized information. Focus on interdisciplinary problem solving, exploration of cumulative effects and dynamics. • Management teams help create time, resources, opportunities for learning teams, whose main job is learning. • Institutional memory is important. • Clarity of decision processes.
Executive Direction / Mandate / Legal & Regulatory Structure	
• Lack of explicit commitment to or direction to use AM at a high level in the organization. • Legal and regulatory structure makes it extremely difficult to implement AM.	• Highest levels in the organization show explicit commitment to AM and call for AM approaches. • AM explicitly recognized in legal and regular structures as a legitimate way to resolve critical uncertainties.
Training of Staff	
• Staff not trained to accept change, to deal with surprises or to focus on learning. • Staff not trained to design and implement AM. • Staff not trained in AM basics	• Staff trained to embrace change, to focus on learning. • Staff well trained to design and implement AM. • Staff are trained in AM basics.
How Science and AM is Conducted	
• Advocacy science to support agency's position (selective evidence). Data kept internal; insist on single, dogmatic agency position regarding data analysis. • Agency scientists do work largely independently from public and other institutions. • Goals of AM experiments not well defined or linked to decisions; alternative hypotheses not defined for key uncertainties; experimental design at wrong spatial/temporal scale or inadequate to provide required insights; and/or poor documentation. • Avoid/ignore cumulative effects due to difficulties of drawing	• Staff trained to embrace change, to focus on learning. • Stress on high quality science at appropriate scale, with independent review panels. Data made available; different interpretations of data welcomed, used to postulate alternative hypotheses and design management experiments. Wide publishing of scientific findings. • Agency scientists interact in 'learning teams' and/or 'transboundary issue networks' with scientists from NGOs, academia and stakeholder groups (incorporating traditional knowledge). Involvement in data collection encouraged to build confidence and trust.

POTENTIAL INHIBITING FACTORS	*POTENTIAL ENABLING FACTORS*
scientifically defensible conclusions.	• Clearly defined, measurable goals of AM experiments, linked to decisions; alternative hypotheses defined for key uncertainties; experiments designed at appropriate spatial/temporal scale; thorough documentation; results fed back into revised decisions. • Consider cumulative outcomes even if scientifically defensible conclusions not possible.

C The Elements of AM (10 minutes)

AM is often described as a **cycle with six main steps**:



C-7. Were there any activities that were part of your AM approach that do not fit into any of these steps?

C-8. Does your organization have an "official" description of AM?

In Section B we considered a wide range of factors that encourage or inhibit AM. Here we zoom in on the elements of the tenth factor: how AM was conducted. We would like to work through the questions giving simple answers. The '?' column can used when you don't know how to answer a specific question.

	Assess and define the problem	Yes	No	?
C-1	Was this step part of your project?			
C-1.1	Did you have a clearly stated management goals or objectives?			
	a) What were they?			
	b) Was "learning about the system" one of them?			
C-1.2	Did you identify/explore alternative actions to achieve them? (implicit recognition of uncertainty)			
C-1.3	Did you identify measurable indicators of these goals or these objectives?			
	a) What were they, or at least what were a few of them?			
C-1.4	Did you identify spatial and temporal boundaries to these goals/objectives, actions and indicators?			
C-1.5	Did you explicitly identify key uncertainties about how the actions will affect the indicators?			
	a) What were they?			
C-1.6	Did you articulate these as hypotheses to be "tested" through different management actions?			
C-1.7	Did you build a conceptual model of the problem?			
	a) What other tools did you use (e.g. computer simulation models, decision analysis, stakeholder workshops)?			
C-1.8	Were assumptions explicitly stated about how the system works, or cause/effect relationships between the actions and indicators?			
C-1.9	Did you involve stakeholders in the assessment and definition of the problem?			
C-1.10	Did you involve scientists in the assessment and definition of the problem?			
C-1.11	Did you involve managers in the assessment and definition of the problem?			
C-1.12	Were there any reports describing this step?			
	a) If so, the reference?			

	Design actions	Yes	No	?
C-2	Was this step part of your project?			
C-2.1	Did you decide to proceed with more than one management action (i.e., "active AM")?			
C-2.2	Did your design include creating contrasts in either space or time, replication, controls, and avoiding confounding?			
C-2.3	Did you receive statistical advice for the design step? (e.g. power analysis)			
C-2.4	Did you predict outcomes from these actions (in terms of indicator response) prior to actually undertaking them, based on current knowledge?			
C-2.5	At this stage did you think about what you would do in terms of "next steps" under different outcomes?			
C-2.6	Did you develop a data management plan?			
C-2.7	Did you develop a monitoring plan?			
C-2.8	Did you write up a formal AM plan?			

	Design actions	Yes	No	?
	a) Was it for one year or multiple years?			
C-2.9	Was the design peer-reviewed?			
C-2.10	Did you establish a multi-year budget commitment for the project?			
	a) Did it include contributions from multiple contributors?			
C-2.11	Did you involve stakeholders in the design step?			

	Implement actions	Yes	No	?
C-3	Was this step part of your project?			
C-3.1	Were contrasting treatments carried out in the field, over space or time?			
C-3.2	Were the actions implemented as designed?			
	a) If not, was this clearly documented, and then communicated to those involved in interpreting and evaluating the outcome of the management experiment?			
C-3.3	Was there some form of implementation monitoring to track and confirm this?			

	Monitor	Yes	No	?
C-4	Was this step part of your project?			
C-4.1	Did you implement the monitoring plan as designed?			
C-4.2	Did you do effectiveness monitoring (i.e. of the indicators discussed in step 1 above)?			

	Evaluate results	Yes	No	?
C-5	Was this step part of your project?			
C-5.1	Were the monitoring results compared against the goals or objectives?			
	a) Was a determination made about which actions were effective (or not)?			
C-5.2	Were the monitoring results compared against the assumptions, uncertainties and hypotheses identified earlier in the process?			
C-5.3	If you used a computer model, did you compare actual results to those predicted by the model at the design stage?			
C-5.4	Did you receive statistical or analysis advice for the evaluation step?			
C-5.5	Did the data analysis keep up with the data generated through monitoring? (e.g. annual evaluations or reports)			

	Adjust and revise hypotheses and management actions or policies	Yes	No	?
C-6	Was this step part of your project?			
C-6.1	Did any meaningful learning occur?			
	a) If so, what was learned? (Briefly!)			
C-6.2	Was this communicated to decision-makers/policy-makers?			
	a) How?			
	b) What was done with this information?			

	Adjust and revise hypotheses and management actions or policies	Yes	No	?
C-6.3	Were any management actions, policies, guidelines, BMPs or other instruments revised based on what was learned?			
	a) What reports or documents were created?			

How influential was the level of completion of each of the above major Elements in affecting the overall success of AM in this project?

	Element in AM Cycle	Effect on AM Success of Level of Completion of this Element						
		Primary Factor for Failure	Strongly Inhibited	Inhibited Somewhat	Neutral or Don't Know	Enabled Somewhat	Strongly Enabled	Primary Factor for Success
C-9	Assess and define the problem							
C-10	Design							
C-11	Implementation							
C-12	Monitoring							
C-13	Evaluation of results							
C-14	Adjustment / Revision of Hypotheses and Management							

D Perspectives on Public and Private AM (5 minutes)

How do you respond to this statement?

	Strongly Disagree	Disagree Somewhat	Neutral or Don't Know	Agree Somewhat	Strongly Agree
D-1. AM is working better in private sector forest management than in public sector forest management.					

If you agree or disagree, please elaborate.

E Some Open Ended Questions (5 minutes)

E-1. Were management policies or practices revised in light of learning that took place during your project? Is there any written documentation of this learning and change in policies/practices?

E-2. Were there any surprises during the project? What were they? How did you deal with them and how did they affect the project?

E-3. If you could turn back the clock and start your AM project over again, and could change one thing to make it more successful, what would that be? Why?

E-4. If you could give 2 or 3 pieces of advice to someone just starting to implement AM, what would that advice be?

E-5. Did you learn anything about the AM process as a result of the project?

E-6. Is there anything else you have learned through your experience in trying to implement AM, that you think is important, but we've not yet discussed?

E-7. Do you know of other successful AM projects? Which ones? Who else should we be talking to?

Appendix 3: Survey Participants

ID code	First Name	Last Name	Organization	State or Province
10	John	Cissel	BLM	Oregon
17	John	Gerritsma	BLM	Oregon
13	Dan	Devlin	Bureau of Forestry	Pennsylvania
6	Bill	Beese	Cascadia	British Columbia
16	Jay	Francis	Collins Wood	California
12	Steve	Gatewood	Greater Flagstaff Forest Partnership	Arizona
8	Kenneth	Munson	International Paper	Tennessee
2	Bill	Bourgeois	Lignum	British Columbia
20	Wayne	Barfield	MeadWestVaCo	South Carolina
1	Brian	Nyberg	MOF	British Columbia
4	Jim	Rice	OMNR	Ontario
7	Liz	Dent	Oregon Department of Forestry	Oregon
19	Jeff	Brandt	Oregon State Forests Program	Oregon
15	Mari	Wood	Peace Williston Fish & Wildlife Program	British Columbia
14	Fraser	Corbould	Peace Williston Fish & Wildlife Program	British Columbia
11	Bernard	Bormann	USFS	Oregon
9	Phil	Kemp	USFS	Colorado
5	Mike	McClellan	USFS - PNW	Alaska
18	Peter	Heide	Washington Forest Protection Association	Washington
3	Scott	McNay	Wildlife Infometrics	British Columbia

A survey from Gary Blanchard of Starker Forests was received too late to include in this Discussion Paper.

Appendix 4: Brief Summary of Each Project Surveyed

McCully Creek Watershed

BC Ministry of Forests
British Columbia

This project was aimed at assessing alternative forest management regimes in the northwest transitional zone, and the desire to develop and test harvesting practices that were less oriented toward large clearcuts. The project was motivated by a "crisis of change" that included many factors: collective unhappiness with previous management regimes, typically large clearcuts; the collapse of pulp and timber markets in the area; risk to steelhead streams, and the creation of the BC Forest Practices Code, which provided top level direction for the project. The project enjoyed support across federal and provincial government agencies and a high level of trust and willingness to give the AM approach a good try. A number of internal reports were created, some best-practices guidelines were altered, and some talks were given to business groups. Archives are available.

Over a period of four years a total of 25K hectares were manipulated at a cost of $150K, not including routine logging costs. Although experiments lasted a short span of years, the practices tested over this period are intended to be applicable to a good part of a 120 year rotation. A long list of indicators includes timber yield and quality, bird and mammal responses to change in canopy, water quality and regeneration. Experimental manipulations were carried out essentially as designed, with small modifications to accommodate logging crews. As a result of the project some standards for partial harvest and regeneration have changed.

The project suffered slightly from a failure to maintain momentum following routine staff turnover, but the two project leaders took strong leadership roles for the first four years. Greater spatial replication of treatments was intended, but has not been implemented. The provincial budget cycle is annual only, and even though planning may extend a project a number years into the future, there is no guarantee of future funding.

Forest Grassland Study

Lignum
British Columbia

This project was aimed at experimentally studying whether stand thinning policies could affect the forest grassland interface, and control the encroachment of forest into grassland areas. It was intended to be a multi-year study that tried to find a balance between economically viable forestry and more open grassland conditions. The project design included monitoring the costs of harvesting under a selection system, the success of methods to incorporate smaller wood, the amount and kinds of grass initiation.

The project suffered from a number of difficulties related to leadership and funding. There was a lack of top level support or supporting policy from the organization, and the perception that operational trials should provide results within 1-2 years. Since this project was not able to provide results this quickly (5 years would have been a minimum), it was perceived as discretionary research and of little operational

significance. Failure to have a top level policy for AM trickled down to all levels, and attempts to develop support did not succeed. There was resistance to the scientific rigor and the high cost of AM. A passive AM approach with less monitoring might have been more acceptable. (Lignum was bought by Riverside Forest Products, which was subsequently purchased by Tolko Industries.)

Adaptive Management of Pine-Lichen Woodlands

Canfor Corporation
British Columbia

The goal of this project was to find silvicultural methods to maintain and enhance terrestrial lichens for Mountain Caribou following harvest, and was part of a larger Caribou research program. The project was motivated by issues raised in the provincial Landscape Regional Management Plan (LRMP), as well as a desire to avoid land use conflicts like those that occurred elsewhere in the province.

The ongoing project has been operating for 5 years with annual costs of about $38K, not counting routine logging operations. The project has a fairly loose organizational structure, and the mandate falls under the LRMP. The project members are young and open-minded, but do not have extensive experience in AM. The experimental design includes 3 replications of 9 treatments of about 1000 hectares each. Pre- and post-harvest harvest lichen abundance is being monitored under a variety of clearcut silvicultural and yarding systems. Although fast-response variables are viewed more favorably, the slow growth of lichen makes it essential that the program continue for several years in order to track lichen response to different stand management practices. The project is expected to produce best management practice documents and policy improvements, some of which are pending.

The project has suffered somewhat following the administrative centralization of Canfor, moving company personnel farther from the field setting: the project would likely not be approved if it were proposed today. However, as a result of the project's existence, the company was able to have revised spring harvesting plans approved quickly. Paradoxically, anticipated changes to provincial logging regulations for sites with ungulate winter range, prompted by this research, may be perceived by Canfor as a bit onerous.

Developing Sustainable Mixed Wood Practices in a Stand Level Adaptive Management Framework (SLAM)

Ontario Ministry of Natural Resources
Ontario

This goal of this project was to develop operational scale methods for the sustainable use of mixed wood forests in Ontario. AM was adopted because of the general lack of understanding about the behavior of mixed wood systems and stand treatments: the productivity of crop trees after management or harvest, subsequent success of seedlings, or other ecological effects. Among the project partners there was openness to doing a case study, and AM was expected to accelerate the pace of learning for such large scale experiments.

The project began with AM training modules for all partners. Industrial partners tend to want to figure out a plan quickly and then do it immediately, but AM "speed" is constrained to the cycle of the research trial. Although the project has good industry support and an understanding that AM learning and results will take some time, the length of the AM cycle is a concern when experiments take over 2 years to

complete. The project has been under way for 5 years now, using treatment units of 100-300 ha in 2 locations. The annual budget of the 10-year project is about $100K, with additional in-kind funding from industry and research partners. Initially, project planning was a bit inhibiting, since mixed wood is not traditionally thought of as a managed resource. This has improved with improved experience. Experimental treatments have generally followed the design plan closely.

More spatial replication was intended, but had to be scaled back because of funding constraints and the cost of field work. It is a challenge to try to maintain the integrity of the research plan when funding is reduced and priorities shift faster than the experiments. The project has also suffered slightly from staff turnover. As the initial champions move elsewhere, subsequent leaders may not show the same commitment. Continuing education is suggested as the means to keep new personnel on track.

Tongass Wide Young Growth Studies (TWYGS)

USDA Forest Service
Alaska

This purpose of this project was to discover whether it was possible to develop stand structures that would support deer foraging during the stem-exclusion stage that occurs 15-20 years after clear cut harvest. Deer forage has historically been very low during this period of stand development. There are four experimental trials, each with 20 replicates along a north-south transect spanning a variety of habitats. By including stands at different stages of maturity, time is also an experimental variable. Understorey biomass, nutritional quality, a deer forage supply model and a stand growth model are all used to assess usefulness for deer and for timber quality. The project was prompted in part by frustration with fragmented decision making and a lack of follow through and weak experimental design in earlier studies.

The study began in 2001 and has made use of the entire Tongass National Forest $7M research budget in some years, as well as involving participation from other federal and state agencies. The addition of AM-specific components to the normal timber-improvement program added only a few percent to the cost of the program. The project has a strong champion and most of the participants – researchers and managers – have worked together for years. In addition to a high level of trust among participants, there is also a strongly shared view that management must be integrated across agencies. These attitudes have all helped to achieve and maintain consensus. The experiments are also highly visible (some involve extensive fencing), which has helped to publicize the research.

Preliminary results are being used to develop plans for Prince of Wales Island, and the results are set up to feed into the decadal update of the TNF management plan.

Coast Forest Strategy

Weyerhaeuser, BC Coastal Group
British Columbia

This project was initiated in 1997, prompted by two key marketplace forces in coastal BC: the ecological simplification and aesthetic shortcomings of clearcut harvesting; and pressure to halt logging in old growth stands and create more reserve areas. The decision to phase-out clear cutting on a tenure that currently comprises 800,000 hectares had dramatic impacts on logging operations and the potential for negative impacts on forest growth and future yields. The expected benefits for biological diversity and wildlife habitat were well-reasoned but largely untested. For these reasons, an AM approach was adopted

so that the outcomes could be scientifically tested and documented and changes made if a balance of economic, social and biological benefits was not achieved.

The goal being evaluated by the AM program is to sustain biodiversity, or native species richness and associated values, within the company's managed forest land-base. Monitoring is focused on three indicators:

1. The full range of ecosystems represented in un-harvested areas to maintain lesser known species and ecological functions.
2. Stand and forest structures important to sustain biological richness are maintained over time.
3. Productive populations of forest-dwelling species are well distributed.

Currently 9 of 15 planned operational experimental sites have been established. A group of five leaders guided the AM team, which has been supported corporately and through a number of government programs, with an approximate total cost of about $3M. The program has been widely supported within the company by other forestry staff. Government cooperation has also been very good. Communication is strengthened by public advisory groups and working groups to address issues; over 250 staff (foresters through to machine operators) received a 4-day training course. Information has also been shared with other forest companies, some of whom are cooperators. An international peer review panel has been set up to provide advice on scientific and technical issues.

A key piece of good advice from this panel has been the importance of not diluting the AM effort by trying to measure everything: it is better to do a few things well rather than many things poorly. It is suggested that the AM process could be further strengthened by the creation of a regional cooperative organization that would receive and disburse financial support indexed to the portion of AAC of the participants. The need for strong commitment and financial support from corporate leadership is crucial, and operational staff must also adopt the process. This requires time, and leadership and training are essential to success.

(The project was originally begun by MacMillan Bloedel, under the name “The Forest Project”. It was subsequently renamed “Coast Forest Strategy” by Weyerhaeuser and continues under the current owner, Cascadia Forest Products.)

Riparian Function Study

Oregon Department of Forestry
Oregon

This purpose of this project was to test the effectiveness of current harvest regulations at maintaining shade and large wood recruitment in and adjacent to small and medium streams. The project was prompted by a committee of stakeholders formed to examine harvesting regulations. The trials monitored large wood recruitment and shade index on streams with different buffer width setbacks. Previous experimental studies had not included monitoring and evaluation steps. A secondary goal was to record stand composition and conifer regeneration in riparian areas.

Twenty-four sites were set up and followed over a three-year period at a cost of about $115K. The study found that wood recruitment was reduced under current harvest regulations, and unlikely to meet management objectives. Once the results were adequately understood, they were supported and accepted by private land owners. Stakeholder support was important in the review process, along with an emphasis

on areas of certainty and uncertainty. The results of the study have been adopted in the Oregon Forest Practices Act and are being considered in other legislation and by other state agencies.

The experimental design would have been stronger if it had used before-after control-impact principles and more adequate replication and randomization. A more difficult issue, not part of the original scope of the study, was that decision makers really wanted to know the experiment's biological significance to fish. A clearer inclusion of social and economic impacts in the project scope would also have made an explicit linkage between regulation change and employment and profitability. These questions are important, and weren't asked until the very end of the project.

Genesys Landscape Planning System

International Paper
Tennessee

This project was prompted by the decision to adopt the SFI forestry certification system, which incorporates AM principles as one method of improving forest management. The 3-year project created a spatially referenced database and management/harvest planning system for all IP forest holdings, covering 22 states and 3.2 million hectares. Now that the landscape level system is in place, specialized management, green-up, riparian buffers and special areas are under much more rigorous protection and monitoring. The corporate model is closer to one of continuous improvement.

The development received strong executive support and vision for the necessary features. Before the decision to create the system there was failure to recognize the importance of change issues and underestimation of the amount of effort required to overcome cultural and training inertia. Managing the "people" side of the process was important to development: regular meetings identified technical and learning barriers as the system was developed and applied.

Note: this project is different from the others – it is more about a tool for the application of AM than a project in which an AM approach was used.

Ponderosa Pine Forest Partnership

USDA Forest Service
Colorado

The goal of this project was to develop stand-level management prescriptions that would help to move a 3,600 ha landscape on a path thought to be representative of pre-civilization stand structure. The project was prompted by the disappearance of traditional logging and the recognition that an ecosystem-based approach was necessary, but which would also continue to provide small size timber. Great care is taken that the natural range of stocking variability is maintained during stand treatments. The project was also motivated in part by confrontation and distrust from the public.

The project has been in operation for over 10 years and includes thinning trials and prescribed fire. Apart from some academic and county support, the principal funding source is annual, so care has been taken to build the program into existing stand management budgets.

The program also requires markets for small dimension wood. Management emphasizes ecosystem stability over potential fiber-production, and tries to create stand structures that once treated, will on

average, naturally grow into a pre-civilization condition. Initially it was difficult to get project support from fire specialists trained in suppression, as well as some wildlife resource managers. This was overcome in part through a search for common goals, paying attention to other points of view, and through on-ground trial demonstrations of timber sales and prescribed burns, to win support.

The project started with a rigorous academic approach which has become more practical and less rigorous over time. One other ongoing challenge of the project has been to find markets for small dimension timber.

Blue River Landscape Study

USDI Bureau of Land Management
Oregon

This project was established as part of the Central Cascades Adaptive Management Area (AMA) created by the Northwest Forest Plan (NWFP). The goal of the study was to use AM approaches to encourage and monitor the creation of late succession habitat with the emphases of emulating natural disturbance processes and providing a sustainable timber supply. The initial intention was to design and perform experimental manipulation across watersheds, focusing on spotted owl, coarse woody debris and streams. Because of NWFP constraints, the final program was more focused on monitoring and experimental manipulation was curtailed.

The project covered a 23K hectare watershed and continued for 12 years, with annual monitoring and salary costs around $150K. The study was led by two committed champions, with one of the leadership positions receiving dedicated funding. A key reason for success was the partnership of science and management that are part of the history of the region (H.J. Andrews Experimental Forest), with innovative and positive attitudes from the participants. An earlier prototype project was also very useful, and gave clarity to the subsequent activities. Overall, the project was considered very successful locally: the disturbance regime concept was adopted in the Umpqua National Forest management plan, and initiatives and attitudes were strongly positive. Many briefings and field tours were also given.

Regional results were less remarkable than local, but some approaches (for example, riparian management and thinking at the landscape scale) may still be evolving in response to the Blue River "template" even though the project has ended. Paradoxically, the NWFP proved to be inhibiting to active AM because of management restrictions inherent in the NWFP, especially a focus on endangered species that constrained testing new management approaches. In retrospect, the time required to implement AM projects and programs was not appreciated, and stronger partnerships with a broader group of stakeholders (for example, NGOs) might have helped to modulate the political extremes that were encountered. Recently, the approaches developed in this Study have also been challenged by administrative reorganization of the Ranger District, and much restricted staffing.

Five Rivers Landscape Management Project

USDA Forest Service
Oregon

This project began as part of the North Coast Adaptive Management Area (AMA) created by the Northwest Forest Plan (NWFP). The primary goal was to find ways to achieve late successional habitat at a landscape scale and in riparian areas, starting from managed plantation stands. Other goals were more

process-oriented: finding new experimental design approaches and ways to include learning objectives in NEPA documents.

Clear-cutting restrictions were put in place after the NWFP and much of the Five Rivers landscape became protected as late successional stage habitat. Thinning in plantation stands subsequently became an acceptable activity to both the logging and environmental communities. As trust developed among stakeholders, different management options were considered; including randomized and replicated thinning, with monitoring of stand structure. The project's single greatest achievement was the inclusion of learning as an objective in the NEPA decision. Some related positive outcomes were the development of impact statements geared to the landscape scale, and the adoption (here and elsewhere) of late successional reserves with widely spaced trees. The creation of interdisciplinary teams initially caused conflict, but eventually the groups learned to find a middle ground with the result that resource integration was improved. Organizational barriers are large, and persistence is required to make any progress. The team tried to institutionalize AM through learning objectives in the NEPA document. Although tedious to implement, they were able to create a NEPA document with a focus on finding evidence to link science with decisions, and each Purpose and Need statement in the document was prefaced by a learning objective. The project has also had some influence on subsequent planning decisions, and widely spaced thinning is now commonly accepted as a means of hastening late succession.

The project suffered from a lack of high level commitment, the inhibiting aspects of the NWFP and the fear of legal action by other government agencies. Initially the project also included an advisory committee of stakeholders. But after two years of involvement, environmentalists in the group withdrew their support and became antagonists. Although the project leaders found that members of the public may be interested in participation, they have little capacity for technical involvement in extensive projects. Finally, the project has suffered from insufficient regional scale funding. With a budget reduction of 70% in the last decade, many options cannot be pursued, even though policy makers continue to ask scientists to provide answers.

Fort Valley Ecosystem Restoration Project

Greater Flagstaff Forest Partnership
Arizona

The goal of this project is to use AM to find ways to restore forest health in the urban interface forest, creating a range of stand structures resistant to catastrophic fire, restoring normal ecosystem function, as well as monitoring and demonstrating the experimental treatments to stakeholders and the public. The project was prompted by complaints from the local environmental community which forced the landowner (USFS) to test and adopt new approaches to fire risk management. Approaches have included the increased use of prescribed fire following mechanical treatment and various treatments for manipulating fire behavior. There are a total of 7 replicated treatments, all based around thinning regimes. Ground cover response, ecosystem diversity and productivity and fire hazard are all monitored on the 800 hectares marked for experimental manipulation.

The project has been ongoing for 5 years at a total cost of about $1M, financed primarily through support from BLM and USFS. Adaptive Management is an explicit part of the agreement, with an emphasis on new approaches, mutual accountability and learning. Generally there is a strong collaborative spirit in the project; decisions are reached only after unanimous agreement among the 24 partner organizations. The project also enjoys good linkages with the academic community. Restoration goals have been devised through stakeholder workshops, supported by some modeling studies. Funding has been strong for fuel reduction programs, with less for research, and some independent environmental groups have begun to

fund and carry out their own experiments using agreed-upon analysis and monitoring methods. One important result so far has been a necessary tradeoff between light thinning, which favors ecosystem function and endangered species and does not significantly reduce catastrophic fire hazard; and heavy thinning, which has the reverse effect. It isn't possible to have both in the same place.

The project has been challenged by the difficulty of finding markets for woody biomass and small diameter trees; there is not yet any sustained economical use for these restoration by-products. Also, the need for tradeoffs and differing viewpoints (for example, whether to all *any* harvest of large timber) has sometimes led to "dueling science", with science used to defend opposing positions. In other cases where opinions have not been unanimous, some treatments have been eliminated near the urban interface. For similar reasons, experimental treatments have also been limited in size. Although informal link with state and federal agencies has been healthy, the formal linkages have not always been positive. Better written agreements with these agencies and among all stakeholders, has been suggested as one way to improve clarity and communication.

Pennsylvania Forest Resource Plan

Pennsylvania Bureau of Forestry
Pennsylvania

This project was prompted by public concern over the future and management of the state's 850K hectares of forested lands, as well as by concerns over the increasing age of the state's forest inventory and planning guide. Inertia eventually gave way to adoption of ecosystem-based management in which a much shorter planning cycle that includes AM, is now seen as necessary. The new approach was preceded by five years of planning, which helped to clarify issues, especially around goals for old growth and age class distribution of timber, and a range of non-timber indicators.

The initiative was strong supported by the governor's office, and the coincidental timing of elections helped to provide acceptance from all political sides. Once there was strong support from state leaders, the Bureau's infrastructure became strongly enabling of ecosystem management. Training programs were developed and delivered to educate staff about ecosystem management, AM and biodiversity goals. An extensive public consultation also revealed some pointed conflicts over recreational use plans, which were subsequently revised. The public attachment to old growth sites also became clear, and a new class of reserves was added to reflect this. The state is currently exploring ways to meet a goal of 20% in this class.

Note: this project is different from the others—it is more about the adoption of an AM approach than a specific application of AM.

Donna Creek Adaptive Management Trial

Peace Williston Fish & Wildlife Compensation Program
British Columbia

This project is a partnership of the province's power generation utility and the provincial government, with the goal of determining whether alternative harvesting practices that create snags are able to maintain or improve habitat for songbirds and cavity nesting birds. The design incorporates 3 replicated sets of 100 hectare cut blocks. In addition to monitoring use of snags over a 30 year period through bird censuses, the project is also tracking snag decay and size distribution over this period.

The project has been ongoing for 15 years. Apart from routine logging, the project will cost a total of about $190K next year, and enjoys committed long-term support and funding from the power utility. Some analyses have already shown the benefit of leaving tall snags as bird habitat in regenerating stands, and this practice has been adopted by some other harvest licensees locally.

There are areas of still some scientific uncertainty about the most appropriate indicators of snag dynamics, especially as regenerating stands mature. In addition, although habitat may be improved, it is not known whether predation has also increased in the cut blocks. The project would also have benefited from more replication, greater distance between the treatments and before-after treatment comparison of habitat use. The close proximity of contrasting treatments confounds some analyses, and fur-bearing mammals were dropped from the study because of overlap of their ranges with different treatment blocks. This constraint is a fact of life, since harvest locations are constrained by factors beyond the control of the Peace Williston Program.

Ospika Mountain Goat Adaptive Management Trial

Peace Williston Fish & Wildlife Compensation Program
British Columbia

This project is a partnership of the province's power generation utility and the provincial government, with the goal of determining whether harvesting has a negative impact on the movements of Mountain Goats migrating from alpine areas through cut blocks to valley-bottom salt licks. Current harvest regulations assume a negative impact, and require that a block be moved if goat trails are found within the block. Through mapping of licks in adjacent drainages it has been possible to design experiments to test this assumption. A variety of telemetry and video recording methods are used to measure the timing, location and frequency of goat movements in control and treated areas.

The Peace Williston Program recognizes the need to design experiments at the population level and has been very supportive of large spatial-scale trials and experimental rigor. The project has been underway for 7 years and field work is expected to continue for another two years. Not including logging costs, it enjoys secure annual funding of about $140K from the power utility and is overseen by a core group of experts who review the work plans annually. Surprisingly, goats have been found to prefer cut blocks. With their good visual abilities, open areas may help them avoid predators.

The project suffers from the difficulties of all large-animal experiments: sample sizes are small, and animals can move over long distances and change their habits over time. The project has also been slightly hampered by difficulties interacting and negotiating with a changing group of forest licensees responsible for designing and harvesting the block. Improved communication with licensees, perhaps including a written MOU, might help to improve and manage the timing of entries, if not the location.

Almanor Forest Group Selection Harvesting

Collins Pine
California

The practice of group selection harvests—removing a group of a few trees—has evolved over time, beginning with anecdotal observations that small area openings embedded in continuous stands could encourage the regeneration of valuable shade-intolerant pines. The practice of intentionally creating small

openings has since been expanded to cover most harvest entries. The status of all group selection units is monitored through annual site visits. In addition to site measurements, sequential photographic documentation of openings is commonly used, creating a library of regeneration images over time.

As a result of trial and error with stand openings, much of their 38K hectares are now managed with group selection. In some settings they continue to practice single-tree selection. Guided by their group selection experience, these stands are often harvested quite aggressively at less frequent intervals, providing light for regenerating trees, with less disturbance to the local environment.

(Survey filled out without interview)

Applegate Adaptive Management Area

USDI Bureau of Land Management
Oregon

The principal goal of this AMA is to develop approaches to encourage low-impact harvesting, learn to use prescribed burning to create fuel breaks and reduce fire risk, and provide collaborative opportunities for the public to learn about AM. At least 18 AM projects took place in the 200K hectare area, with $100K in annual funding provided by BLM and USFS. There is limited documentation of the projects: a number are replicated trials of thinning treatments intended to reduce risk of bark beetle attack.

(Survey filled out without interview)

The Forests and Fish Report

Washington Forest Protection Association
Washington

The principal goal of this 8 year project was to create a management framework among all forest stakeholders in Washington: federal, state, county, tribal and private landowners; to revise forest practices to protect fish, amphibians and water quality. The area affected by the framework is about 3.2M hectares, and $3M/yr is received across all agencies for support and staff. The agreement and subsequent legislation include guidelines, program and funding for AM studies. A variety of studies were proposed: assessment of riparian habitat indicators; methods for stream classification; methods road maintenance and sediment control; over 50 questions in total have been proposed as needing science-based recommendations to reduce uncertainty and improved forest-stream practices.

AM will be greatly strengthened if science is conducted thoroughly and impartially. Highly qualified scientists should be engaged to debate the evidence produced by investigations, and should be responsive to a review process. Skilled policy people who can accurately judge scientific evidence and suggest solutions to issues will also be very helpful. Clarity helps to bring consensus where there is uncertainty. While time consuming, consensus can bring significant change in advance of formal legislation. Good relationships among stakeholders are important for site-based studies, where on-the-ground cooperation is required. In the respondent’s view, good funding is also very important for successful AM, since investigations are usually expensive and lengthy. Funding for small landowners usually limits their participation.

The program has suffered from a very large number of questions and very large funding. The new organization was overwhelmed by the tasks, with time and money wasted. There should have been a better way to prioritize the technical investigations, and more resources should have been spent of finding excellent program managers.

(Survey filled out without interview)

Commercial Thinning and Swiss Needle Cast

Oregon Department of Forestry
Oregon

The goal of this study was to clarify the effects of thinning on the occurrence and severity of Swiss needle cast, a fungal infection of Douglas-fir. Trials on paired permanent plots have demonstrated that commercial thinning does not increase the severity of outbreaks, and that residual stands respond positively to treatment.

The study was supported by a state and university cooperative with an annual budget of $200K, active for 8 years so far; formed to investigate the epidemiology of the disease and fungus, design silvicultural treatments to minimize the impact of outbreaks and to understand the response of the host tree to the disease. Other studies recently supported by the cooperative have developed physiological simulation models, foliage retention and litter fall models and investigated the use of fungicides.

(Survey filled out without interview)

Leave Tree Harvesting System for Appalachian Hardwoods

MeadWestvaco
Virginia

The chief goal of this study was to research and design a harvest system that would provide an alternative to clearcut, which would encourage the natural regeneration of Appalachian hardwood species. Other goals were to create a more aesthetically pleasing post-harvest landscape and to maintain or improve wildlife habitat values. The leave-tree sites were developed on sensitive and highly visible sites. These sites would previously have either been completely set aside or else would have produced undesired regenerating species.

This 5 year project was initially delayed by historical inertia. Traditional hardwood harvesting was by complete clear cut, and the idea of leaving behind a proportion of smaller trees was viewed as unprofessional. The project was aided by the difficulty of finding commercial markets for smaller trees and by the waste created in clearing the smaller timber. Local community involvement prompted field foresters to consider the new alternative and to recognize the increased value to birds and other wildlife when small timber was left standing. Good leadership and cooperation with research staff created a set of trials to study tree growth and survival, and was convincing for field forest staff. The research results aided in the design of a harvest system that retained leave-tree species best suited to subsequent stand development. Leave tree harvests are now included as an option in management policies, especially on sensitive sites.

(Survey filled out without interview)

Culvert Replacement Program

Starker Forests
Oregon

This project began with inspections that sometimes showed obstructions to juvenile or adult salmon passage through road culverts. The goal of the project was to develop and implement a 10-year, $1M replacement program that would ensure successful fish passage through culverts, and was established to meet the voluntary objectives of the Oregon Plan for Salmon and Watersheds.

Culvert replacements have been designed to accommodate low water years and to allow natural channel gravels to accumulate through the passage. Surveys have shown that adult spawners make immediate use of the new culverts and observations of juvenile migration are under way. Site-specific adaptations were made to installations, guided by past experience, and bridges are considered an alternative stream crossing if a culvert remains impassable or unused. The family-owned business is committed to maintaining flexibility in their operations and to ongoing learning from their field experience.

(Survey filled out without interview)

Appendix 5: Workshop Participants

Name	Affiliation
Bill Beese	Cascadia Forest Products (Weyerhaeuser), Nanaimo BC
Bernard Bormann	US Forest Service, Corvallis Forestry Sciences Laboratory, Corvallis OR
Bill Bourgeois	New Directions Resources Management, North Vancouver BC
Jeff Brandt	Oregon Department of Forestry, Salem OR
Terry Johnson	Science Coordinator, BLM state office, Portland OR
Phil Kemp	US Forest Service, Dolores CO
Brian Nyberg	BC Ministry of Forests, Forest Practices Branch, Victoria BC
Hal Salwasser	Oregon State University College of Forestry; NCSSF, Corvallis OR
Mike Schnee	Oregon Department of Forestry, Corvallis OR
Randy Selyma	Wildlife Infometrics, Mackenzie BC
George Stankey	US Forest Service (retired), Seal Rock, OR
Lorne Greig	ESSA Technologies Ltd., Richmond Hill ON (facilitator)
Dave Marmorek	ESSA Technologies Ltd., Vancouver BC (facilitator)
Carol Murray	ESSA Technologies Ltd., Quadra Island BC (facilitator)
Don Robinson	ESSA Technologies Ltd., Vancouver, BC (facilitator)