A spreadsheet application for evaluation sub-programs and projects Merit, Worth and Value

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Abstract: Within the NSW Office of Environment and Heritage (OEH), the Science Division undertakes scientific research, investigation, monitoring, analysis, evaluation and reporting on a range of natural resource environmental issues. Covering five broad areas of climate change; land and biodiversity; pollution; water; and community. In 2015, the Science Division managed 54 sub-programs and 144 projects that align to the agencies One Plan services and programs that deliver to the OEH corporate plan.

Summerell et al., introduces the Performance Evaluation Framework (PEF). This is the first time such a process has been used in the Science Division to rapidly access its sub-programs and projects for merit, worth and value. The PEF provides a methodology to capture comprehensive, consistent and rigorous information from sub-program and project leaders. It provides ownership, transparency and a common platform for better understanding of how sub-program and projects deliver to five key benchmarks (i.e. roles of science); strategic organizational management; informing policy; program delivery; public information; and engagement of community in science.

Currently no tool exists within the Science Division other than ad-hoc paper based and non-linked digital format documents. This results in incomplete and inconsistent data, which is difficult to compile and summarise. The result is minimal reporting ability and opportunity for fair assessment and comparison of a sub-program and project outcomes. To overcome these limitations a Microsoft Excel 2013 tool was developed for capture and reporting the PEF information (input/output). PEF information is multi-relational (one sub-program to many projects) and better suited to relational database development; however, Excel was used as an interim simplistic measure. Excel also aligned with other existing OEH financial systems and took into consideration limitations of end user software understanding.

The development of a single tool to provide the capture and delivery of sub-program and project knowledge was crucial to the success of the PEF.

The PEF tool allowed a level of information capture and reporting that has not been provided before within Science Division. The tool was highly accepted and regarded by Senior and Executive Leaders as a pivotal part of providing evidence of the Merit, Worth and Value of current science programs and its funding into the future. The tool allowed staff to evaluate their own projects against set benchmarks. It also provided the Senior and Executive Leaders with rigorous data to support a narrative of the value of science. In the end the tool enabled the Science Division to demonstrate how we deliver science to State, Departmental and community customers.

Keywords: *Environmental science impact, performance assessment, program evaluation, science sustainability, government science*

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1. INTRODUCTION

NSW Premier and Cabinet require Agencies to evaluate their programs in line with the NSW Government Program Evaluation Guidelines (NSW Premier and Cabinet, 2017). Evaluating these programs ensure our services are effective, deliver value for money and meet the needs of customers. Periodic evaluations of all programs with OEH provides a basis for informing policy, vital to funding decisions, relevance, relationship to cluster priorities and effectiveness of outcomes.

The NSW Office of Environment and Heritage (OEH), the Science Division (SD) undertakes scientific research, investigation, monitoring, analysis, evaluation and reporting on a range of natural resource environmental issues (OEH Science Division, 2017). The research is guided by the OEH Knowledge Strategy (OEH Knowledge Strategy Implementation, 2017) and covers seven knowledge themes: biodiversity, climate change impacts and adaptation, coastal estuarine and marine environments, landscape management, pollution, resource efficiency theme, and water and wetlands. In 2015, the Science Division managed 54 sub-programs and 144 projects that align to the agencies One Plan (OEH One Plan Overview, 2015) services and programs that deliver to the OEH corporate plan (OEH Corporate Plan, 2014).

Summerell et al., (2017), introduces the Performance Evaluation Framework (PEF), which enables the SD to rapidly evaluate its sub-programs and projects for merit, worth and value. The PEF provides a methodology to capture comprehensive, consistent and rigorous information from sub-program and project leaders. It also provides ownership, transparency and a common platform for better understanding of how sub-program and projects deliver against five key benchmarks (i.e. roles of science): strategic organizational management, informing policy, program delivery, public information, and engagement of community in science.

A key challenge for the implementation of frameworks like PEF is how to collect the data from multiple projects, analyse it, role the project data up to sub-program level for reporting and display the results. Spreadsheets are commonly used in all facets of business, including financial, human resources, spatial and statistical analysis, project data capture and in many other fields of work. Microsoft states "spreadsheets give businesses the tools they need to make the most of their data. And when it comes to making the most of resources, and maximising return on investment, this is becoming increasingly important" (Williams, S., 2017). This is the case for OEH Science Division. Microsoft Excel 2013 is OEH corporate licensed, available to all OEH staff for use. Staff are familiar with its operation and it aligns with existing OEH spreadsheet systems, therefore it was considered to be the appropriate platform for PEF tool development.

The purpose of this paper is to describe the co-development, the technical methods used to build a tool in Excel 2013 and to discuss the lessons learnt for evaluating SD sub-programs and projects for their Merit, Worth and Value.

2. METHOD AND RESULTS

2.1. Co-Development

Developing the spreadsheet based tool required knowledge from OEH Science Division Senior Management and Science Division Senior Leadership Team (SLT) on what are the key evaluation questions to be answered. Examples of some key evaluation questions by Senior Management and SLT are: Size of sub programs by FTE and funding; Ranked sub-programs to decide cutoff; Sub program by cash (all) budget; Ranked projects to decide cutoff; What proportion of budget does SD spend on the OEH goals? For development, this was considered the most important step as it provided the basis of data structure, the minimal criteria of information needed, and format and information for delivery when reporting. The second area of development were technical questions relating to the functionality of the spreadsheet. These were also critical as what was possible in Excel also limited the types of evaluation questions and how the analysis and reporting could be achieved.

To further understand the complexity of the task at hand a small working group (Summerell et al., 2017) was established to implement the technical aspects of the spreadsheet development and act as liaison between Senior management and SLT requirements and in-house excel program developer. This group also was charged with increasing awareness of the project and training the project managers in data input. The STL and working group developed a base set of data capture fields relating to the evaluation questions. The result was eleven core evaluation criteria and nine supplementary criteria, benchmark score values for each role of science, financial and resources information sought; and textual based descriptions of projects and their merit to be captured for transparency, evidence and summary reports.

From numerous discussions, the development of the system required multiple user input, simplified GUI based forms, shared network accessibility, minimum required inputs, validation, dynamic reporting and built on a

hierarchal concept of sub-program to project level which aligned with OEH Science Division Knowledge Strategy. The tool allowed for a reduction in data repetition by end users, collated numerical, textural data at both sub-program level and project level, analyzed vast amount of information quickly, somewhat dynamic and effectively provided reporting through a simplified dashboard.

Overall the system comprised of 54 sub-program and 144 project excel workbook files. A single point of data capture (excel workbook) acting as a read/write database table was created; this containing linkages (20k+) to all files and cells within each and a single dashboard based workbook consisting of multi worksheets summarizing all data was further created for access by management providing simplified reporting through pivot summaries, charts and textural comment. Figure 1 presents a simple schema of overall concept design.

The initial stage of the development required a work break down structure (WBS) / file naming convention to be established in combination with each other. As the sub-programs and projects are based on a hierarchal system as per the OEH SD knowledge strategy, so too the WBS and naming convention had to allow for unique identification of each of the 54 sub-program files and 144 project files. The convention allowed for minimal filename length and easy identification when linkages were to be made i.e. what projects relate to which sub-programs; this is multi-relational. A complete list (text file format) was created for all sub-program and project filenames, the purpose of this list discussed in later text.

2.2. Base Data

From information provided by SLT, a single excel multi-worksheet workbook was created which acts as the base data. This data being consistent throughout all sub-program and project workbooks. This workbook was used as the key background source such that a change within this data could automatically be reflected through all other sheets dynamically. This data needed to be reflected through all 54 sub-program and 144 project workbooks without the need for individual editing. Through using absolute references (Microsoft Support, 2017) the dynamic nature of the values could be reflected within the active sub-program or project workbook. Multiple worksheets were created for varying information such as five roles of science; core and supplementary evaluation questions; benchmark criteria; drop down menu items etc.

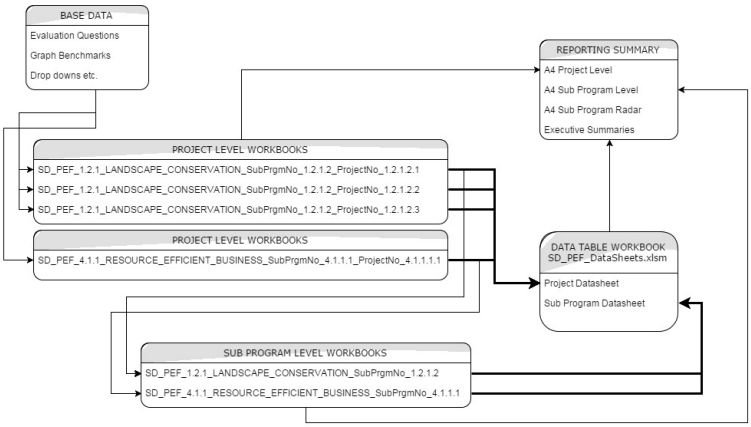

Figure 1. Simple schema of PEF design

2.3. Data Table Workbook

A single excel workbook where all data would be retained for sub-program and project level was created, this acting as the database table for data capture and retrieval. The workbook labelled SD_PEF_DataSheets.xlsm, consisted of multiple worksheets, one for sub-program data and one for project data, as information collected is independent of each other. The basic structure of each worksheet is simple row and column format. Each row within the sub-program worksheet and project worksheet related to its equivalent sub-program or project excel workbook file. Each column in each worksheet represented a field (cell) from the related excel workbook file and a header row provided the name of the field. Additionally, calculated columns from captured information were created in both worksheets to allow for additional reporting scenarios, and within the sub-program sheet some existing columns were a concatenation of multiple projects to single sub-program level. The sub-program worksheet resulted in 54 rows + 1 header row, and 216 columns. Project worksheet resulted in 144 rows + 1 header row, and 236 columns. For each cell/row combination complex formula and defined functions created the key links to capturing the associated data from the individual sub-program and project workbooks. Error trapping where required was provided through use of ISBLANK, IFERROR or ISNA formula functions (Microsoft Support, 2017).

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2.4. Project Level Workbook

The development of each individual project excel workbook started with a draft concept (excel template) derived from the SLT. For each project workbook file, contained three worksheets; An instruction sheet, containing simple outline on the use of the workbook and data entry. A project evaluation sheet, this the key single point of data entry; and an A4 summary sheet (Figure 2). The project evaluation sheet contained a variety of input fields (numerical, text and selective) which covered areas of project responsibility, resourcing, budgeting, descriptors, collaborators, customers, distribution of role within Science, 11 core and 10 supplementary evaluation criteria questions; these based on a matrix of category (appropriateness, effectiveness, efficiency and impact) versus score of 1 (low) to 5 (very high) to reflect an assessment score of performance. Cells were formatted per the input data type and validation was applied to various cells to limit error. Cells were conditionally formatted where user inputs are required, when data was entered and when error/warning was required, this providing a visual queue to the end user. The use of data validation drop down lists for entry e.g. assessment scores provided a simple means of input only valid data. Worksheets were protected, and cells where data entry was required were unlocked, this limiting access to other cells and or minimize error input. The layout was broken up into 5 main areas, project information, budgetary and resourcing, project descriptions, roles of science, and core and supplementary questions. This provided a basic workflow for the end user.

Summary of Science Division Project Evaluation 2015-16

Office of Environment & Heritage

OEH Goal :	1	Ensure vibrant natural assets for the health and prosperity of NSW			
OEH Service :	1.2	Landscapes and Aquatic Ecosystems			
SD Program :	1.2.1	1.2.1 Landscape Conservation			
SD Sub-Program :	1.2.1.2	Landscape data, information and knowledge			
SD Project :	1.2.1.2.3	Landuse and management assessments and impacts			
Status of project (yr) :	2	Term of Project (yrs) :	5	Complete Status (%) :	40%
Program Manager :	John Leys			Branch :	EMS
Project Manager (Lead) :	John Leys			Branch :	
Project Manager(s) (Other) :	Stephan Heidenreich				
FTE :	1.35				

Budget 2015-16	$	In-kind	Total
Science Division :	$ 190,231.00	$ -	$ 190,231.00
OEH (except Science Division) :	$ -	$ -	$ -
External ($, cash) :	$ 180,701.00	$ 580,166.00	$ 760,867.00
TOTAL BUDGET 2015-16 :	$ 370,932.00	$ 580,166.00	$ 951,098.00
		Full life of project $:	$ 570,693.00

Why should the people of NSW invest in this project/sub-program? :	DustWatch is NSW's only dust storm early warning system and is part of a national landscape condition monitoring program. It provides advice to EPA, NSW Health, industry and Local Land Services. Dust storms have considerable impact on our lives. The 2009 Sydney dust storm cost the NSW economy $300 million. The community has strong enduring ownership and involvement having made considerable in-kind and cash investment over the last 10 years. It's Science's largest Citizen-science project.
Project Description :	DustWatch is an intergrated program that tracks landscape condition for Open Plan indicators. OEH collaborates with community, research agencies, EPA, NSW and Federal government departments, universities and Local Land Services. Is reports the landscape condition via monthly the extent and serverity of wind erosion, dust, groundcover and land management status and trends. The project has been running for 10 years and is largely externally funded. It dellives a range of customer focused products.
Achievements to date :	DustWatch makes a difference! It has changed the way we do landscape monitoring. Dustwatch one the Innovation in Public Sector science award in 2011. It is Science's longest running and largerst citizen science project. Is is showcased in the Chief Scientist's recent Citizen Science paper. It levers a high ratio of funds from LLS, EPA and other orgainisations. It makes its data available on the web and updates the data weekly thus increasing it's relevance. The DustWatch Alarm notifies OEH air quality staff of incomeing rural dust.

Collaborators	Collaboration/Orgainsational Type	End user - Customer
LLS	LLS	LLS
EPA	EPA	EPA
Research	Research	Research
CSIRO	CSIRO	NSW State Gov
Aust Gov	ANU/Griffith	Aust Gov

Five (5) Roles of Science - Percentage (%) in Class :	
1. Excellence in delivery and use of relevant, rigorous, accessible, timely science	0
2. Foresighting and policy development	20
3. Environmental program delivery	50
4. Public environmental data, information, knowledge	30

Figure 2. Summary A4 Worksheet

The project worksheet file was named as per the first WBS / filename convention and to create 144 individual project workbooks the use of simple python 2.7 (Python 2.7.x, 2017) code, utilizing the filename list automated this process. This allowed a means to quickly generate all project files initially, and if there was a need to regenerate due to design/layout if changes from decisions by SLT were required. In general terms project workbooks were simply for data entry, and write to PEF_DataSheets.xlsm project worksheet.

2.5. Sub-Program Level Workbook

Sub-programs may contain one to many projects, i.e. multi-relational and the creation of the sub-program excel workbook required a slightly different approach. Almost identical in format as the project template, but not only was specific information to be captured (user input) at the sub-program level and written to the

PROJECT Min - Ave -Max	SCORE - Project Name - Project Leader
No of PROJECTS [2]	
MIN [3]	5 - Support OEH, regional and local planning for the environment - Brian Jenkins
MAX [5]	3 - Modelling biodiversity and landscape processes - Mark Littleboy

Figure 3. Use of INDEX/MATCH functions provided return of associated project data to be displayed on the active sub-program worksheet

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SD_PEF_DataSheet.xlsm in the same manner as project information, certain fields within the excel workbook were automated; by using complex array based formula these fields were inclusive of a concatenation of textual data and/or sum, average, mean of numerical information of all its individual associated projects. This information was read and retrieved from the project and sub-program worksheet within the SD_PEF_DataSheet.xlsm, through using INDIRECT/MATCH (Microsoft Support, 2017) functions of excel (Figure 3). To allow for data that was unique to sub-program level only, and to be written and retrieved, the use of user input forms utlising visual basic developer and visual basic code allowed this functionality. On selecting 'Add/Edit Sub-program Text' command button a user form was displayed, existing information retrieved and displayed if any, and the ability to add, edit or delete any of the information was provided.

2.6. Summary and Reporting

The PEF enables reporting at project and sub-program levels and can further to summarise data at OEH SD Branch level as required. Reporting required both textual and numerical content (for the detail) and graphical representations (for quick visual assessment). At project level, reporting is delivered via the textual and numerical A4 summary sheet (Figure). At sub-program level (which includes the associated projects), an A4 summary worksheet was included to summarise textual and numerical data. Unlike the project level an additional graphical worksheet, in a dashboard format, was developed. A mix of graphical representations (bar, pie and radar plots) showed the resources/budget, percentage delivery to five roles of science, and a breakdown of each science role representing the core evaluation questions, and how projects and sub-programs scored against pre-defined bench marks (Figure 4). All graphs were dynamic in nature in that as information for each project, and or subprogram was updated so did the graphs. For OEH SD branch reporting, the use of multiple pivot tables, bar and pie graphs, formula based tables provided summaries based on resourcing, budgeting, project ranking, collaborations and many combinations as required.

Figure 4. Example only of summary reporting at Sub-program level, radar graphs representing multiple data series (sub-program, multiple related projects vs benchmarks), resourcing and percentage delivery against science roles.

3. DISCUSSION

Evaluation of projects and programs, using a consistent approach to provide evidence of program outcomes is a major aim of the NSW government. There are many challenges to achieving this, and one is a system by which to do the evaluation. Other challenges included resourcing, user acceptance, knowledge and intent of the PEF application, distribution across OEH IT network and simplification of a very complex multi scale reporting matrix.

The resources of this project fell into several areas and were estimated to be about 0.8 EFT where there are (261 days per EFT). A break down is estimated below:

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- Awareness raising – meetings with SLT, working group and piloting staff to indicates why an evaluation tool would benefit decision making:12 days
- Development time – programing, manual writing, logic and standards development required to both give the SLT and users confidence in the rigour of the process and implement the tool and guidelines: 45 days
- Piloting - testing the draft work books, explaining the logic of process, testing of benchmarking and summary reports with small test group = 29 days
- Data input (36 staff involved), quality assurance (3 staff) and analysis (3 staff): 120 days

The SD had a total of 230 EFTs at the time of the evaluation, with the equivalent of one EFT, from within these existing resources being required to undertake this activity.

The ability to report at the project and sub-program level enables users from different managerial levels, such as project leaders and the SLT, to assess and evaluate the work undertaken by SD. While the textual and tabular data was used for detailed evaluation, the graphical A4 summary page (Figure 4) quickly provided comparisons of project performance and enabled sub-program comparison by the SLT. The radar graphs (Crocker, T. 2015) provided a means of being able to extract multiple data series (sub-program, multiple projects and benchmarks) to a single graph with overlaid data. An interpretation of these graphs can be found in Summerell et al., (2017). The use of radar graphs was simply evaluated by asking some project leaders and the SLT if they understood the graphs. Responses were mixed with some liking and others disliking them. However, once the SLT were "walked through" the graphics there was general, though not total, acceptance of their use.

Lessons learnt included, although an access database may have been more beneficial for data storage and robustness, the level of expertise needed for design, implementation is by far greater and a complexity with rational database development that goes beyond the norm of end user understanding. The development of the PEF on the Excel platform, while somewhat 'clunky', provided a simpler level of end user familiarity and efficiency, as existing excel use is common among OEH staff. The Excel platform allowed for simpler form based design, ability to introduce easier calculations, some data efficiency as 'flat' type table. The acceptance by the end users, both the project managers to input the data and the SLT to use the data was a pivotal reason for Excel based design.

At recommended by Patton (2008), in his book "Utilization-Focused Evaluation" this evaluation is tool was built with utility and ease of use in mind. Similarly, the co-development principles were used were like those reported in Steen et al., (2011), that is, SLT who were the customers, were involved in the creative process (e.g. developing the concept of benchmarks and defining outputs, e.g. roles of science), helped development (e.g. set questions and acceptable benchmarks) and tested outputs (e.g. A4 summaries met their needs). We also focused on providing a benefit to the organisation (e.g. development of a useful tool). This was indeed achieved as the PEF results were used to demonstrate the role of SD to the OEH CEO, this subsequently led to a budget enhancement to SD.

The PEF tool improved effectiveness and efficiency of SLT decision making. Such attributes are hallmarks of co-development as outline by Hoyer et al., (2010). The efficiency is demonstrated by the short delivery time of the project and this is due to the development of the PEF tool in Microsoft Excel 2013. This was because it was relatively quick to implement, providing training in its use, was flexible, which enabled changes to be made during its implementation.

In summary, the success of the tool is based on the co-development that allowed a combined and unified effort of the SLT, working group and developer. These combined skills, along with a desire to collaborate and compete the project, enabled the team to develop and deliver an effective, comprehensive and purpose built tool for rapid assessment of NSW Office of Environment and Heritage Science Division environmental science.

4. CONCLUSION

A first of its kind within OEH Science Division, the PEF tool allowed a level of information capture and reporting that has not been provided before within OEH. For the investment of under one EFT, the tool was highly accepted and regarded by Senior and Executive Leaders as pivotal to providing evidence of the importance of current and proposed science programs. The co-development increased the ownership and transparence of the tool. This is reflected in the 100% uptake by the SLT. Many of the experiences and benefits are like other co-development projects (Steen et al., 2011). As reported in Summerell et al (2017) the results have been a positive step in understanding the importance of SD programs and projects, providing evidence of projects Merit, Worth and Value and gaining invaluable knowledge of the importance of how we deliver science at State, Departmental and customers.

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Future development is currently considered for the PEF tool and lessons learnt have provided all a far better understanding of how to structure, streamline, and provide a more robust system.

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