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Abstract: This paper describes the approach being used to engage stakeholders for the development of the River Manager river systems modelling tool, which is designed to simulate river system hydrology and water management rules for water management planning. River Manager software is being developed to replace three river system models (MSM-Bigmod, REALM, IQQM) that are currently applied in different parts of the Murray-Darling Basin, Australia. Engagement is occurring as a multi-part process that comprises the following elements: (1) An initial round of stakeholder discussions in 2005/06 that elicited the user requirements. This process was repeated in 2008/2009; the requirements were largely unchanged. (2) A governance structure organised into three levels: (a) technical user group providing technical advice; (b) technical managerial group deciding requirements and approving functionality specifications; and (c) steering committee of user representatives providing strategic direction. Interactions between the project and these governance groups are mostly formal, through periodic meetings and out-of-session papers. (3) User acceptance testing that is via four complex river system model trial applications. (4) Other stakeholder communication processes, which include bi-annual planning meetings, monthly project update meetings, fortnightly eNewsletters and shared files stored on a SharePoint site. For a wider audience, there is user documentation and training materials, training workshops, public seminars, exposure in the corporate magazine and descriptive fliers. This formal approach to stakeholder engagement has some advantages: (a) encourages all identified stakeholders to be active in the decision-making process; (b) provides equity of stakeholder influence; (c) provides a transparent forum for decision making; (d) fosters cohesion of vision and commitment; (e) is important for achieving a collective responsibility for project success; (f) achieves stakeholder buy-in to the project; (g) ensures the software is fit for purpose, technically and for policy development; (h) provides a pathway for uptake and adoption; and (i) socialises project performance risks. The main disadvantage is that the governance gates in the engagement process slow project progress.

Keywords: stakeholder engagement; governance; users; river systems model

1.   INTRODUCTION

This paper provides input into the search for best practices in stakeholder engagement for software development. In particular, we describe the approach being used to engage stakeholders in a project to develop a new large-scale river systems modelling tool.

The project is developing a new generation planning model for river systems, called River Manager. The River Manager model will replace three disparate river system modelling software tools currently in use in Australia:

- MSM-Bigmod (Close 1996a, 1996b; Murray-Darling Basin Commission 2002);
- REALM (Diment 1991; Perera et. al. 2005; VU and DSE 2005a, 2005b, 2005c); and
- IQQM (Simons et al. 1996; Podger and Beecham 2004; Podger 2004).

Such models are designed to simulate river system hydrology and water management rules for water management planning. Applications of these three models are used to estimate the effectiveness of different water management policies on water availability for consumptive and non-consumptive uses. MSM-Bigmod, REALM and IQQM are currently applied in different parts of the Murray-Darling Basin, Australia, but they differ markedly in their structure and range of applicability. For example, MSM and REALM are monthly models, where MSM is a simulation model specific to the Murray River and REALM is a generic optimisation model, while Bigmod and IQQM are generic daily simulation models. These differences complicate cross-model comparisons, as well as river modelling across the Queensland, New South Wales, Victorian and South Australian state boundaries that the rivers of the Murray-Darling Basin straddle.

The new software is being developed by a number of partners of the eWater Cooperative Research Centre (eWater CRC, http://ewatercrc.com.au/), Australia. This partnership includes the principal users and developers of MSM-Bigmod, REALM and IQQM. The involvement of these people ensures that the project has active involvement from key stakeholders. Other water management organisations Australia are being engaged, and are providing lesser levels of input. This has initiated a broader dialogue with these future users that will be useful when application of the software is extended to the rest of the country.

2.   USER REQUIREMENTS

Interested eWater CRC partners, predominantly the lead water management organisations in jurisdictions of the Murray-Darling Basin, attended two workshops and provided email feedback on the user requirements in 2005-2006, at the outset of the project. However, there have been significant institutional and technical changes in water management in Australia since 2006, including the first Commonwealth Water Act [2007], and research projects re-assessing water availability (for example, CSIRO [2008]). The 2007 Water Act is a major driver of a nationally consistent approach to modelling for water management planning and the CSIRO project highlighted the difficulties of linking the models currently in use in the Murray-Darling Basin and comparing their results.

Consequently, the user requirements were reviewed in late 2008 and early 2009. A team of senior project staff travelled across Australia holding meetings with the key water management organisations in all states and territories, including those not partners in eWater CRC, with the aim of gaining their engagement. No major new user requirements were identified but some requirements were clarified, refined or re-prioritised, although there were some divergent views between jurisdictions. One of the states not a partner in the eWater CRC agreed to become involved in steering and directing the project, while the other state and territory opted to maintain a watching brief.

In summary, the user requirements were captured through workshops and feedback. They are written-up in corporate documents and included in the relevant software specifications. When a software specification is released for coding, the user requirements are stored in Quality Center (https://h10078.www1.hp.com/cda/hpms/display/main/hpms_content.jsp?zn =bto&cp=1-11-127-24_4000_100__), which is a web-based test management tool. This will enable the requirements to be tested against later.

In the software specifications, the user requirements are listed in a table that includes: (1) requirement number; (2) short description; (3) requirement priority, such as essential or desirable; and (4) the Quality Center identifier.

3.   GOVERNANCE ARRANGEMENTS

Initial stakeholder engagement early in the software development phase relied heavily on one-to-one discussions between the project manager and technical experts in the five most-involved eWater CRC partner organisations. There were also approximately six-monthly visits to these organisations to share information on project progress with a wider technical audience. However, critical senior project team members were diverted onto another high national priority project for about a year in 2007-08. As a resut, progress on the eWater CRC project was stalled and partner disengagement was occurring. The project was at risk of failure.

It became clear that a formal governance structure, including technical-level and managerial-level committees, would be a more efficient platform for providing technical input, guidance, information sharing and feedback.

In 2008 the project expanded rapidly due to additional Australian government funding supplementing funding by partner organisations via the CRC. This necessitated the creation of a strategic-level governance group to provide direction and support.

Representatives from the partner organisations and other stakeholders were formally invited to participate in these governance committees. Terms of Reference were circulated and endorsed at the inaugural meetings. The groups convened are the:
- Technical User Group (TUG), providing input from technical experts representing six eWater CRC partner organisations actively involved in software development.
- User Reference Group (URG) of senior experts from the same eWater CRC partner Commonwealth, state and territory organisations, plus a Western Australian and Commonwealth funding agency (National Water Commission and Department of the Environment, Water, Heritage and the Arts) representatives, who provide guidance on priorities and requirements, and approve the more complex or contentious software specifications.
- High Level Steering Committee (HLSC) of Chief or Deputy Chief Executive Officer level executives representing the same organisations as in the URG.

Meeting frequency for the TUG and URG is approximately quarterly, while the HLSC usually meets twice yearly. These committees also deal with additional matters out of session when needed.

Meeting dates are set so that, typically, a TUG meeting precedes an URG meeting, which precedes a HLSC meeting. In this way, representatives in the HLSC have an opportunity to be briefed before their meeting by their URG representative, who have an opportunity to be briefed before their meeting by their TUG representatives. Formal agenda papers are sent around prior to meetings. Minutes and actions are recorded and circulated.

A project management system was implemented to improve management of the project. This includes: (1) a project control plan; (2) a project schedule, (3) a risk register; and (4) a communication plan. These were approved by the HLSC. Other aspects include the budget and monitoring actual progress against planned progress. A change control process is required for changes to the project control plan or the schedule. The extent of the change in scope, time or cost determines which committee, URG or HLSC, deals with the change request. Risks to success are discussed and adjudicated at each URG and HLSC meeting.

4.   USER ACCEPTANCE TESTING

In addition to system testing of the software, which confirms that the coded software conforms to specifications, the users need to verify that the software is fit for purpose. This part of the user acceptance testing is being carried out by partner representatives (stakeholders) who are hydrologic modellers. Four complex river system model trial

applications are being developed for this purpose in parallel with River Manager software development. The approach the modellers use is to test individual aspects of the software under various river flow conditions, and progressively add more complexity to their models. The stakeholder feedback from this testing is proving highly valuable in refining critical aspects of functionality.

5.   OTHER STAKEHOLDER ENGAGEMENT

There are additional mechanisms to keep the wider project team informed about progress and activities, and to receive stakeholder input. These are: (1) sharing files via a web-based SharePoint site that gives everyone access to the same information; (2) fortnightly newsletters that broadcast technical-level information and upcoming activities; (3) monthly project update meetings that provide a synopsis of the current status, recent happenings and upcoming events; and (4) annual to six-monthly planning meetings that provide an opportunity to give a wide audience of project staff and stakeholders a common view of the project and to re-assess priorities as required.

The wider community of river system modellers are primarily being engaged via training workshops. However, as the software is not yet in the public domain, attendance at the workshops is by invitation. The training materials include training modules and a user guide, which are available in a software installation pack and on-line.

To inform the general public about the project, there are descriptive text-based fliers available from the eWater CRC website and there have been public seminars and conference presentations. There was also an article about River Manager in the corporate magazine, H2O Thinking, and in the journal of the Australian Water Association [Wallbrink, 2008].

6.   DISCUSSION

6.1   Stakeholder Analysis

Grimble and Wellard [1997] define stakeholder analysis as '*a holistic approach or procedure for gaining an understanding of a system, and assessing the impact of changes to that system, by means of identifying the key actors or stakeholders and assessing their respective interests in the system*'. They identify characteristics of natural resources management that are relevant to the application of stakeholder analysis as including: (1) conflicting views from different stakeholder groups; (2) multiple interests and objectives; and (3) trade-offs. All apply to the River Manager project. For example, there is a large amount of functionality that stakeholders would like included in the software, but resources to implement these are limited. Consequently, the degree of complexity of individual solutions, and the relative priority of each new functionality are negotiated.

Grimble and Wellard [1997] also classify stakeholders into: (1) active stakeholders who make decisions, and passive stakeholders who are affected by the decisions; (2) primary stakeholders who are the heart of interest and the intended beneficiaries, and secondary stakeholders who are of less interest; (3) important stakeholders, being those whose needs and interests are the priorities, and (4) influential stakeholders who have some power over the success of the project. In the River Manager project, the eWater CRC partner organisations are active; water management organisations outside the eWater CRC are mostly passive. The Australian public and the environment are the primary stakeholders through all the funding agencies (CRC partners and external Australian government agencies) with which the project has agreed delivery milestones. The URG members are important, but the HLSC members are most influential.

The consequences of different choices for different stakeholders, the trade-offs and the impacts on stakeholders are also aspects of stakeholder analysis, but for this discussion these details are not relevant.

6.2   Participatory Modelling

Although stakeholders are actively engaged in River Manager development, this does not fully align with traditional participatory modelling. Hare et al. [2003] describe participatory modelling as possibly involving stakeholders in the design and social learning of solutions. They specify levels of participation ranging from: (1) receiving information; (2) providing information; (3) two-way discussions; (4) active involvement in problem analysis and policy design; (5) joint decision making; and (6) independent decision making by stakeholders. They specify the goals of participatory modelling as: (a) to empower stakeholders and improve the democracy in decision making; (b) to increase the legitimacy of solutions; (c) to increase project effectiveness; (d) to improve management in response to high uncertainty and risk; (e) to include local knowledge in decisions; (f) to manipulate public opinion; and (g) to encourage social learning.

The River Manager project stakeholders participate at levels (1) to (5) above, and the goals of their participation include points (a) to (e) above. For example, the hydrologists with the best knowledge of a particular functionality develop or document the method for its implementation in the software. The proposed implementation method is then sent to all the jurisdictions for review and comment. Many of the functionalities being implemented are currently in use by only one or two of the jurisdictions, so each jurisdiction is learning more about the modelling methods of the other jurisdictions. Proceeding with software coding only when all jurisdictions agree with the proposed method increases the legitimacy of the software and decreases the risk of solutions being incorrect or not accepted.

Although this project does not manipulate public opinion or encourage social learning (f and g above), our stakeholders have roles and responsibilities to their stakeholders that cover these goals.

Generally, stakeholder participation is contributing to a product that merges existing functionality and is a generational improvement on the existing products. However, scope creep is resulting from participants each wanting the functionality they now have, plus new functionality that was not originally planned. This is being managed by gaining stakeholder agreement to making trade-offs, where some functionality originally planned to be delivered early is being deferred to enable the changes to be accommodated. On the other hand, stakeholder participation has led to more efficient solutions to a number of functional needs, such as (a) for tracking water ownership along river reaches and (b) for providing a choice of rules-based or optimisation-based modelling of ordering of water. In addition, new ways of sharing capacity and ownership of multiple storage outlets have been devised and a generic approach to routing flow that covers linear, non-linear and Bigmod routing has been developed. Old solutions are being retained where appropriate, such as the method in Bigmod for modelling salinity in rivers. This method uses particle tracking and was devised a decade ago. As it is quite robust, it is being re-written in the new software.

6.3   Governance

Governance can provide an effective platform for stakeholder engagement. Kemp et al. [2005] define governance structures as a platform for negotiation processes, determining objectives, influencing motivations, setting standards, performing allocation functions, monitoring compliance, imposing penalties, initiating and/or reducing conflict, and resolving disputes among actors. Governance is a mode of social coordination that can have formal or informal arrangements. They list the desirable attributes of governance bodies as having: (1) a reasonable coherence of vision and commitment; (2) accountability; (3) trust; and (4) sufficient capacity for coordination, direction and re-direction. They note the positive role of sectoral specialisation in dealing with differentiated problems.

As described above, the governance groups for the River Manager project are the TUG, URG and HLSC. All levels are involved in negotiation processes, provide advice on objectives and priorities, set standards and monitor compliance. Reducing conflict and resolving disputes rests with the project team, but can involve input from, and interaction with, all three governance groups. Motivations for the project are primarily influenced by the recognised need for a consistent, robust and credible modelling platform to support water management decision making in Australia, particularly in the Murray-Darling Basin. Allocation of functions is decided within the project. These follow priorities set by the project team, but which are endorsed by the URG and HLSC. The URG and HLSC monitor progress compared to milestones (i.e. compliance) and review priorities in the light of actual progress compared with planned progress. When appropriate, they can assist in resolving the relative importance of aspects of model development. As with all research and development projects, there is an element of risk that solutions initially envisaged will not be workable in practice, in which case the URG and HLSC are involved in agreeing alternative conceptual approaches. These might or might not involve further interaction with the TUG.

There is a reasonable coherence of vision and commitment in the governance groups, which has increased over time. Interestingly, this is inversely related to the technical content of the meetings. For example, the strategic vision for the new river modelling software differs little between agencies, but there is often robust debate on the best method of incorporating individual river system components. Continuing with the comparison between Kemp et al.'s [2005] desirable attributes of governance bodies, there is accountability, trust and a sufficient capacity for coordination, direction and re-direction in the River Manager governance groups. Sectoral specialisation in the technical areas occurs due to the eWater CRC partners having differing business needs, and consequently a history of differing river modelling methods. This is playing an important role in developing a quality product.

All three governance groups are operated similarly. For each meeting, a preliminary agenda is circulated and suggestions for additions or modifications are welcome. The meeting invitation includes an agenda paper for each item on the agenda. During the meeting, discussions are led by the person presenting the agenda item. The chair moderates the discussion. Each governance group member has priorities and motivations determined by their jurisdiction, and their role in their organisation. For a contentious item where the chair suspects that the discussion might not be allowing equity of stakeholder influence, each attendee in turn is asked for their comments. If a group cannot agree on a way forward, the issue is taken to the next level governance group for a decision. If after further negotiations the HLSC cannot agree, we implement more than one solution. Consumptive use of river water is one such example. Users can choose to model this explicitly at irrigation nodes or as distributed diversions along links.

The combination of these formal meetings and gathering out of session feedback, for example on software specifications, has been highly effective in engaging the stakeholders.

For the River Manager project, the main advantages of the formal approach to stakeholder engagement are that it: (1) encourages all identified stakeholders to be active in the decision-making process; (2) provides equity of stakeholder influence; (3) provides a transparent forum for decision making; (4) fosters cohesion of vision and commitment; (5) is important for achieving a collective responsibility for project success; (6) achieves stakeholder buy-in to the project; (7) ensures the software is fit for purpose, technically and for policy development; (8) provides a pathway for uptake and adoption; and (9) socialises project performance risks. The advantages listed by Coenen [2002] also apply: (1) enhancing the legitimacy of decisions; (2) helping to reduce the risk of conflict; (3) offering an additional source of ideas and information; and (4) enabling learning. In this case, the process involves structured governance to deal with the technical conflict associated with different stakeholder preferences, priorities, and legislative requirements. It is anticipated that dealing with contentious issues during model development will increase acceptance and uptake of the completed product.

There is also a time cost to these governance arrangements. For example, stakeholder input to software specifications requires a pause in development each time they need to consider and comment, then resolve issues. The project has attempted to mitigate this by running some processes in parallel, but this carries the risk of the need to re-work tasks when requirements change.

Further, approaching stakeholders on the governance groups bilaterally in advance of formal meetings to sort out individual issues and concerns has been effective for resolving contentious issues efficiently during the governance meetings themselves. This is because there is not always sufficient time in these meetings to fully understand and address individual viewpoints and issues.

7.   CONCLUSIONS

It is widely acknowledged that stakeholder engagement is necessary for end-user acceptance and adoption of project outputs. The experience from the River Manager project is that regular formal engagement of stakeholders via governance groups is highly effective, but also extends time frames. Both stakeholder analysis and participatory modelling are partially relevant. Engaging stakeholders both individually and in groups has been advantageous. The most contentious issues benefit from bilateral engagement as well. The main advantages of group meetings are that they:
(1) encourage all identified stakeholders to be active in the decision-making process;
(2) provide equity of stakeholder influence;
(3) provide a transparent forum for decision making;
(4) foster cohesion of vision and commitment;
(5) are important for achieving a collective responsibility for project success;
(6) improve stakeholder buy-in to the project, thereby facilitating acceptance and uptake;
(7) ensure the software is fit for purpose, technically and for policy development;
(8) provide a pathway for uptake and adoption; and
(9) socialise project performance risks.

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