

## Development of a Water Management Decision Model for Limpopo Province of South Africa Based on Congruence between Sector Challenge and Service Organization Capacity

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### Abstract

*The study highlighted challenges affecting the water sector in Limpopo Province, identified water service organisations (WSOs), assessed the degree of congruence between the challenges and capacities of WSOs, and finally proposed a water management decision model for the area. Water challenges were (a) scarce resource availability and inadequate storage, (b) some dam never filling up, (c) poor resource knowledge of water managers, (d) lack of stakeholder participation in resource decision making, and (e) poor allocations to rural communities. The main WSOs were Department of Water Affairs-DWA (congruence rating=2.00) and water service authorities (WSAs), namely: Mopani District Municipality-MDM (congruence rating=2.15), Vhembe District Municipality-VDM (2.15) and Polokwane Local Municipality-PLM (2.15). The degree of congruence was high (2.75) between challenges and strategies, moderate (2.45) between strategies and tasks and low between allocation and use of human resources (1.50), making it the most significant constraint to WSOs addressing water challenges.*

**Key words:** Congruence, water challenge, water service authority, organizational capacity, decision model

### 1. Introduction, Congruence Model

Periodic droughts and population growth have placed burdens on water supply and demand. This results in communities being faced with challenges such as resource scarcity resulting in negative socio-economic impacts. In order to successfully address water challenges, an appropriate resource management decision model that takes into account the relevant capacity of service organisations is required. Such a model should be based on the degree of congruence between the sector challenge and relevant capacity of service organizations and hence the Congruence Model (Nadler and Tushman, 1980) was identified as a basis for development of the water management decision model.

The Congruence Model views organisations as made up of components that interact with each other (Figure 1). These components are **inputs** that include environment, resources, history and strategy; **transformation** that is influenced by tasks, human resources, financial resources and formal and informal organisational arrangements; and **outputs** that may be organisational, group or individual (Nadler and Tushman, 1980). The model provides for flow of information and / or action from a source component to a recipient component and this information and / or action may be subjected to congruence rating to assess its relevance (Figure 1).

The description of Nadler and Tushman (1980) was affirmed by Gill (2000), Bezboruah (2008) and Mertikas (2008) who indicated that an organisation as represented by the Congruence Model takes input, put them through transformation and produce outputs. The congruence between two components is defined as the degree to which the needs, demands, goals, objectives, and structures of one component satisfy those of the other (Nadler and Tushman, 1980). The concept 'congruence' may be understood through illustration of the fit between units (1) across components, e.g. person-environment (P-E), and (2) those within components, e.g. (a) person-organization fit, (b) person-group fit and (c) person-job fit.

The concept of 'person-environment (P-E) fit' refers to similarity or convergence between a particular set of person-related attributes and a set of environment-related attributes (Schneider *et al.*, 1992). The underlying assumption is that organisations will be more effective when the attributes of a person and those of environment match or are highly congruent (Ostroff, 1993). The P-E fit has been positively related to job satisfaction, organisational commitment and career success (Bretz and Judge, 1994; Chatman, 1991 and Kristof, 1996). Considering the water sector, a high degree of congruence between the unit of *environment* under input and that of *person* under transformation (within the water service organization) will contribute to a more effective service organisation. Similarly, high degrees of fit between pairs of other units across the two components of environment and transformation in water service organisations will make the organisation to be more effective.

The concept of 'person-organisation (P-O) fit' refers to a match between individual and organisational characteristics (Kristof, 1996). The P-O fit may be defined as the congruence between individual values and organisational values (Boxxet *al.*, 1991; Chatman, 1989, 1991; Judge and Bretz, 1992; O'Reilly *et al.*, 1991). Organisational values include such aspects as culture which informs people about the appropriate way things are done in the organisation (Balkin and Schjoedt, 2012). Some organisational cultures are rigid and do not provide for employees to make independent decisions while others are flexible and allows the employees to make decisions. Self-motivated persons (employees) would want to decide on their own goals, work schedules, methods of work and outputs (Cascio, 1999; Sparrow and Daniels, 1999) and would therefore fit in flexible work situation such as that offered by virtual organisations (Boudreau *et al.*, 1998; Jarvenpaa and Leidner, 1999). These organisations that offer a flexible work situation are often multicultural (DeSanctiset *al.*, 1999; Jarvenpaa and Leidner, 1999) and are therefore able to accommodate employees from different cultural backgrounds. The attainment of P-O fit is very necessary for water service organisations to be effective.

Person-group (P-G) fit is defined as the compatibility between an individual and his or her workgroup (Kristof, 1996). The P-G fit is a measure of the similarity in personality among group members or possession of effective interpersonal skills (Werbel and Gilliland, 1999). The Congruence Model promotes (1) similarity among group members' personality, values, and goals (Klimoski and Jones, 1995); and (2) possession of interpersonal skills that are necessary for effective cooperation with other group members (Werbel and Gilliland, 1999). It may be inferred that attainment of a high degree of similarity among the personality and values of different group members requires regular communication among the members. The regular communication allows the group members to share their diverse personality and values and to gradually establish a state of homogeneity with regards to these personality and values.

The concept of 'person-job (P-J) fit' refers to the degree of congruence between individual characteristics and job requirements (Edwards, 1991; Caldwell and O'Reilly, 1990). The P-J fit commonly lacks where employees have a shortage of competence that is critically required by the job (Cascio, 2000). Issues resulting in employees lacking critical competence required by their jobs could include problems at recruitment. In situations where employees do not have the required competence for their jobs, attainment of P-J fit will require the organisations to invest in interventions such as human resource development.

The purpose of this study was to (1) highlight the challenges faced by the water sector in the study area, (2) analyse the degree of congruence between the challenges and the capacity of identified water service organisations as reflected by strategies, tasks, and allocation and use of resources, and (3) to subsequently propose a water management decision model. The Congruence Model of Nadler and Tushman (1980) provides a suitable framework for developing the water management decision model and will accordingly be used.

## **2. Research Methodology**

### **2.1. Sampling Procedure**

Purposive sampling was used to select the water service organisations to be evaluated for development of a water management decision model within the framework of the Congruence Model. The Limpopo Regional Office of DWA was selected as it is the custodian of water in the province. The WSAs of Mopani District Municipality (MDM) largely in the Luvuvhu-Letaba WMA, Vhembe District Municipality (VDM) across both Limpopo and Luvuvhu-Letaba WMAs and the Polokwane Local Municipality (PLM) in the Limpopo WMAs (Figure 2) were deliberately selected for their proximity to the place of stay of the researcher.

### **2.2. Data Collection and Analysis**

Information on major challenges affecting the water sector in the study area was obtained from relevant literature studied to provide insight on the type and magnitude of the challenges. The study of literature was followed by interviews of water sector stakeholders, and these included the water service organizations sampled for the study, municipal water managers and community members of selected villages in the study area.

Data on capacity of sampled water service organisations was obtained from the strategic and integrated development plans and annual reports of these organizations. The WSAs are newly developing organisations without some of the necessary information available over the years, especially that on resource allocations and utilization. Where information was provided, the plans and reports dealt with different issues across the WSAs and across the years and this made analysis difficult. A fair amount of information with some degree of convergence on issues covered was obtained for the 2009-10 financial year and hence analysis was based on this year. The documents used to obtain information on the capacity of water service organisations were the 2007/08-2009/10 Strategic Plan for DWA (DWA, 2007), 2006-12 Integrated Development Plan for MDM (MDM, 2009), 2009-10 Integrated Development Plan for VDM (VDM, 2009) and 2009-11 Integrated Development Plan for PLM (PLM, 2009). Information was also obtained from other relevant literature.

In order to ensure consistence in the type of information collected from the plans of the water service organisations, the major challenges experienced by the water sector were highlighted. The statements in the plans of water service organisations that proposed solutions to the sector problems were noted and used to assess the congruence between the capacity of the organisation and the water sector challenge. The congruence analysis was based on the plans of the water service organisation and hence estimates the prospects for the organisations to successfully address the water sector challenges.

Although the information was mainly qualitative, some quantitative data was used and that included data on the amount of resources allocated and those utilized by the organisations. Spread sheet calculations were performed on quantitative data and objective rating of congruence between planned and utilized human and financial resources was conducted. The qualitative information on different aspects of organisational capacity was properly summarized, organised and subjectively rated for congruence with the water sector challenges (Lee, 1999; Leedy and Ormrod, 2010). Arbitrary numerical scores were decided upon and used for the rating of the degree of congruence between aspects of capacity of water organisations and the sector challenges. The scores were in a scale of 0-3 where 0 indicated no congruence, 1 indicated low, 2 indicated moderate and 3 indicated a high degree of congruence. This type of research where both quantitative and qualitative data is collected and analysed is described as a mixed study (Hurmerinta-Peltomaki and Nummela, 2006).

The congruence scores were accordingly interpreted in the context of determining the prospects for water service organisations to successfully address sector challenges. Higher congruence scores for both quantitative and qualitative aspects suggested a higher degree of fit between the water sector challenge and the capacity of the service organisation to address it and *vice versa*.

## **3. Results and Discussion**

### **3.1. Major Challenges Faced by the Water Sector**

In accordance with the negative influences brought by the different components of input to the water sector, various challenges were identified which require major attention, and those include:

**(a) Scarce Water Resource Availability and Inadequate Storage**

A study on runoff and storage capacity of the Limpopo and Luvuvhu-Letaba WMA (Tshikolomo *et al.*, 2009) revealed the study area to be water scarce with the storage capacity not adequately developed, especially in the Limpopo WMA. As a result, the supply of the resource is insufficient for meeting the demands for social and economic activities in the province.

**(B) Some Dam Never Filled Up**

Some dam never filled up except during floods and this confused water managers who could not reliably predict the supply and as a result could not make appropriate resource management decisions. The dam of concern in this regard is the Middle Letaba Dam in the Luvuvhu-Letaba WMA (Tshikolomo *et al.*, 2012a). Inappropriate water management decisions were made and these did not improve the effectiveness of the water sector.

**(C) Poor Resource Knowledge of Water Managers**

Water managers lacked knowledge of the water resources in their areas (Tshikolomo *et al.*, 2012b). The managers did not know all the major rivers and dams from which water is supplied in their areas. Instead of understanding the entire supply chain of the water resource, the managers only had a fair understanding of the consumption of the resource and would therefore not make comprehensive decisions on management of the resource.

**(D) Lack Of Stakeholder Participation**

In a survey of the perceptions of rural municipal water managers on stakeholder participation on water issues in the area under study, it was shown that the involvement of stakeholders in decision making for water issues is very poor. Government based stakeholders were more influential in water issues than their counterparts from communities (Tshikolomo *et al.*, 2012c).

**(E) Poor Resource Allocations to Rural Communities**

A study of water supplies and uses by rural households in the province revealed that the supplies were very low. More households in the study area reserved water for only basic activities of drinking by people (95.9% of households), preparing food (95.4%), bathing (92.8%) and laundry (90.8%) compared to those who used the resource for productive activities of washing car (6.6%), irrigating crops (5.7%) and livestock drinking (3.5%) due to scarcity of supply (Tshikolomo *et al.*, 2012d).

**3.2. Congruence between Water Sector Challenges and Organisation Strategies and Among Components of Capacity of Service Organisations****3.2.1. Organisational Strategies and Their Congruence with Water Sector Challenges**

Strategy entails the whole set of decisions that are made about how a water service organisation will configure its resources taking into consideration the demands, constraints, and opportunities of the environment within the context of its history. The strategy refers to the issue of matching the service organisation's resources to sector inputs, or making a fundamental decision of the business the organisation is in (Nadler and Tushman, 1980) and should address the needs of the clients.

There was a high degree of congruence (rating=3) between the challenge of water resource scarcity and inadequate storage and the responsive strategies of each of the water service organisations (Table 1). The DWA and MDM reported in their strategies the need for resource conservation, the VDM mentioned resource protection while PLM identified the use of rainwater harvesting to reduce resource scarcity. The DWA reported the establishment of an infrastructure agency to manage infrastructure development and this includes storage infrastructure. Although MDM and PLM reported the building of dams, this is the mandate of DWA (DWAf, 2004a) and the WSAs' involvement is mainly in community mobilization. The infrastructure construction by VDM included community participation in development of storage facilities. The MDM and VDM are largely located in the Luvuvhu-Letaba WMA where available storage capacity constitutes 64.2% of mean annual runoff (Tshikolomo *et al.*, 2009).

The decision to develop additional storage in this area should consider the availability of water for further impoundment without contravening international agreements with neighbouring Mozambique located downstream of the rivers flowing through this WMA. As revealed by Tshikolomo *et al.* (2009), the available storage capacity of the Limpopo WMA where the PLM is located is only 33% of mean annual runoff which suggests a higher potential for development of additional storage capacity.

As for the challenge of dams not filling up, the strategies of DWA, MDM and PLM were to conduct research and to properly manage information and were highly congruent (3) with the challenge. The strategy of VDM was 'proper planning' and was rather broad and was not specific to the challenge and hence the congruence was low (1), resulting in a mean congruence rating for this challenge to be between moderate and high (2.5).

For the challenge of poor resource knowledge of water managers, the strategy of DWA of establishing an institution for skills development for water sector was highly congruent (3) with the challenge. Although the strategies recorded by the three WSAs (MDM, VDM, PLM) were about human resource development, they were not specific on water resource issues and hence moderate congruence (2) occurred between each strategy and the challenge resulting in a moderate mean congruence (2.25). The strategies of the four water service organisations were highly congruent (3) with the challenge of lack of stakeholder participation and with that of poor resource supply to rural households.

With DWA being the custodian of water resources (DWA, 2004a), it would be expected that the department should have a full understanding of the challenges faced by the water sector. It was therefore not surprising that all the strategies of DWA were highly congruent (3) with the corresponding challenges faced by the water sector. This resulted in a high mean congruence (3) for the department, suggesting that it had highly relevant strategies for addressing the water challenges. Although smaller than that of DWA, the mean ratings of strategies of MDM and PLM were each also highly congruent (2.8) with the challenges faced by the water sector while the mean rating of congruence of VDM strategies was moderate (2.4). With the exception of the VDM whose strategies were moderately relevant, the water service organisations had highly relevant strategies to address the challenges of the water sector.

### **3.2.2. Transformation Components and Their Congruence with Strategies**

The transformation process in water service organisations entails the use of inputs to produce a set of outputs. Some components influence transformation within water service organisations, and those include: (1) tasks, (2) human and (3) financial resources (Nadler and Tushman, 1980; Gill, 2000; Ostroff, 1993; Wyman, 1998; Wyman, 2003).

#### **(a) Congruence between Strategies and Tasks**

Although the water service organisations used different statements to reflect their strategies to address the challenges faced by the water sector, the strategies generally captured similar messages. The strategies of the water service organisations may be summarized as: (1) conserve water and develop storage capacity, (2) research and manage information on dam hydrology (3) build managers' knowledge of water resources, (4) promote stakeholder participation, and (5) improve water supply to rural households.

In addition to development of strategies to address water sector challenges, the service organisations also identified specific tasks to be performed to implement the strategies. The success of implementation of the tasks will depend on the degree to which they are congruent with the strategies (Table 2). The DWA and of PLM recorded tasks of promoting efficient water use to provide for resource conservation while also including tasks of storage development and were highly congruent (rating=3) with the strategy of conserving water and developing storage capacity. The tasks of MDM and VDM only focused on promotion of efficient resource use with no provision for development of storage capacity and were moderately congruent (2) with the strategy. The omission of development of storage capacity by these WSAs was possibly due to the fact that they are located in the Luvuvhu-Letaba WMA with highly developed water resources (Tshikolomo *et al.*, 2009). The subsequent mean congruence rating for the tasks planned by the water service organisations and this strategy was moderate to high (2.5). The tasks of DWA and PLM were highly congruent (3) with the strategy of investigating and managing information on dam hydrology.

The tasks of the MDM and VDM only focused on issues of information management with no provision for research and were therefore rated moderately congruent (2) with the strategy. The mean congruence rating for the tasks planned by the water service organisations and this strategy was also moderate to high (2.5).

As for the strategy of building managers' knowledge of water resources, it was the DWA and the VDM that stated specifically issues of water resources in their human resource development interventions and hence their tasks were rated highly congruent (3) with the strategy. The tasks of the PLM highlighted the essence of technical development and were rated moderately congruent (2) with the strategy as they will possibly include water resources. The task pledged by the MDM was too broad with no sense of focus on water resources and was therefore rated lowly congruent (1) with the strategy. The mean congruence rating for the tasks recorded by the water service organisations and the strategy of building managers' knowledge of water resources was therefore moderate (2.25).

The task of DWA of forming CMAs and WUAs and those of PLM of reaching out to communities and promoting active participation in water issues were highly congruent (3) with the strategy of promoting stakeholder participation. The MDM and VDM pledged to form IDP forums and facilitate politically driven community gatherings and these are often too broad to give the water sector fair attention. The tasks of these WSAs were general and not focused on water and were therefore of low congruence (1) with the strategy. A moderate mean congruence (2) rating was recorded for the tasks planned by the service organisations and this strategy. The tasks of the four water service organisations were highly congruent (3) with the strategy of improving water supply to rural households. Although the tasks were different, they complemented each other.

The mean rating of congruence between the tasks recorded by water service organisations and the strategies for addressing water sector challenges was high for DWA (3) and for PLM (2.8). The mean rating was moderate for MDM (1.8) and VDM (2.2). The high congruence rating for DWA could be due to the fact that the department has water resource management as its main mandate while the high rating for PLM could have resulted from the WSA being relatively more urbanized and with financially sound basis. In addition to water services, the MDM and VDM have a lot of other functions to take care of and are relatively more rural with limited financial and personnel resources.

### ***(b) Congruence between Allocated and Utilized Organisational Resources***

According to Nadler and Tushman (1980), human and financial resources are very important for water service organisations to implement their strategies. The allocation and utilization of these resources according to the five water service strategies was only available for DWA and not for the three WSAs. The WSAs neither had resource allocation nor use information according to water service strategies in their integrated development plans for the period under investigation.

As shown in Table 3, the analysis of the allocation and utilization of human resources by DWA revealed a low degree of congruence (1). Only 64.9% of the 37 posts allocated were filled (2009), suggesting a probability that the water service organisation would under-perform as a result of 35.1% of the posts being vacant. The analysis of the allocation and utilisation of financial resources revealed that the department over-spent its R143 million budget for water issues by 39.9% and this resulted in a negative and low degree of congruence (-1) between the allocation and the expenditure. With some posts not filled, the department still exceeded the planned financial spending for water services, suggesting that the available personnel had a high spending capacity in order to surpass the budgeted financial resources. The high capacity to spend with only 65% of the posts filled could be a result of some functions being outsourced.

As for the MDM, the human resource allocation was 283 posts of which only 133 (47%) were filled and hence the degree of congruence between the allocation and the use was low (1). With this low (47%) post filling rate, the WSA spent all (100%) of its allocated water budget of R323 million revealing the degree of congruence between the budget allocation and its spending to be high (3). As was the case with DWA, the congruence analysis for MDM suggests that the WSA could be outsourcing some of its functions for them to spend the entire budget with only 47% of the posts filled. The VDM had a human resource allocation of 314 posts of which 263 (83.8%) were filled, suggesting a moderate degree of congruence (2) between the allocation and the filling of the posts.

With more posts filled and lower budget allocated compared to the MDM, the VDM only spent 79% of its budget allocation of R270 million, resulting in a moderate congruence (2) between the budget allocation and its spending. The result of the congruence analysis of the VDM reveals that non-filling of some posts leads to poor spending and subsequently poor performance.

The human resource allocation of 1 796 posts for PLM far exceeds those of the other WSAs of MDM and VDM. This large number of posts for PLM probably includes those allocated for non- and semi-skilled jobs such as gardening and cleaning while those of the other WSAs are mainly for skilled jobs. Of the allocated posts in the PLM, 81.5% were filled and this translates to a moderate level of congruence (2) between the allocation and the filling. The WSA over-spent its water services budget of R116 million by 40.7% and this resulted in a low degree of congruence (-1). With this very large staff complement, the over-spending of the budget is not surprising as part of it could have been consumed by personnel related activities. A total of 2 430 posts were allocated among the four water service organisations and 77.49% of them were filled. The mean congruence rating was low to moderate for human resource allocation and use (1.50) and moderate for financial resource allocation and use (-1.75) and therefore the non-filling of posts (human resource) was the most significant constraint to organisational effectiveness.

### **3.2.3. Congruence Flow Analysis**

The purpose of congruence flow analysis was to assess the variation in levels of congruence along the input and transformation components. The congruence for DWA was high for strategy (3) and for tasks (3) and was low for both human (1) and financial (-1) resources (Table 4) and hence the last two components were major constraints to successful implementation of water programmes. For MDM, the congruence was high (2.8) for strategy and financial resource management (3), moderate (1.8) for task and low (1) for human resources, implying that the human resource provision was the largest constraint to successful implementation of water programs. Similarly, the largest constraints to successful implementation of water programmes were human and financial resources for VDM and were financial resource for PLM. With DWA being the custodian of water resources (RSA, 1998; DWAF, 2004a), it would be expected for the Department to have appropriate allocation and utilization of the human and financial resources and subsequently a high degree of fit between the supply and use of these resources.

Considering the different components defining the capacity of service organisations, congruence was high (2.75) for strategy, moderate for task (2.45) and financial resources (-1.75) and low (1.50) for human resources. According to these results, the human resources were the most significant constraint to successful implementation of water programmes. Moderate congruence was recorded for all the four water service organisations of DWA (2), MDM (2.15), VDM (2.15) and PLM (2.15), suggesting that the organisations only had moderate capacity to address water sector challenges.

The study area is water scarce (DWAF, 2003; DWAF, 2004b) and subsequently community access to water is limited (Stats SA, 2009; Manaseet *al*, 2009). The demand for water is high due to intensive competition among users (Randall, 1981; Backeberg and Groenewald, 1991). It is important that the capacity of the service organisations be improved for these organisations to adequately address sector challenges.

### **3.3. Proposal of a Water Management Decision Model**

In accordance with the results of congruence analysis, an appropriate water management decision model for Limpopo Province should address the following issues:

#### **(a) Strategy**

Although there was an overall high degree of congruence (2.75) between strategies and challenges, some issues require attention, e.g. (i) VDM should develop focused strategies involving research and information management to address the challenge of dam not filling up; (ii) MDM, VDM and PLM should have in place human resource development strategies that are specific to water resources.

**(b) Tasks**

There was overall a moderate degree of congruence (2.45) between tasks and strategies and: (i) MDM and VDM should develop specific tasks on research aspects of dam hydrology (in addition to information management) and promote stakeholder participation on water issues; (ii) As was the case with strategies, MDM and PLM should implement human resource development tasks that are specifically focussed on water resources.

**(c) Human Resources**

There was overall a low degree of congruence (1.50) between human resource (post) allocation and their utilisation (filling), and: (i) All the water service organisations had vacant posts which should be filled. The DWA should review its post allocation as part of its restructuring where some functions will be decentralised while the PLM should check if the large number of posts is indeed needed. (ii) In addition to allocation according to departments within WSAs, human resources should also be allocated according to types of services to be executed such as water and electricity and according to major strategies within each type of service.

**(d) Financial Resources**

The degree of congruence between the allocation and spending of financial resources was moderate (-1.75) in overall. The service organisations except MDM should allocate financial resources according to needs and informed by the capacity to spend, more so for DWA and PLM. In addition to service areas such as water and electricity, the three WSAs should also reveal the allocation of funds according to strategies (activities) within a service. In accordance with the above proposals based on the congruence analysis, a water management decision model as shown in Figure 3 is proposed for Limpopo Province.

**3.4. Model Description**

The degree of congruence was mostly high (2.50 to 3) between challenges and strategies (except for challenge of poor resource and use knowledge (2.25)), moderate to high (2 to 3) between strategies and tasks and low to moderate (1.50) between transformations and output (Figure 3). In order to effectively manage water resources in the study area, the service organisations should improve on components that are less congruent with strategies for addressing the challenges. Except for the tasks for achieving the strategy of improving water supply to rural households, the tasks for the rest of the strategies should be reconsidered for those strategies to be achieved and hence for water challenges to be addressed. The service organisations should also improve on their resource planning, both human and financial. The resources should be allocated based on sector needs for addressing challenges and should be properly utilised. The low to moderate congruence (1.50) between allocation of posts and their filling (human resources) was the largest constraint for the service organisations to achieve their tasks and requires urgent attention. This should be accompanied by correct allocation (informed by available human resources) and use of financial resources.

**4. Conclusions**

The results of the congruence analysis revealed the service organisations to have achieved overall ratings of 2.00 for DWA, 2.15 for MDM, 2.15 for VDM and 2.15 for PLM, implying a moderate ability of all organisations to address the water sector challenges. The overall degree of congruence was high (2.75) between strategies and challenges, moderate between tasks and strategies (2.45) and between allocation and use of financial resources (-1.75) and low between allocation and use of human resources (1.50).

Although the service organisations presented strategies and tasks to address challenges faced by the water sector, it was noted that some strategies and tasks were either not focused or did not address the challenge in its entirety. The service organisations seemed to experience major challenges with resource allocations and their subsequent utilisations. Although posts were created by the water service organisations, they were mostly not all filled and that resulted in the low level of congruence (1.50) between the allocation and the use of the posts. The under-filling of posts was the most significant constraint to the performance of water service organisations. The proposed water management decision model takes into account the major challenges experienced by the sector and advocates for relevant strategies and tasks to address them as well as proper allocation and use of resources to execute the strategies and tasks.

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6. Figures and Tables

6.1. Figures

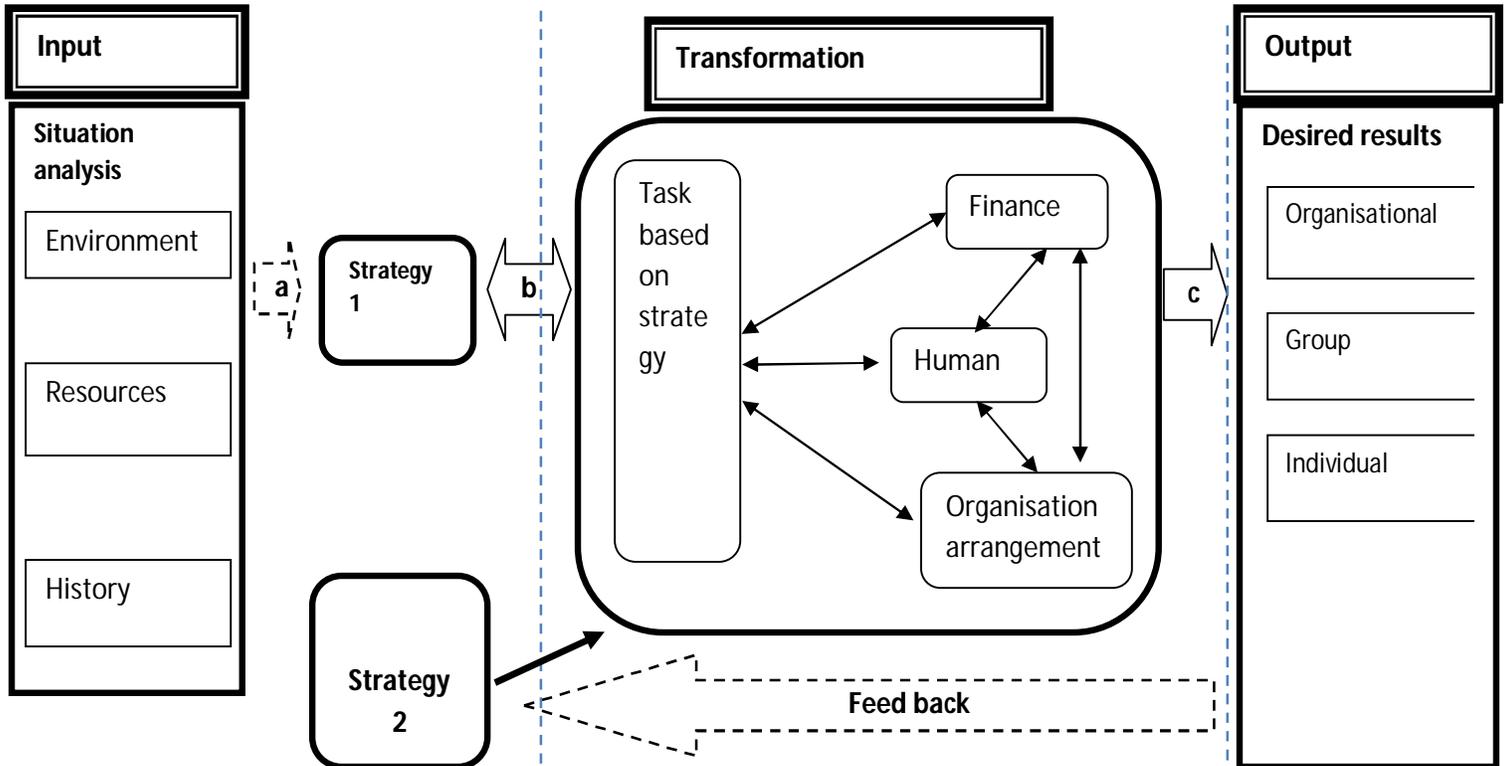
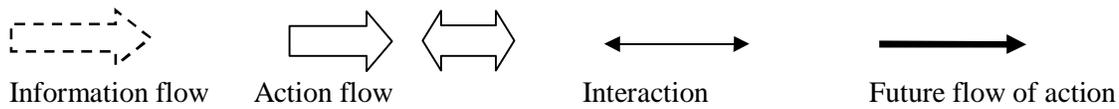


Figure 1

Adjusted Congruence Model of Nadler and Tushman (1980)

Key:



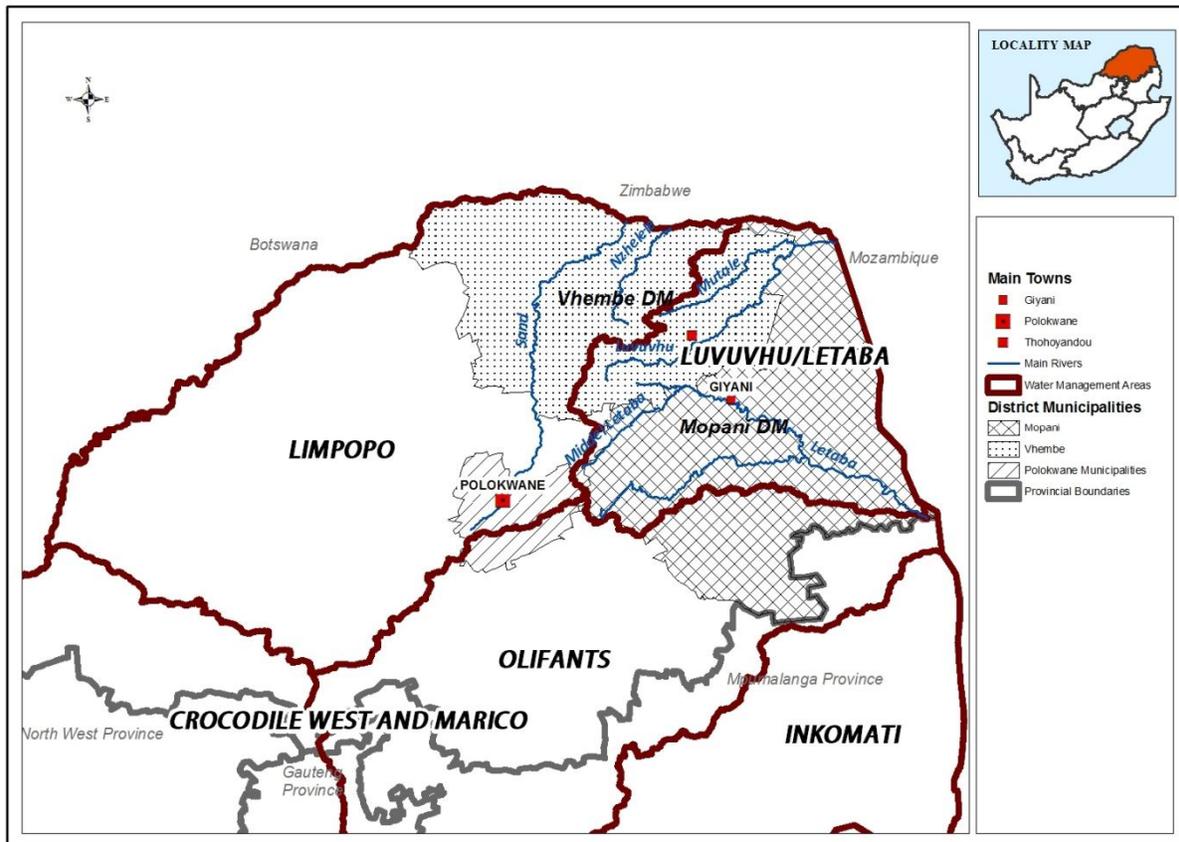
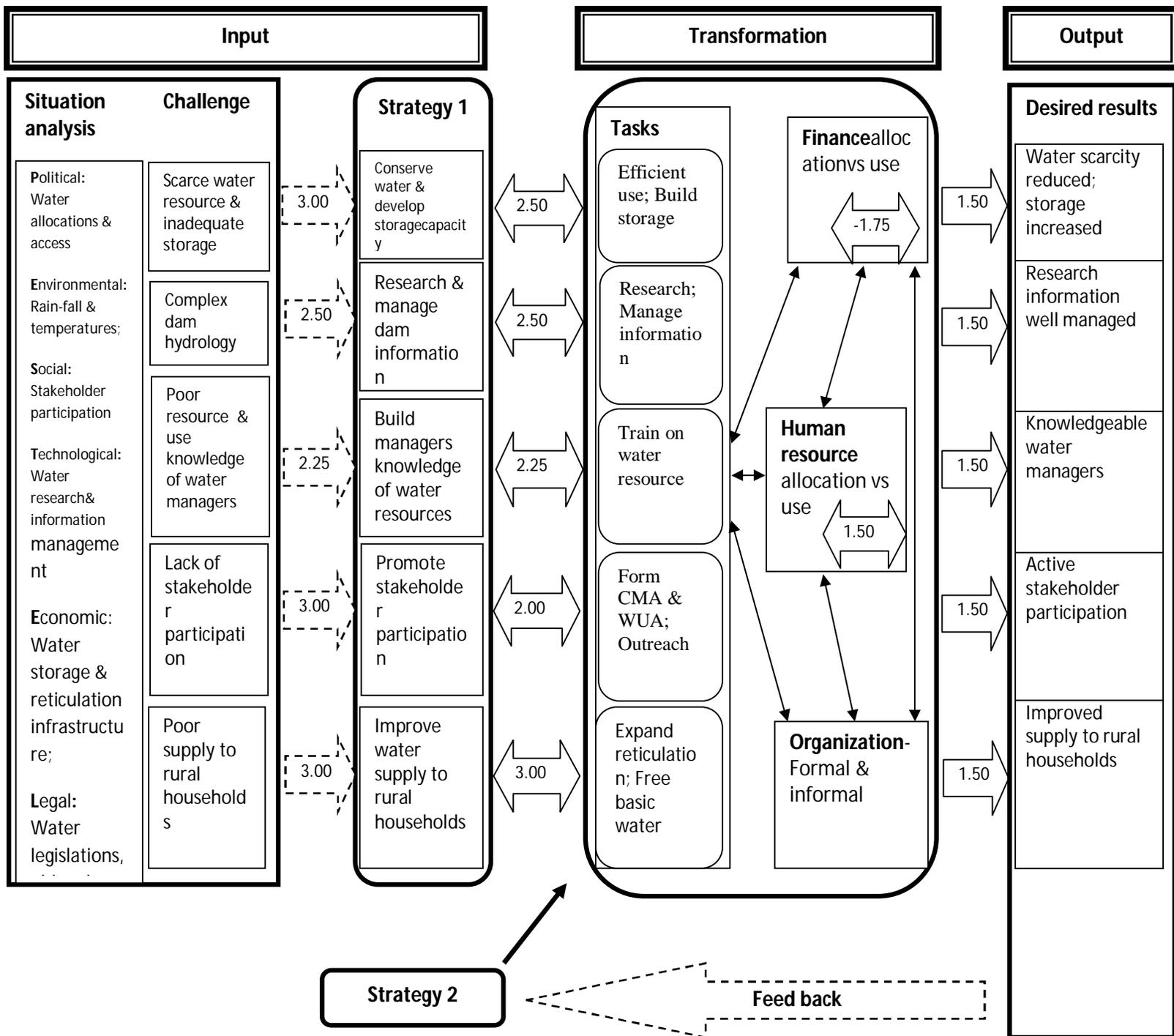


Figure 2 Map of Limpopo Province showing the Limpopo and the Luvuvhu-Letaba WMA (red line), Mopani and Vhembe District Municipalities and the Polokwane Local Municipality (hatchings)



**Figure 3** Proposed water management decision model for Limpopo Province adapted from Congruence Model of Nadler and Tushman (1980)

## 6.2. Tables

**Table 1 Congruence rating between water sector challenges and responsive organisational strategies of Limpopo Regional Office of DWA and the WSAs of MDM, VDM and PLM**

Challenge	Strategy and congruence rating								Mean
	DWA	Rate	MDM	Rate	VDM	Rate	PLM	Rate	
Water resource scarcity & inadequate storage	Conserve water resources; Establish infrastructure agency	3	Conserve water resources; Build dams and raise dam walls	3	Protect resource; Build infrastructure	3	Promote use of rainwater harvesting; Build reservoirs	3	<b>3.00</b>
Some dams do not fill up and water supply remains low	Research by WRC; Water resource plan & information management	3	Research & development; information management	3	Proper planning;	1	Undertake research & development Implement e-governme-nt strategy	3	<b>2.50</b>
Poor resource knowledge of water managers	Establish academy for water sector skills development	3	Capacity building and training	2	Work place skills planning and reporting;	2	Ensure municipality has capable managers	2	<b>2.25</b>
Lack of stakeholder participation	Involve stakeholders throughout	3	Involve stakeholders in IDP and implementation	3	Involve stakeholders in IDP and implementation	3	Municipality to have functional community participation	3	<b>3.00</b>
Poor resource supply to rural households	Promote access to basic water supply by all	3	Water provision made top priority	3	Water provision made top priority	3	Provision of water to those with no access	3	<b>3.00</b>
<b>Mean</b>		<b>3.00</b>		<b>2.80</b>		<b>2.40</b>		<b>2.80</b>	<b>2.75</b>

**Congruence Rating:** 0 = None; 1 = Low; 2 = Moderate; 3 = High

**Table 2 Analysis of congruence between strategies and tasks of water service organisations of Limpopo Regional Office of DWA, MDM, VDM and PLM**

Strategy	Task and congruence rating						PLM	Rate	Mean
	DWA	Rate	MDM	Rate	VDM	Rate			
Conserve water and develop storage capacity	Promote efficient use; Increase storage	3	Prioritise domestic use	2	Adopt user pay principle for non-indigents	2	Educate on efficient use; proper storage	3	<b>2.50</b>
Research and manage information on dam hydrology	Research on water; Manage knowledge on water	3	Manage information effectively; Manage data & keep records	2	Develop credible & reliable geographic information	2	Identify research areas; Use information technology	3	<b>2.50</b>
Build managers' knowledge of water resources	Skilling in water engineering & science; Graduate training	3	Ensure skilled & capacitated workforce	1	Develop officials' competence ; water and sewerage skilling	3	Introduce planning & technical development program	2	<b>2.25</b>
Promote stakeholder participation	Form CMAs and WUAs	3	Form IDP forums and facilitate imbizos	1	Form IDP forums and facilitate imbizos	1	Community outreach; Participation in water issues	3	<b>2.00</b>
Improve water supply to rural households	Provide support to districts and municipalities	3	Expand reticulation and improve access	3	Improve supply of free basic water, increase use of tankers.	3	Upgrade reticulation & improve access to all; Free basic water	3	<b>3.00</b>
<b>Mean</b>		<b>3.00</b>		<b>1.80</b>		<b>2.20</b>		<b>2.80</b>	<b>2.45</b>

**Congruence Rating:** 0 = None; 1 = Low; 2 = Moderate; 3 = High

**Table 3 Analysis of congruence between allocation and utilisation of human (posts) and financial (budget) resources of water service organisations of Limpopo DWA, MDM, VDM and PLM (DWA, undated; MDM, 2009; VDM, 2009 and PLM, 2009)**

Water service organization	Human resource				Financial resource			
	Allocation	Use	% Use	Rate	Allocation	Use	% Use	Rate
<b>DWA</b>	37	24	64.90	1	142 963 037	200 012 993	139.90	-1
<b>MDM</b>	283	133	47.00	1	323 470 851	323 470 851	100.00	3
<b>VDM</b>	314	263	83.80	2	270 750 271	213 892 714	79.00	2
<b>PLM</b>	1 796	1 463	81.50	2	116 276 917	163 593 034	140.70	-1
<b>Total</b>	<b>2 430</b>	<b>1 883</b>	<b>77.49</b>	<b>1.50</b>	<b>853 461 076</b>	<b>900 969 592</b>	<b>105.57</b>	<b>-1.75</b>

**Congruence Rating:** 0 = None,  $\geq 67\%$  gap from 100%; 1 = Low, 66 – 33% gap from 100%  
 2 = Moderate, 33 – 10% gap from 100%; 3 = High, < 10% gap from 100%  
 + = Allocation  $\geq$  utilisation; - = Allocation < utilisation

**Table 4 Congruence flow analysis of input and transformation components of four water service organisations: DWA, MDM, VDM and PLM.**

Component of capacity	Water service organisations and congruence ratings of components				Component mean
	DWA	MDM	VDM	PLM	
Strategy	3.0	2.8	2.4	2.8	<b>2.75</b>
Task	3.0	1.8	2.2	2.8	<b>2.45</b>
Human resource	1.0	1.0	2.0	2.0	<b>1.50</b>
Financial resource	-1.0	3.0	2.0	-1.0	<b>-1.75</b>
<b>WSA mean</b>	<b>2.0</b>	<b>2.15</b>	<b>2.15</b>	<b>2.15</b>	

**Congruence Rating:** 0 = None; 1 = Low; 2 = Moderate; 3 = High