Project Proposal Template

A. TITLE OF PROJECT

5.1.4 Interactive tools for enabling participation and knowledge exchange

B. IDENTIFICATION

Project Leader:
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Jeremy McKenzie (NIWA).
Additional investigator(s) to be identified during year one

C. ABSTRACT

The proposed project works at the boundary of science and society, and will develop and implement widely accessible tools for facilitating participation in decision making and communicating science findings and knowledge in new and exciting ways. The success of the Managed Seas programme, and indeed the overall challenge, depends on active participation and effective engagement with Iwi, stakeholders and the wider public. The project aims to develop novel interfaces that enable wide participation within the Managed Seas programme and other projects across the Sustainable Seas challenge. The project includes two strands: 1) interactive interfaces for underlying models that support decision making, and 2) digital platforms for two-way exchange of data and knowledge (e.g. information capture, visualisation, interacting with data). The first strand will deliver a user interface to facilitate scenario testing and visualisation of predicted outcomes from Bayesian network (BN) models. The second strand will focus on web and mobile enabled applications that encourage stakeholders and the public to become active participants in information capture and sharing in science discoveries and findings from the challenge.

D. INTRODUCTION

Participation is required to achieve the Challenge objective of sustainable utilisation of marine resources that reflects the aspirations, expectations and agreed rights of New Zealanders. Within the context of Challenge, participation is defined as the practice of involving stakeholders and communities in agenda-setting, decision-making, and policy-forming activities[1]. Communication and consultation, while considered forms of engagement, are one-way transactions, whereas participation involves the two-way exchange of information between the public and sponsors through active dialogue. The best way to address unstructured, wicked problems is through a process of learning[2,3,4], and there are a number of conditions that are necessary for learning to

occur. The first of these is meaningful participation, which is a deliberative process that involves dialogue, questioning and self-reflection to understand what really matters, and what doesn't[5].

The first strand of the project will link to heuristic approaches, and construction of Bayesian network (BN) models, leading to dynamic influence diagrams and visualisations that allow participants to experience decision making under various scenarios and with differing levels of uncertainty. The second strand will leverage off the latest communication platforms and mobile devices that enable participants to both contribute and access data, and in turn visualise and interact with the inner workings and outputs of the Challenge.

Potential technologies to utilise within the project include open source geographic information systems (QGIS), computer-generated visualisations, interactive mobile applications, keypad voting and strategy mapping tools. Tools such as these will facilitate community involvement in decision making in complex situations where there is actual and / or perceived risk and uncertainty. The tools will serve as interactive portals into the Challenge's research, e.g. to enable users to not only contribute knowledge but also sit in the 'driver's seat' and engage with the programme's inner workings and complex outputs. Ultimately, participation in the Challenge will lead to enhanced understanding and trust in the science and durable solutions to complex problems. This includes contextualising the effects of different stressors, including cumulative effects of multiple stressors, on ecosystem components, and evaluating the consequences of alternative scenarios and management decisions for both ecosystems and associated social, cultural and economic values.

E. AIM OF THE RESEARCH AND RELEVANCE TO OBJECTIVE

The project aims to facilitate and encourage participation by interested parties (e.g. Iwi, planners, industry, civil society organisations and decision makers) and the wider public in Sustainable Seas by providing tools that will enable the co-production of knowledge and increased public confidence in the implementation of ecosystem-based management (EBM). The project outputs will enable two-way exchange between stakeholders and the Challenge, which is critical to facilitating participation in decision making and effective EBM. This in turn is required to *enhance utilisation of our marine resources within environmental and biological constraints.*

Research objectives include: 1) **identifying** the elements of effective interactive tools, 2) **developing** tools that facilitate participation in the Challenge and two-way exchange of data and knowledge, and 3) **testing and implementing** tools for use in the Challenge and beyond. These objectives will be achieved within the available budget by leveraging existing open-source and / or funded platforms, and building on previous progress on similar tools. The first strand of the project will link with decision support tools developed for a specific issue (e.g. restoring shellfish fisheries, social license for aquaculture) within a case study area (Tasman-Golden Bays). This will enable the project to align with stakeholder and Māori engagement planned for other projects. The second strand aims to achieve National reach and impact.

F. PROPOSED RESEARCH

Over the next 3.5 years, the project will focus on developing at least two interface tools that (1) encourage participation in decision making around a case study issue (e.g. shellfish fisheries and resources in Tasman-Golden Bays), and (2) allow participants to engage with the science in the challenge. The purpose of the interface tools is to engage participants in the management / research process by:

- Providing "hands on access" to BN type probabilistic network models for decision support and scenario testing
- Communicating and visualising science and model (e.g. Atlantis) outputs e.g. tables, trends, plots and especially GIS type visualisations

- Allowing stakeholders to provide real world observations in support of marine research (science data provision)

Central to the **first strand** of the project is the development of an underpinning BN model[6] representation of a case study ecosystem. The intended use of BN models is to link between the complex science knowledge on ecosystem function (cause and effect) and stakeholder world views and understanding. Information going into the BN can come from expert opinion, from real world observations (data) and from more complex ecosystem or population models. Their component graphical nature means BN models are easily understood by lay people and hence well suited for stakeholder engagement.

One way to develop a resource management BN model is in conjunction with stakeholders[7]. Typically a range of BN models representing different stake-holder "world views" are constructed and compared in a consultative setting leading, hopefully, to a single consensus model. Information to construct the conditional probability matrices which define the "causal" relationships between BN nodes can come from a combination of expert knowledge, actual observational data, or predictive outputs from more complex ecosystem / fisheries models such as Atlantis. The foundations of the BN model will involve work on values, objectives and indicators, which are all part of structured decision making. It is anticipated that much of the BN model development will be carried out through aligned core-funded work led by NIWA, and that this project will focus primarily on developing the interface tool for participants to engage with the models (Participatory Tool 1; Figure 1).

The **second strand** of the project aims to develop at least one interface tool that enables exchange of data and knowledge between participants and projects within Dynamic Seas and Managed Seas programmes (Participatory Tool 2; Figure 1). Development of this tool will leverage off the latest communication platforms and mobile devices to enable stakeholders and citizens to become active participants in information capture, evaluation and communication for the marine environment.

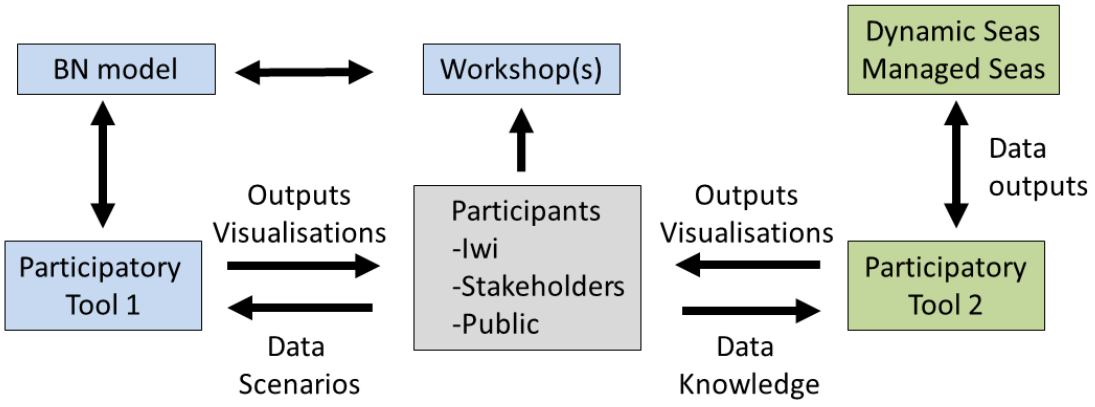

Figure 1. Schematic of participatory tools and flow of data and outputs.

The project includes the following key steps (see Section P for outputs and milestones):

1) Develop plans for coordinating across projects within the challenge and supported by aligned core funding
2) Review and identify elements of effective participation and interactive tools

3) Review and identify existing platforms (e.g. software, programmes) and tool(s) to be developed
4) Establish a small, embedded focus group that participates in tool development
5) Identify a case study, and develop design brief / framework for development
6) Coordinate with the development of a BN model for the selected case study, and other modelling efforts such as Atlantis
7) For strand one, develop / customise an interface for a BN model for facilitating participation in at least one Sustainable Seas project and case study area / defined issue
8) For strand two, develop at least one application for collecting knowledge from participants, and enabling visualisations of challenge outputs
9) Beta-testing of prototype(s) by participants followed by tool refinement / improvement
10) Launch tools

The first three steps represent the planning and review phase, and research to identify elements that make a participatory tool successful. The initial research is required to answer the question: "What tools best communicate EBM concepts, and facilitate stakeholder engagement in the EBM process?" The early steps also include identifying existing and aligned platforms that may be leveraged to maximise efforts and serve the purposes required for Sustainable Seas. Linkages between tools being produced across the challenge, and in particular Our Seas, will be established during the planning stage. In addition, gaps in capability and expertise in the research team will be identified, and where required additional expertise (e.g. mobile app design) will be engaged in the project.

One of the key early steps is to establish a small focus group that includes end users of the tools. Individuals from the focus group will participate throughout the project. This approach is referred to as participatory design, using methodologies such as agile programming that allow users to assist in design as well as be experimenters of an evolving participatory tool[9,10].

The fifth step will be to define the brief of the selected case study and identify stakeholder groups and associated representatives. The tools will need to be tailored to meet the needs of the challenge, and a component of the work will include engaging with stakeholders within the first year in the case study area to identify needs and preferences to guide tool development. This broader engagement will be coordinated with workshops and events organised for other projects within the region.

Steps six through nine represent the development and launch phase of the project. One of the participatory tools will provide an interface for a decision support system based on BN model for one of the focal case study areas where a complex problem exists and solutions have not been identified or implemented (such as loss of shellfish populations and fisheries in Tasman-Golden Bays). The interface will be developed to allow participants to visualise the outcomes of collective choices (i.e. pull levers and see what happens). This portion of the project will be closely aligned to NIWA core-funded work on BN models and the development of an Atlantis model for the case study region (project 5.1.1). Underlying work will likely include development of a methodology for utilising Atlantis structure and outputs to build the BN schematics.

Tasks to develop the BN model and interface tool include identification of values and objectives, network construction, development of probability tables and cause-effect relationships between values, performance indicators, and management options. There are a number of BN modelling tools available that could suitably meet the underlying BN modelling requirements; these include both public domain (e.g. Hugins® and Genie®) and commercial (e.g. Netica®, Bayesia®) applications. An evaluation of BN modelling products will be undertaken to determine which best meets the needs for our specific case study and for more general application. The interface developed within this strand of the project will utilise existing programming platforms (e.g. Shiny in R) and may also include mechanisms for canvasing participants and populating network models.

There are a number of platforms (e.g. QGIS) and programmes (e.g. Shiny, Leaflet) that may be used to develop the interface tool(s) for the second strand. The investigators have expertise in using R programming language and Shiny to develop interactive apps for accessing and visualising data and model outputs (e.g. CawthronEye for visualising satellite imagery, BluesRadar forecasting tool for aquaculture). We will investigate use of existing mobile applications / platforms versus development of more fit for purpose front-end applications. Where possible we will leverage off web-based and mobile applications that are already in development, such as SeaSpotter (in development at Cawthron). In addition, we will seek to align efforts with emerging Global citizen science initiatives such as Plankton Planet (planktonplanet.org) and Naturewatch (naturewatch.org.nz).

Following the development of prototypes, the tools will be tested, refined and then launched. The second phase of the project (beyond 3.5 years) will involve development of additional tools, with prioritisation driven by needs and interests of challenge participants, iwi and stakeholders and the wider public.

F. PROPOSED RESEARCHG. ROLES, RESOURCES

Chris Cornelisen (Cawthron) – Project lead
Natasha Berkett (Cawthron) – Participatory processes
Ben Knight (Cawthron) – R coding and software development
Jeremy McKenzie (NIWA) – Bayesian Network models
Additional capability / expertise to be identified within year one

H. LINKAGES AND DEPENDENCIES

The proposed project will link with a number of projects across the Challenge. In order to minimise 'participant fatigue', efforts under this project that require stakeholder participation will need to strongly link with engagement occurring in other projects and programmes. Where possible, the project will leverage off centralised efforts around the challenges and CoREs being coordinated by the Science Media Centre.

Development of the first type of tool that provides the interface with decision support tools such as a BN model will be closely linked with projects in Our Seas, and in particular project 1.1.2 on participatory processes. The proposed tools may be used to collect input from stakeholders and visualise results from BN models. This project will also align with stakeholder and Māori engagement for other projects within the Tasman-Golden Bays case study area, which will assist in strengthening cross-project linkages and guiding tool development.

The second type of tool(s) for facilitating participatory collection, dissemination and visualisation of data will have links across multiple programmes (Dynamic Seas and Managed Seas), and will also contribute toward engagement and communication with the wider public.

I. COLLABORATIONS

We will seek to enhance the research through National and International collaborations developed during the first year. Potential collaborations of interface technologies include individuals / groups working in this space, such as Waka Digital (www.wakadigital.co.nz), Massey University's Open Lab (www.openlab.ac.nz), and the Science Media Center. Potential International collaborators include CSIRO and University of British Columbia for international best practice in participatory models and tools.

The following international collaborators have agreed to provide advice on the development and use of BN models:

Drs Mika Rahikainen and Sakari Kuikka; Dept. of Environmental Sciences, University of Helsinki, Finland
Dr Murdoch McAllister; Canada Research Chair in Fisheries Assessment, University of British Columbia, Canada
Dr David Albrecht; Faculty of Information Technology, Monash University, Clayton, Australia

J. INTERNATIONAL LINKAGES

Where possible, this project will capitalise and leverage off International programmes and advances in the development of participatory tools. Such opportunities will be identified within the first year as part of the first objective, and through collaborations as identified above.

K. ALIGNED FUNDING AND CO-FUNDING

The Bayes net development component of this project (strand one) is strongly aligned to the NIWA core-funded Ecosystem Approaches to Fisheries (EAF) project and there are likely to be co-funding opportunities.

The interface modelling components of this project (strand two) are currently not dependent on or linked to aligned funding; however, it is possible that co-funding can be secured during the early stages of the project if opportunities can be identified. Efforts will be made to seek out aligned projects and where possible build upon similar efforts. For example, Cawthron has been supporting the early development of open-source mobile apps that can be further developed within this project and tailored for use in the Challenge.

L. VISION MĀTAURANGA (VM)

Vision Mātauranga is seeking to unlock the innovative potential of Māori knowledge, resources and people to assist New Zealander's to create a better future. There are four themes in the Vision Mātauranga (VM) policy framework (Indigenous Innovation, Taiao, Hauora/Oranga, and Mātauranga). It is considered that there is an opportunity in this project to develop innovative and/or distinctive products, processes, systems, and services.

One of the four themes in VM is Taiao. This theme looks to achieve environmental sustainability through iwi and hapū relationships with land, and in this Challenge, sea. Participation of Māori in the Challenge is critical if we are to move toward successful management models within an ecosystem-based management framework. Iwi from the case study region will be engaged in the workshops and also in the focus group for developing and testing interface tools.

Another theme of VM is Mātauranga. Accessing Mātauranga Māori will assist the Challenge with identification of environmental and biological constraints; similarly, Mātauranga Māori may be used to enhance utilisation of our marine resources. It is with this in mind that it is imperative that both Māori knowledge, and the users of that knowledge, work together. The use of software coding that enable multiple front ends to accommodate different ways of sharing and interpreting knowledge; for example, sharing information spatially according to rohe, can identify how indigenous knowledge interacts across different domains in a cross-disciplinary and cross-cultural style. The project will also benefit from close connections with the newly funded MBIE programme *Oranga Taiao, Oranga Tangata; Knowledge and toolsets to support co-management of estuaries*, which aims to develop web-enabled tools for developing cultural health indices.

M. COMMUNICATION AND OUTREACH

This project involves creating the interfaces for communicating and connecting to government, Māori, stakeholders and general public. The project will be carried out in close communication with the Science Leadership Team in order to ensure an integrated approach across the Challenge. The

project will require close involvement of Jenny Rock, leader of communication and engagement for the challenge. We will also seek opportunities in the first year for co-development with other Challenges that aim to develop similar end user interfaces, and will do so through on-going communication with the Science Media Centre. We will explore opportunities to link with existing platforms for making scientific data accessible to the public.

N. CAPACITY BUILDING

The project will draw on areas capability and expertise that will require significant capacity building in New Zealand. All of the National Science Challenges require a major step change in the ways data and knowledge are collected and used, and how science is communicated. Modes of data and knowledge dissemination and exchange, currently dominated by one-way transactions such as technical reports and journal papers, need to diversify and transition into more interactive two-way modes of exchange such as mobile applications for collecting data, providing access to data and tools, and communicating science outputs. No formal mentoring opportunities have been identified; however, as the project progresses, opportunities will be sought to engage students; for example in the design and development phases as either individual projects or even competitions. In addition, the trialling and refinement stages of tool development will also result in informal education of participants.

O. ETHICS APPROVAL

Any research that involves public participation will be assessed using Cawthron's Human Ethics policy and procedures or, in the case of researchers from other organisations, their equivalent policy if it exists. Any research activities that are deemed to pose risk to participants will then be subject to further provisions to protect participants' privacy and well-being.

P. OUTPUTS AND TIMETABLE

Project Number:	5.1.4
Project Name:	Interactive tools for enabling participation and knowledge exchange
Project Leader:	Chris Cornelisen

Milestones and Outputs	**Delivery date**
1. Planning interactive participatory tools	
Milestone 1.1 Challenge meeting of all project leaders	31 Mar 2016
Milestone 1.2 Agreed coordination plan with SS projects (e.g. Our Seas 1.1.2) and identification of case study (see component No. 3)	30 Jun 2016
Milestone 1.3 Agreed coordination plan with aligned NIWA core funded projects	30 Jun 2016
Milestone 1.4 Small workshop connecting expertise / capability	15 Aug 2016
Milestone 1.5 Detailed overarching project plan	31 Aug 2016
Milestone 1.6 Provider for web-based / mobile app design identified	31 Oct 2016
Milestone 1.7 Initial review / identification of technologies and approaches	30 Nov 2016
Output 1: Technical report identifying options for tool development	31 Dec 2016
2. Elements of effective participation and interactive tools	
Milestone 2.1 Design / drafting of engagement plan complete (links with 1.4)	31 Aug 2016
Milestone 2.2 Establish small end user focus group	30 Sep 2016
Milestone 2.3 Document discovery (lit review) and focus group input complete	28 Feb 2017
Milestone 2.4 Presentation to annual SS meeting	30 Apr 2017
Output 2: Peer-reviewed article (e.g. Science Communication) *Elements of successful participatory tools for engaging with ocean science*	31 Jul 2017
3. Participatory decision making tool	
Milestone 3.1 Agreed coordination / implementation plan with BN scientist(s)	31 Aug 2016
Milestone 3.2 Framework and software / programming language chosen	30 Sept 2016
Milestone 3.3 Prototype web-based interface for BBN developed for one case study BBN model (e.g. Nelson Bays Fisheries)	31 Mar 2017
Milestone 3.4 Prototype tested with end user focus group	28 Feb 2018
Milestone 3.5 Prototype and test results presented at annual SS meeting	30 Apr 2018
Milestone 3.6 Prototype improved / refined / re-tested with focus group	31 Aug 2018
Milestone 3.7 Tool finalised and graphical design complete	31 Jan 2019
Output 3: Tool for participatory decision making for case study launched	28 Feb 2019
4. Participatory knowledge exchange tool	
Milestone 4.1 List of existing and aligned platforms / programmes complete	30 Jun 2016
Milestone 4.2 Co-funding sources identified and approached	31 Aug 2016
Milestone 4.3 Identification of chosen coding language, platform	31 Oct 2016
Milestone 4.4 Coordination plan completed if decided to link to existing programme / platform (e.g. NatureWatchNZ)	31 Dec 2016
Milestone 4.5 Scope and framework for mobile app	28 Feb 2017
Milestone 4.6 Prototype complete	31 May 2017
Milestone 4.7 Prototype beta tested by select user groups for data collection and interfacing with at least one project in the Challenge	31 Oct 2017
Milestone 4.8 Prototype improved / refined / re-tested with end users	31 Aug 2018
Milestone 4.9 Tool finalised and graphical design complete	31 Jan 2019
Milestone 5.0 Tool launched at annual SS meeting	30 Apr 2019
Output 4: Official web and mobile app application for collecting and disseminating knowledge and data fully operational and project outcomes presented at Intl conference	30 Jun 2019

Q. REFERENCES

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