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A resource allocation model to support efficient air quality management in South Africa

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Abstract

Research into management interventions that create the required enabling environment for growth and development in South Africa are both timely and appropriate. In the research reported in this paper, the authors investigated the level of efficiency of the Air Quality Units within the three spheres of government *viz.* National, Provincial, and Local Departments of Environmental Management in South Africa, with the view to develop a resource allocation model. The inputs to the model were calculated from the actual man-hours spent on twelve selected activities relating to project management, knowledge management and change management. The outputs assessed were aligned to the requirements of the mandates of these Departments. Several models were explored using multiple regressions and stepwise techniques. The model that best explained the efficiency of the organisations from the input data was selected. Logistic regression analysis was identified as the most appropriate tool. This model is used to predict the required resources per Air Quality Unit in the different spheres of government in an attempt at supporting and empowering the air quality regime to achieve improved output efficiency.

Key words: Air quality, resource allocation model, project management, knowledge management, output efficiency, logistic regression.

1 Introduction

The South African government departments are widely praised for having the most innovative and progressive legislature, policies, and programmes in the world. However, a considerable gap was identified between written regulation and implementation into reality (Aladin, 2006). Efficient implementation of policies and strategies require that organisations allocate resources to activities that support project management, change management, and knowledge management practices (Rosacker, 2005; Batley, 2005).

A literature search on project management, change management and knowledge management practices in South African Government Departments revealed that these activities are

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not adequately addressed (Foti, 2005; Bridgman & Davis, 2004; Rosacker, 2005). Streit and Guzman (1995) claimed that to be efficient, government departments must have a good understanding of the resources allocated to manage projects, deal with collaboration initiatives, address resistance to change and implement air quality management strategies. In their study, the term "resources" referred to peoples' time and the departments' budgets, which is similar to the approach in this study. Davenport and Marchand (2000) added that organisations which focus on knowledge management create an environment that facilitates the creation of knowledge, support the way people share and apply it, and improves the organisations' ability to manage change.

This paper deals specifically with the South African Air Quality Units within the national, provincial and local government departments; 228 units in total. The recent emphasis on air quality management was largely due to the increased awareness of the potential health impacts of air pollution, the lack of compliance action by government environment departments and the need for industries to rapidly change technology through efficient environmental authorisation processes (Pape, 2001). Regarding effective air quality management, Hadfield and Seaton (1999) identified gaps with respect to the lack of effective information management and developing knowledge systems to defend regulations on emissions for improved compliance actions.

Numerous air quality management challenges have been published on specific air quality management units in South Africa. One example is described in the work by Mokgoro (2000) who reported on the difficulty in implementing the National Department of Environmental Management's policies in the North West Provincial Department of Environment. These challenges included:

- Lack of reliable data and information to make informed decisions;
- An inadequate information management system; and
- National policies were imposed on the Department without regard to the capacity of the North West Province and other specific circumstances.

Foti (2005) supported the work of Mokgoro (2000) and added that the lack of continuity and sustainable decision support tools were the greatest weakness in the adoption of project management practices by provincial and local environment departments. Riege and Lindsay (2006) confirmed that knowledge management played a key role within public service, but stated that there was limited research and few guidelines on how governments can develop more effective knowledge management and public policy partnerships with stakeholders.

The Air Quality Units were also experiencing several challenges in terms of improving communication across the different spheres, accessing air quality information, and using the information to support the decision making required for effective management of air quality in the country (Lukey, 2007). Therefore, it was opportune to evaluate the potential for improving the output efficiency in this sector by evaluating their resource allocation trends to activities relating to project management, knowledge management and change management.

The aim of the work reported in this paper is to fit a resources allocation model that contributes towards the prediction of the output efficiency of the Air Quality Units, which may support efficient planning and budgeting. This raised the following question, investigated in this paper: To what extent can the South African Air Quality Units' efficiency be explained by the percentage of the resources allocated to indicators relating to project management, knowledge management and change management?

The term "resource allocation" refers to the apportioning of the officials' man-hour costs into activities relating to project management, change management and knowledge management. The "efficiency" of the units refers to the percentage completion of the mandated outputs, activities and strategic projects (where 100% efficiency implies that all required activities are completed).

2 Measuring public sector efficiency

Webster and Omar (2003) state that efficiency relates to the comparison between the inputs and outputs of an organisation. The measurement of efficiency generally requires (a) an estimation of input variables, (b) an estimation of output variables, and (c) a comparison between the two. At a given input, the greater the output, the more efficient an activity or organisation is (Webster & Omar 2003).

Organisations use models as important tools for analysing businesses and developing strategies to improve efficiency (Recklies, 2004). Existing models for measuring efficiency suffer from limitations in the sense that the focus is primarily on improving product delivery time and requires the use of vast volumes of data that are not readily available in the public sector (Durant-Law, 2008). The model fitted in this study focuses on data that are captured as part of the public sector budget and performance reporting systems.

An efficient public service is one that undertakes its functions in the best possible and least wasteful manner (Webster & Omar, 2003). In the absence of market force incentives, public service departments must utilise their resources optimally to carry out their mandate (Webster & Omar, 2003). This emphasises the need for the Air Quality Units in order to understand the efficient allocation of their resources.

3 The input variables of the Air Quality Units

The studies published by previous researchers in the field of project management, knowledge management and change management that were reviewed in order to identify the activities to monitor as input variables into the model are summarised in Tables 7 in Appendix A. The man hours spent managing knowledge and knowledge processes, for example, was an important indicator used by Rwelamila (2007) in his work on understanding project management competence in public sector infrastructure organisations. He also argued that the public sector must allocate resources to formulating work processes, role descriptions, and databases of products or services to deliver efficiently on their routine activities.

Shenhar (2004) stressed the need for allocating resources to the implementation of strategic plans to support improved organisational efficiency. Crawford *et al.* (2003) also assessed activities relating to project management. They agreed that project management had the potential to improve the efficiency of government services if resources were allocated to managing the outsourcing of projects. Bridgman and Davis (2004) asserted that the better the knowledge base upon which public policies was built, the more likely the public sector departments were to succeed in implementing the policies. Their study focused on allocating resources to knowledge transferred within government, and prioritising and addressing system failures. Longman and Mullins (2004) recommended that for an organisation to resourcefully manage change, it must capture the learnings in a "projects lessons learned event and report."

The activities that were monitored in the different studies, as summarised in Tables 7 in Appendix A, were used to inform the selection of the twelve input variables, as listed in Table 1. These input variables were further grouped, as shown in Appendix A, into five categories *viz.* project management, knowledge management, routine, other and change management with the aim of simplifying the model.

X_1:	Routine tasks as per job description
X_2:	Managing strategic project or projects
X_3:	Set up and maintain monitoring stations for managing air quality information
X_4:	Develop legislation and decision support tools
X_5:	Document learnings and set up inhouse knowledge systems
X_6:	Communication with other Department
X_7:	Training and Development
X_8:	Manage Outsourcing as per business plans *i.e.* managing consultants and contracts
X_9:	Prioritising and addressing system failures
X_{10}:	Partner with other organisations
X_{11}:	Manage knowledge (centralised reporting system, updating department performance indicators)
X_{12}:	Other inputs

Table 1: *Input variables used in this study. Of these, X_2, X_6, X_7, X_8, and X_{10} are project management input variables, X_3, X_9 and X_{11} are knowledge management input variables, and X_4 and X_5 are change management input variables.*

4 The output variables of the Air Quality Departments

The outputs used in the model were based on the mandates of Air Quality Units, detailed in the Air Quality Act of 2004, as follows:

- Timeous development and adoption of regulations under the Act (for example, ambient air quality standards, emission limits, guidelines for air quality monitoring, modelling and management);
- Capacity building of local, provincial and national government personnel in terms of provision of adequate training, support and resources;
- Development and effective implementation of coherent air quality management systems comprising current and comprehensive emissions inventories, cost-effective and well run monitoring networks, suitable air dispersion models; and
- Standardisation of monitoring methods, emissions inventories, modelling approaches and source, emissions, air quality and meteorological data reporting.

The resulting fifteen output variables are shown in Table 2.

Y_1:	Number of decision support tools approved
Y_2:	Ambient dust levels (quantified as micrograms per cubic meter)
Y_3:	Ambient NOx levels (quantified as micrograms per cubic meter)
Y_4:	Ambient SO_2 levels (quantified as micrograms per cubic meter)
Y_5:	Ambient Heavy Metals levels (quantified as micrograms per cubic meter)
Y_6:	Number of industrial applications reviewed
Y_7:	Number of non compliances identified
Y_8:	Number of non compliances managed
Y_9:	Number of completed outsourced projects
Y_{10}:	Number of industry-NGOs - government forums established
Y_{11}:	Number of cross functional project teams established
Y_{12}:	Number of air quality monitoring stations operational
Y_{13}:	Number of knowledge systems operational
Y_{14}:	Number of alternatives implemented to manage air quality
Y_{15}:	Other Outputs

Table 2: *Output variables used in this study (Air Quality Act, 2004).*

5 Methodology

The research methodology focused on developing a regression model that could predict the efficiency of the Air Quality Units, based on the actual data collected for the period of two financial years (2005/06 and 2006/07).

The officials that were responsible for managing air quality in the South African National, Provincial and Local Environmental Departments were approached for the information relating to the identified inputs and outputs. Based on actual work hours, the officials estimated their man-hours spent on the input variables. The man-hour data set from the Air Quality Units was converted into man-hour costs, using the hourly compensation rates of the responsible individuals. The man-hour cost data set was then expressed as a percentage of the total available working hours in the year. The output information was extracted from the Air Quality Units' management reports. The number of completed items was expressed as a percentage of the total number of mandated activities. An extract of the input-output data set is shown in Appendix B. The respondents required that their information be maintained as confidential; therefore no further breakdown of the responses is included.

The data were validated and corrected for missing cells and possible incorrect entries. An exploratory analysis of the data was undertaken, followed by data preparation and grouping into categories. Preliminary assessment of the data was undertaken to test whether the data are amenable to linear regression. Violations in assumptions of normal distributions in the data set were identified which implied that linear regression analyses were not appropriate. Subsequently, the logistic regression technique was applied, as its application is not limited to many of the restrictive assumptions of linear regression models and is suitable for use with categorical data (Garson, 2008).

The input and output variables were subject to recoding of the original scores to ensure suitability of analysis, as recommended by Pallant (2005). A summary of the recoded variables used for the modelling process is shown in Table 3. SPSS (Statistical Package for the Social Sciences) [43] was used to fit the "best" logistic regression model.

Variables	**Type**	**Categories and values**
Routine	Continuous/Independent	0 – 100 %
Change Management	Recoded/Categorical data/Independent	2 categories: 0: $<1.5\%$ 1: $\geq 1.5\%$
Knowledge Management	Recoded/Categorical data/Independent	3 categories: 0: $<10\%$; 1: 10 – 20%; 2: $>20\%$
Project Management	Continuous/Independent	0 – 100 %
Other	Continuous/Independent	0 – 100 %
Output Efficiency	Recoded/Categorical data/Dependent	2 categories: 0: 10 – 50%; 1: $\geq 50\%$

Table 3: *Summary of the categories of the variables used to fit the model.*

Cross validation of the logistic regression model was performed to overcome the problems relating to over fitting the model to noise in the data, generally experienced in using stepwise methods, by fitting the model to the data collected for the 2006/07 financial year. The 2006/07 data were also used to test the robustness of the model.

The logistic regression curve was developed to predict the probability of the outputs of the model, when the variables of interest were changed in terms of man hours allocated.

6 Results

The response rate from the air quality officials approached for information that was required to the fit the model was 100%. The model fitted, using logistic regression, is shown in Table 4. The model allows for predicting the classification of the Air Quality Units as either less than 50% or greater than and equal to 50% efficient. The resource allocation model fitted is able to correctly predict, with a high degree of accuracy (89%), the efficiency category of the Air Quality Units. Both data sets predominantly satisfied the statistical requirements for a significant model, which indicates the robust character of the model.

The two variables, resources allocated to other activities and the category allocation for knowledge management *i.e.* between 10–20% of resources allocated to knowledge management are the only two inputs which contribute to the prediction of the Air Quality Units' output efficiency. This implies that between 10–20% of the man-hours available in the Air Quality Units must be used to undertake activities relating to knowledge management.

The positive and negative values in the models indicate the direction of the change (*i.e.* allocating resources to other activities would result in a decrease in output efficiency, while allocating between 10–20% of the resources on knowledge management would result in an increase in efficiency).

The chi-square goodness-of-fit test performed (see Table 5) indicated that the inclusion of the variables was justified, as the significance of the steps was less than 0.05. This implies that there is adequate fit of the data to the model, meaning that at least one of the predictors is significantly related to the response variable.

2005/06	2006/07
P(output 50% or higher) = $\frac{1}{1+e^{-z}}$	P(output 50% or higher) = $\frac{1}{1+e^{-z}}$
where	where
$z = 2.556 - 0.063$ other	$z = 2.0473 - 0.062$ other
$+ 0.631$ KM (if $>$ 20% man hours)	$+ 0.64$ KM (if $>$ 20% man hours)
$+ 4.372$ KM (if 10-20% man hours)	$+ 4.372$ KM (if 10-20% man hours)

Table 4: *The logistic representation models for the 2005/06 and 2006/07 data sets.*

Year			Chi-square	Degrees of Freedom (Df)	Significance
2005/06	Step 1	Step	49.974	2	0.000
		Block	49.974	2	0.000
		Model	49.974	2	0.000
	Step 2	Step	23.411	1	0.000
		Block	73.384	3	0.000
		Model	**73.384**	**3**	**0.000**
2006/07	Step 1	Step	49.235	2	0.000
		Block	49.235	2	0.000
		Model	49.235	2	0.000
	Step 2	Step	22.854	1	0.000
		Block	72.089	3	0.000
		Model	**72.089**	**3**	**0.000**

Table 5: *Chi-square goodness-of-fit test for the resource allocation model for the South African Air Quality Units. P: Estimated probability for Air Quality Units; KM: Knowledge Management.*

7 Discussion

The model fitted showed that the Air Quality Units must allocate 10–20% of their resources to managing knowledge in order to be more than 50% efficient. The individual activities that must be prioritised, as shown in Appendix A, are as follows:

- Manage air quality information from monitoring stations:
  - Validate the air quality data,
  - Inspect monitoring stations,
  - Generate air quality reports with trends.

- Prioritise and address system failures:
  - Prioritise outputs based on planned goals,
  - Document system failures and solutions,
  - Establish monitoring and evaluation programmes,
  - Review systems failures.
- Manage knowledge and knowledge processes:
  - Set up knowledge systems,
  - Have centralised reporting systems, performance indicator systems and project tracking systems.

In addition, the Air Quality Units must limit the resources allocated to managing other activities. These activities include:

- Reviewing housing development impact studies,
- Addressing public nuisance complaints,
- Supporting the development of local air quality bye-laws that were not related to air quality management (for example, bye-laws relating to managing informal settlements and traffic offenders),
- Managing projects that were not related to air quality management (for example, solid waste disposal site guidelines and land use management planning).

8 Conclusion and way forward

The resource allocation model is able to predict, with a high degree of accuracy, the output efficiency of the Air Quality Units based on actual resources allocated to project management, change management and knowledge management. This provides a firm guideline for Air Quality Units in South Africa to increase their output efficiency and ultimately improve air quality.

The work done with the Air Quality Units also showed that efficiency could be encouraged through the following activities:

1. Greater understanding of the definition of performance efficiency in terms of using the desired outputs to define the allocation of resources to inputs and working towards planned targets;
2. Securing commitment from top management to operate as a project management learning organisation and developing and sustaining interdisciplinary project teams both within the departments and across the different spheres;
3. Coordinating effort and exchanging technical information among different departments, industry sectors and non-government organisations to establish a comprehensive air quality knowledge system;
4. Emphasising the need within departments to prioritise and address system failures and share lessons learnt within the entire air quality regime;
5. Increasing the focus on developing a "collective brain" within government through an improved learning network system that would support the planned change in policies, institutional arrangement and behaviours within the air quality regime;

6. Allocating 10–20% of resources to knowledge management activities; and
7. Clearly defining the "Other tasks" that must be undertaken and minimising the resources allocated to these tasks.

An output of this study is that more is known about the concept of public sector output efficiency, its different interpretations and the relationship between knowledge management and output efficiency in the South African public sector. Future research work must focus on quantifying the minimum resources that must be allocated to the other activities performed by the Air Quality Units, which are over and above their mandates, to establish optimal resource allocation requirements for maximum output efficiency.

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Appendix A

This appendix contains a summary (in tabular form) of the studies previously published in the field of project management, knowledge management and change management and how these studies gave rise to the set of input variables to the logistic regression model described in the main body of the paper.

Independent Variables	Indicators used in this study to quantify the independent variables. Man hours spent on:	Activities referred to in previous research in the field of Project Management, Change Management and Knowledge Management to support the grouping of factors	References that support the grouping of factors
Routine Work	X_1: Routine Work – Human resource function – Performance assessment – Financial management – Reviewing industry applications	Public sector must formulate work processes, role descriptions, and routines. Standards for the main services referenced.	Rwelamila (2007)
Project Management	X_2: Managing strategic project (as per business plans) – Identifying strategic projects in business plans – Establishing project teams – Internal communication – Developing project plans, – Monitoring and reporting progress	Group your projects based on their strategic impact and implement as per plan Teams perform better than individuals perform and transfer knowledge better. Internal communication helps employees to have a better idea of how what they do impacts upon the organisation. Greater the focus on developing and managing interdisciplinary project teams; greater output efficiency.	Shenhar (2004) Thompson & Strictland (1996) Moorcroft (2006) Englund, *et al.* (2003)

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Independent Variables	Indicators used in this study to quantify the independent variables. Man hours spent on:	Activities referred to in previous research in the field of Project Management, Change Management and Knowledge Management to support the grouping of factors	References that support the grouping of factors
Knowledge Management	X_3: Managing air quality information from monitoring stations – Validating data, – Inspecting monitoring stations – Generating air quality reports with trends	Data collection and reporting used as an indicator for knowledge management Air quality monitoring increasingly important issue in developing air quality management plans. The trends in terms of reliability of data from public departments in developing countries were quoted as major obstacles to efficient air quality management. Air quality information required to make informed and efficient decisions on industrial applications.	Mrayyan & Hamdi (2006) Foti (2005) Air Quality Act (2004)
Change Management	X_4: Developing legislation and decision support tools – Drafting policies – Commenting on relevant legislation – Developing decision tools	Develop processes that lead to changes in policy, institutional arrangements, and behaviour. Increase focus on developing dynamic processes of learnings results in greater adoption of changes in policy, institutional arrangements and behaviour and improvement in air quality Reported on the need for empowerment tools to support efficient decisions on industrial air quality management applications.	Hadfield & Seaton (1999) Air Quality Act (2004)
Change Management	X_5: Documenting learnings and evaluating knowledge systems – Establishing trends through – Monthly report on performance, – Quarterly meeting feedbacks, – Interrogation of the knowledge systems	Evaluating change was key for relapse prevention There is a culture of learning by the organisation Lessons learnt are disseminated Every project should be a platform for learning and growth Summarise your project in a lessons learned event and report Every monitoring and controlling activity must include lessons learned. Organisations need to effectively manage knowledge through action learning Organisations must focus on centralised expertise, problem solving and reflection (learning function) The more the focus on capturing learnings and moving towards a project management learning organisation; greater the output efficiency.	Herzog (1991) Dvir, *et al.* (1998) Cleland (1999) Moore (2003) Dvir, *et al.* (1999) Longman & Mullins (2004) Shenhar (2004) Zuber-Skerritt (2002) Kessels (2001) Nonaka & Takeuchi (1995) Wenzel (2007)

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Independent Variables	Indicators used in this study to quantify the independent variables. Man hours spent on:	Activities referred to in previous research in the field of Project Management, Change Management and Knowledge Management to support the grouping of factors	References that support the grouping of factors
Project Management	X_6: Communication with other Department – Interdepartmental meetings – Communication to address synergies between departments – Share ideas on challenges and improvements *etc.*	Intergovernmental relations is key to efficient public sector Participation by members are encouraged Emphasis must be on the flow of communication Organisation fosters openness of communication and information Organisations must become boundaryless with open communications Decentralised air quality management is more effective, however governance structures must be clearly established with the efficient flow of information at all levels of government to support decision making. The greater allocation of time to communication and engaging people; the greater output efficiency. The greater the sharing and collaborating between different government department; the greater the output efficiency.	Africa & Nicol (2006) Cleland (1999) Gray & Larson (2000) Morrison, *et al.* (2006) Beer & Nohria (2000) Krupnick (2008) Wenzel (2007) Quassim (2005) Roseau (1998)
Project Management	X_7: Training and Development – Develop project competence – Developing training plans – Attending training	Project management competence part of AQOs development plan. There is a general culture of learning, personal development and professionalism Critical success factor in public sector is the empowerment and training to do the job.	Thamhain & Wilemon (1987) Dvir, *et al.* (1998) Frame (2002)
Project Management	X_8: Managing Outsourcing as per business plans – Managing consultants as per contract conditions – Reviewing regular progress – Using close out reports	Outsourcing must be grounded in a project management approach with risks and controls captured in contracts. Outsourcing of government work must be project managed using project management tools (work breakdown structures, progress reports and close out reports).	Kakabadse & Kakabadse (2001) Manley, *et al.* (2007) Crawford, *et al.* (2003)

(Continued)

Independent Variables	Indicators used in this study to quantify the independent variables. Man hours spent on:	Activities referred to in previous research in the field of Project Management, Change Management and Knowledge Management to support the grouping of factors	References that support the grouping of factors
Knowledge Management	X_9: Prioritising and addressing system failures – Prioritising outputs based on planned goals – Documenting system and addressing failures with sustainable solutions – Establish monitoring and evaluation programmes to address systems failure – Reviewing of systems failures	Goals must be set with due consideration to the resources available Clearly identify priorities and each priority is translated into action items with clearly defined accountabilities, timetables and key performance indicators. Failures in addressing priorities are documented and share. Efficient public sector requires supporting monitoring and evaluation programmes to address systems failures Coordinate and monitor progress to achieving mandated objectives is critical in public sector. Projects may fail due to not addressing systems failure in planning and execution phases. The greater the focus of resources on planning and tracking projects changes the greater the output efficiency.	Posner (1987) Thamhain & Wilemon (1987) Pinto & Slevin (1988) Mankins & Steele (2005) Crawford, *et al.* (2003) Gabriel, *et al.* (2005) Blair (2001) Quassim (2005)
Project Management	X_{10}: Partnering with other organisations for example industry associations and NGOs – Attending environmental stakeholder meetings – Collaborating on initiatives – Undertaking joint projects	Develop management community as a key resource Important factor for effective air quality management was the need to encourage cooperation and involvement.	Sterner (2003)

(Continued)

Independent Variables	Indicators used in this study to quantify the independent variables. Man hours spent on:	Activities referred to in previous research in the field of Project Management, Change Management and Knowledge Management to support the grouping of factors	References that support the grouping of factors
Knowledge Management	X_{11}: Managing knowledge and knowledge processes – Setting up knowledge systems – Centralised reporting system – Performance Indicator Systems – Project tracking systems	The greater the application of knowledge management by developing and implementing knowledge systems; the greater the output efficiency. The greater the time spent on monitoring of targets and objectives of project and sub projects against planned targets, the greater the output efficiency. Knowledge systems empower departments to make informed decisions and support required change to facilitate improved output efficiency. Sound information infrastructure Make systems and procedures user friendly The organisation should establish firm, standardised project management systems Information systems must be purposeful to serve the requirements of users Public departments must gather knowledge and experience and store this in a collective mind.	Durant-Law (2008) Grimshaw, *et al.* (2002) McCourt (2005) Sharon & Prefontaine (2003) Jupp & Younger (2004) Kanter & Walsh (2004) Laufer, *et al.* (1996) Frame (2002) Longman & Mullins (2004) Tatikonda & Rosenthal (2000) Rwelamila (2007)
Other	X_{12}: Other Variables – Tasks undertaken that were excluded from mandated requirements	All tasks outside the mandates of the unit.	Air Quality Act (2004)

Table 6: *Selection of the input variables from the literature review on project management, change management and knowledge management.*

Appendix B

This appendix contains a summary (in tabular form) of the input-output data set used to construct the logistic regression model described in the main body of the paper.

Year	%y	Routine	PM	KM	CM	Other	N	Year	%y	Routine	PM	KM	CM	Other
2005/06	100%	21%	48%	13%	12%	6%	1	2006/07	100%	20%	51%	12%	15%	2%
2005/06	100%	24%	31%	22%	7%	16%	2	2006/07	100%	23%	32%	22%	7%	16%
2005/06	93%	32%	43%	11%	10%	3%	3	2006/07	93%	33%	37%	13%	10%	8%
2005/06	93%	23%	9%	16%	2%	50%	4	2006/07	93%	23%	9%	16%	2%	50%
2005/06	93%	32%	43%	11%	10%	3%	5	2006/07	93%	33%	43%	11%	11%	2%
2005/06	93%	24%	32%	22%	7%	15%	6	2006/07	93%	24%	32%	22%	7%	16%
2005/06	93%	31%	31%	21%	12%	5%	7	2006/07	93%	27%	31%	23%	10%	9%
2005/06	87%	23%	9%	16%	2%	50%	8	2006/07	87%	23%	9%	16%	2%	49%
2005/06	87%	24%	31%	22%	7%	15%	9	2006/07	87%	24%	31%	22%	7%	15%
2005/06	87%	23%	9%	16%	2%	50%	10	2006/07	87%	23%	9%	16%	2%	50%
2005/06	87%	32%	43%	11%	10%	3%	11	2006/07	87%	32%	43%	11%	10%	3%
2005/06	87%	23%	9%	21%	2%	45%	12	2006/07	87%	24%	9%	22%	2%	42%
2005/06	80%	2%	1%	1%	0%	96%	13	2006/07	80%	2%	1%	1%	0%	96%
2005/06	80%	23%	9%	16%	2%	50%	14	2006/07	80%	23%	9%	16%	2%	50%
2005/06	20%	2%	21%	23%	1%	52%	89	2006/07	20%	3%	21%	24%	1%	52%
2005/06	20%	2%	21%	23%	1%	53%	90	2006/07	20%	2%	21%	23%	1%	53%
2005/06	20%	2%	21%	23%	1%	53%	91	2006/07	20%	2%	21%	23%	1%	53%
2005/06	20%	17%	54%	%	0%	21%	92	2006/07	20%	17%	55%	8%	0%	21%
2005/06	13%	3%	2%	0%	0%	94%	102	2006/07	13%	4%	2%	0%	0%	94%
2005/06	13%	2%	21%	23%	1%	52%	103	2006/07	13%	2%	21%	23%	1%	53%

Table 7: *Extract of the input-output data set used to fit the resource allocation model. N = Number of Samples; KM = Knowledge Management; CM = Change Management; PM = Project Management; y = output efficiency.*