DIGITIZING WATER

Modernizing Water Utility Resiliency With Data Analytics And Digital Transformation

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INTERA

INTRODUCTION

Over the past decade, water industry leaders and researchers have been working to improve the effectiveness and efficiency of the water industry. The growing use of asset management programs and capital planning software, and the development of Effective Utility Management guidelines, point to the need for increased operational efficiency through automation and increased effectiveness through sound decision making processes.

Data is Knowledge.

For water utilities, this knowledge represents the power to forge their own futures, to be what they want to be, to transform. Much has been written regarding the challenges facing utilities around the globe. Challenges such as water supply shortages, aging infrastructure, lack of access to capital funding, aging employees, climate change, cybersecurity, increasing operation and maintenance (O&M) costs, declining revenues, and stagnant water sales, just to name a few.

The Water Industry Continues to Face “Doing More With Less”

Deb Degilio, Chief Customer Officer of American Water recently remarked that, “Every $1 dollar of operation and maintenance costs saved, frees up $8 dollars for capital expenditures”.

MAJOR ISSUES FACING TODAY'S WATER UTILITIES

Each year the American Water Works Association (AWWA) conducts a survey to identify the water utility industry's major issues.

Figure 01 on the next page details the top five issues facing the water industry prior to the Covid-19 pandemic, as reported in AWWA's July 2020 journal.

Survey respondents also identified the following as the top five external factors that have a negative impact on the industry.

1. Extreme Weather Events
2. Pollution
3. Political Instability
4. Climate Change
5. Chemical Costs

FIGURE 01

03

It's Hard to Finance Capital Projects.

How can water sustainability be properly financed if there is not sufficient data to back up the cost and need?

01

Water Infrastructure is Getting Old.

Water system failures due to old infrastructure lead to corrective or emergency actions, which are costly and inefficient.

02

There's a Long-term Water Supply Shortage.

A growing population and changing climate conditions are challenging our systems to meet the needs for drinking water. Long-term water supply planning requires data and information to address the need for new water supplies.

04

Water Sources Aren't Being Protected.

Worsening water quality in lakes, rivers, and reservoirs can lead to expensive treatment needs that are not sustainable or cost efficient.

05

The General Public Just Doesn't Get It.

If people don't fully understand the need for more sustainable water processes, how will we get full support for improved systems?

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THE SMART WATER CYCLE

The major issues faced by water utilities are juxtaposed against the growing longer-term pressure for the entire water industry to embrace the smart water cycle paradigm illustrated in Figure 02 (Smith, 2019). As the competition for new water sources grows, the industry is moving to address supply deficits by using reclaimed water as the "new source". This will require even more monitoring, analysis, and robust decision making to ensure that drinking water remains safe and of high quality. As new technologies emerge, water utilities are moving toward the goal of complete system optimization, or smart water. This requires a holistic approach to resource management and utility operations and reconsideration of what data is critical and how to best use it to support decision making.

FIGURE 02

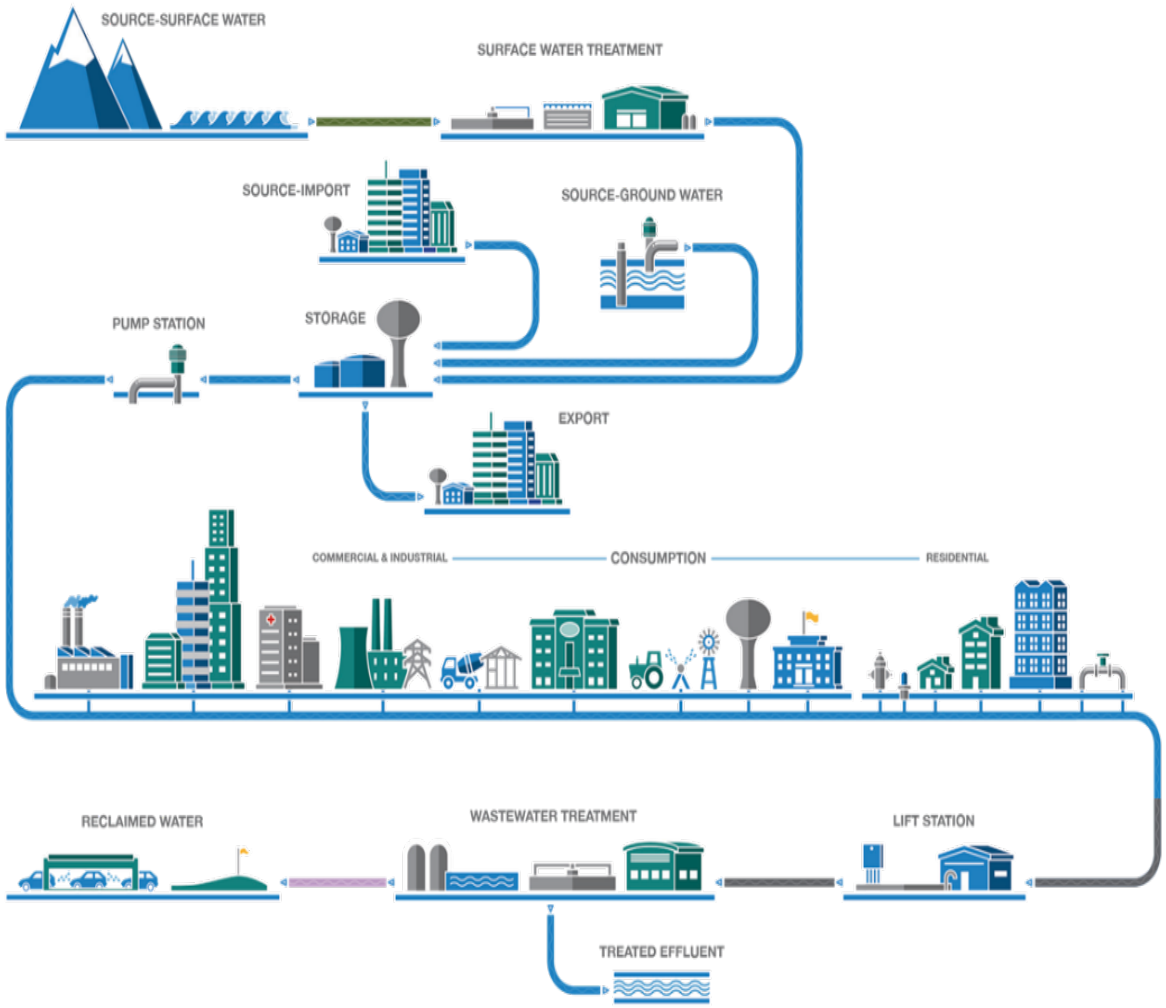


Figure 02. Smart Water Cycle (from Smith, AWWA Opflow June 2019, pp24 -26)

MODERNIZING WATER UTILITIES

Is there a single strategy that can help utilities meet and overcome many of these challenges?

This white paper describes just such a strategy—one that applies data analytics and digital transformation to modernize water utility resiliency.

Using, Centralizing, and Communicating Data

Utilities gather a wealth of data, often driven by regulatory reporting requirements, operational controls, and customer billing needs. With the introduction of automated metering infrastructure (AMI) systems and software, end use customers can track daily water use in homes and businesses. Unfortunately, much of the data is not stored, analyzed, or used to help utilities make strategic decisions. To be useful, this data must be transformed into knowledge.

Utilities often build their technology over time, resulting in systems that are independent with few staff who know how to use or integrate the systems. In addition, most utilities collect and store data using multiple platforms and software systems that do not communicate with each other and other IT systems within the agency or across agencies. In addition to readily available off the shelf software systems, many utilities have developed inhouse custom software and databases that are difficult to maintain and upgrade.

In addition to the utility-wide data collection and storage systems, data is also frequently stored on individual computers or in legacy databases. In some instances, the only record of data may be a written report sent to a regulatory agency. Harnessing the data from all available sources is one of the most important aspects of digital transformation. This data, when analyzed and presented in the form of information, leads to sound, robust, and timely decision making and offers the potential to make more informed decisions.

FIGURE 03

As shown in Figure 03, the water utilities industry is beginning to recognize that innovation through data analytics and digital transformation offers the only path to achieving sustainability of the smart water cycle.

The Answer?

SMARTER DECISION MAKING.

Leadership

Stronger utility management to guide new processes

Digitization

Cloud platforms that share data succinctly

Cognizance

Awareness of field staff for data and local decision making

Vigilance

24/7 monitoring, data collection and analysis

Multidisciplinary

Improved data collection and analytics powers smarter long-term efficiencies

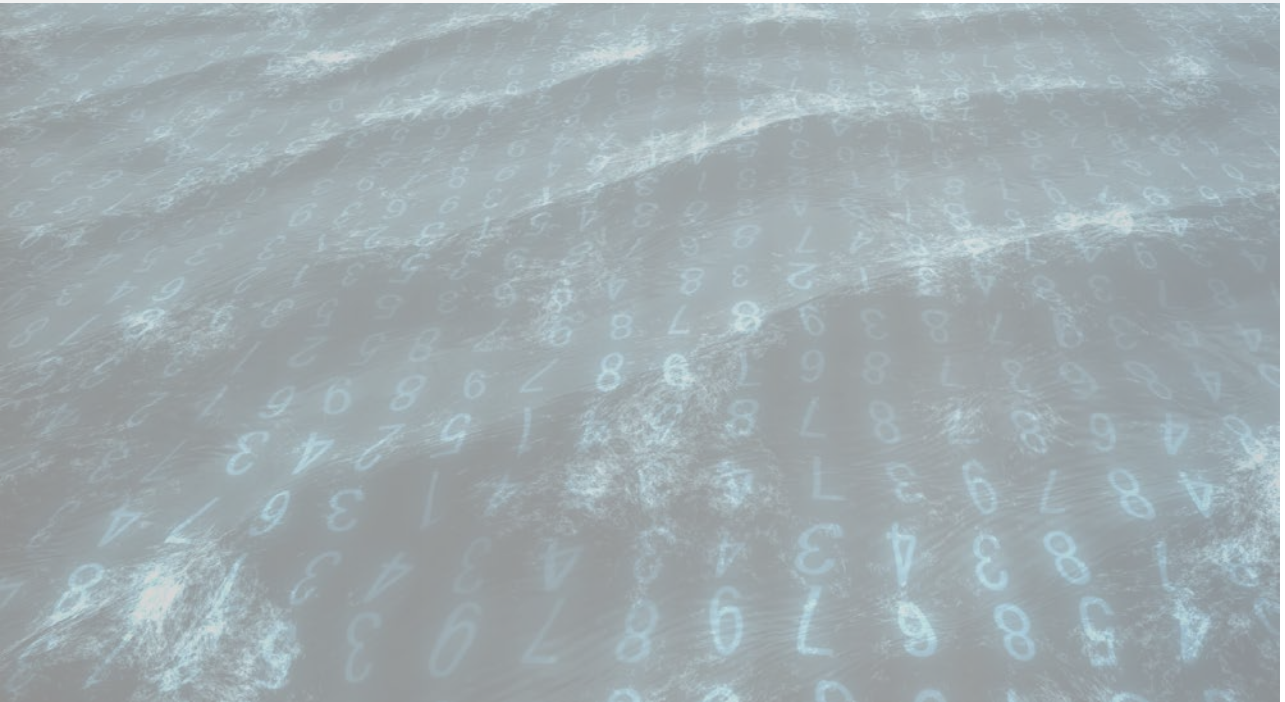
Edge Computing

Network sensors which reveal real-time issues and can make decisions at the edge

INTERA

So Exactly What are Data Analytics?

Data analytics and digital transformation are keys to building resiliency for water utilities. Data analytics are mathematical tools, processes, and reporting that allow quantitative data to be evaluated, analyzed, and summarized to provide information that imparts knowledge about a system. Digital transformation is the process of integrating technology solutions into the decision-making framework for both strategic decision and decision making at the edge. For water utilities, the focus is on process. There is no black box solution. Digital transformation not only requires technology, but an organizational structure and culture that is willing to embrace what the technological changes will bring.



THE QUALITATIVE & QUANTITATIVE BENEFITS

of Data Analytics and Digital Transformation for Water Utilities

INTERA

FIGURE 04

REDUCTIONS

- Lost revenues by identifying system water losses
- Costs of reactionary maintenance by moving to preventative (planned) maintenance programs
- Unplanned capital expenditures through improved asset management programs and better long-range planning decisions
- Water supply vulnerabilities through improved data analytics and resource management
- Cyber security risks through deployment of newer technologies and implementing updated policies and procedures

Protection of public investment in water supply infrastructure and services

IMPROVEMENTS

- Customer relationships by reducing response times to address complaints
- Data management and reporting efficiencies reducing staff time and costs
- Accountability through better data management and analytics
- Agency transparency through data analytics and reporting
- Planning and cross agency interactions through data and knowledge sharing

BENEFITS OF DATA ANALYTICS & DIGITAL TRANSFORMATION

INTERA

THE FOUR STEPS TO DIGITAL TRANSFORMATION

As mentioned, data analytics and digital transformation are keys to building resiliency for water utilities. The Digital Transformation Roadmap, shown in Figure 05 , is comprised of four steps: 1) Agency Commitment, 2) Baselining, 3) Defining the Future, and 4) Implementation. Unfortunately, there is no single approach to executing these steps. The actual activities will depend on how far along an organization is on the digital transformation road and the willingness of the organization to embrace change. The first three steps can typically be accomplished in nine to 12 months. Implementation takes years.

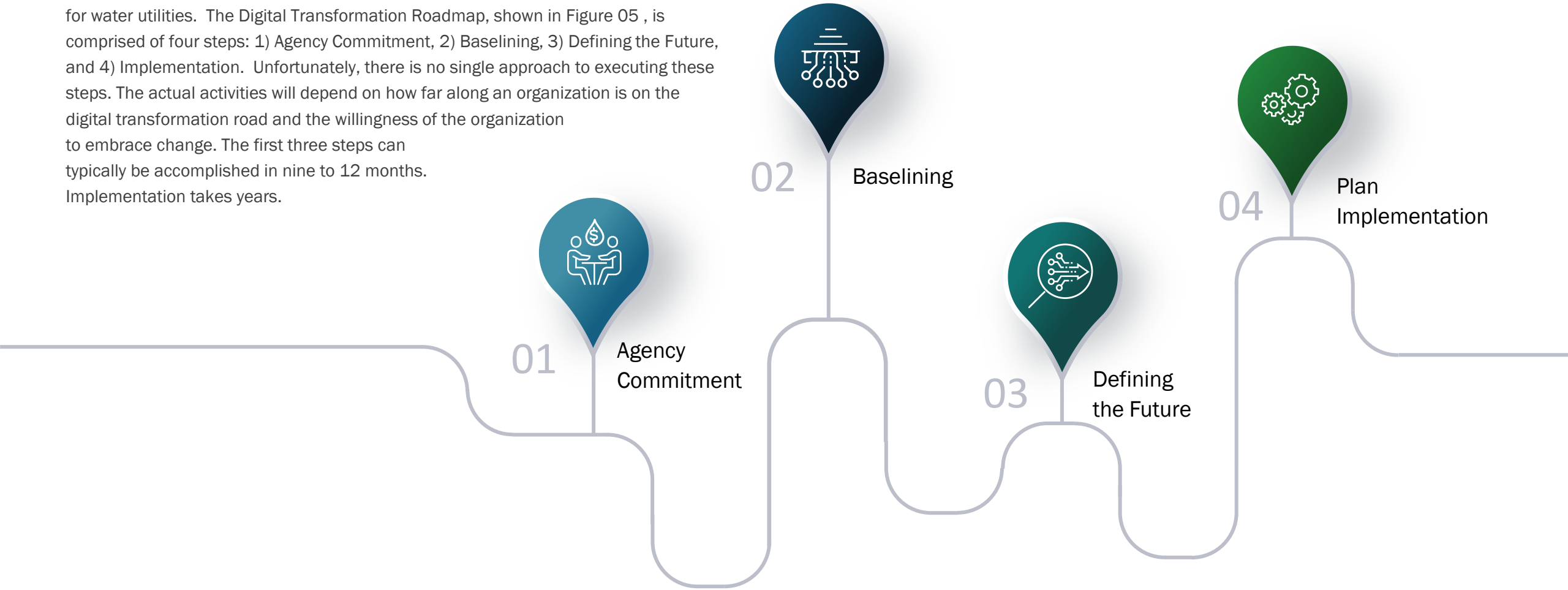


FIGURE 05

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This step of the roadmap results in a written document whereby the organization's top management and staff commit to the process of digital transformation and data analytics. This commitment is written into the organization's mission and vision statements and becomes justification for resource allocations. The organization must also identify a champion, or champions, to complete the digital transformation process. Committed staff members from middle management and executive levels must be identified to lead this effort and are given authority to implement decisions. Since implementation can take years to complete, the organization must have succession plans in place to transition the champion role when staff turnover occurs due to attrition or retirement.

The Agency Commitment step is accomplished through a series of workshops with all levels of staff interacting and engaging in the discussion. All organizational departments must participate to define and map the functional relationship between the various departments. It is very important that all levels of staff feel valued during this process because digital transformation will produce organizational changes. These changes do not mean staff will lose jobs, but rather quite the opposite. However, it should be recognized that some staff may not welcome the new opportunities or be open to the changes that digital transformation will create. The success of this step of the roadmap will ultimately decide the success of the organization's digital transformation and use of data analytics. While this step does result in a product, Agency Commitment never really ends. Communication strategies must be developed and implemented to ensure that staff remain informed of the digital transformation progress, and that the data analytic tools are being used as they are developed. A written Project Charter including mission, vison, goals, and a commitment by the organization should be developed within one to two months of starting the digital transformation process.

AGENCY COMMITMENT

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BASELINING

This step involves documenting what is known about the organization's current data systems, analytical tools, and information technology (IT) maturity.

Data Systems

Data systems include data collection methods, such as supervisory control and data acquisition (SCADA), data storage systems, and the processes and procedures in place. The following types of information are ascertained:

- Data collection methods (e.g, automated, manual, SCADA, or third party collected)
- Management and control of the SCADA system and data
- Data storage processes
- Databases used
- Why the data are collected
- Who collects the data
- What are the quality control/quality assurance processes
- What happens to the data
- What data are used to make what decisions
- What data are used for reporting

The Baselining step will involve staff from multiple departments—O&M, laboratory, engineering, planning, and IT—as well as managers and decision makers. During this step, staff are led through mapping exercises to determine how data that are collected are used by the agency. Documenting the current data systems is an important baselining activity, and includes identifying who owns the data, who uses the data, where the data is stored, what QA/QC procedures are implemented, why the data are collected, and what is the ultimate use of the data. This information provides a starting point for building or improving the enterprise data storage and retrieval system which is core to data analytics and digital transformation.

The Baselining step frequently reveals that staff who collect data have very little knowledge of why the data are being collected except that it may be for some regulatory purpose. This step can also identify legacy systems that store data that no one uses. Workshops held with staff who collect data, staff who use the data, and upper management often produce insightful results.

BASELINING

Data Analytics

The purpose of this activity is to begin aligning data with decision making within the organization and to determine what level or type of data analytics are currently being performed to transform the data into useful information for a decision maker. The data analytics activity starts with performing an inventory of all the software and data analytics tools used by the organization to evaluate data and develop knowledge. While this information can be gathered using a variety of methods, including surveys, it is best accomplished through workshops with staff where interactive discussions occur to solicit detailed information on the tools being used including the SCADA system and how results of analyses are used in decision making. Identifying the cross-functional relationships between departments is one of the workshop activities that allows the organization to gain a better understanding of how data and information should flow. The interactive workshops also provide opportunity to document the organization's key decision-making activities, both operational and planning from the perspective of decision makers. A frequent and important outcome of these exchanges of information is the realization that many departments function in silos, thereby hampering effective and efficient decision making.

BASELINING

IT Maturity

The final activity in the Step 2 Baselining process is a discussion of the water utility's IT system, IT strategic plan, and the relationships between IT and operational technology (OT). Because most utilities add technology over time based on specific needs with little engagement of the entire organization, the resulting IT systems are typically isolated and serve single departments with little to no ability to exchange data or information across platforms. This also leads to duplication of technology systems leaving the IT department struggling to maintain infrastructure, software, and security. The classic example of this is the SCADA system employed by most water utilities. SCADA not only allows for industrial control, but collects all operational data. Unfortunately, most of the data is never used by planning staff or decision makers because of limited access to the data and the lack of understanding by operators of the importance of this data for strategic decisions. Every water utility should conduct an IT assessment periodically as part of a larger IT strategic plan. While outside the realm of this digital transformation roadmap process, the successful completion of the Baselining step requires an IT assessment. The baselining process can then identify whether the organization has an IT strategic plan, and if so, whether the plan is being followed. During this portion of Baselining step, enough information about the existing IT systems should be documented to identify the current level of maturity. This information is obtained through surveys and workshops with the organization's IT staff.

Ultimately, the Baselining step documents the status of the data system, data analytics, IT platform, and decision-making system within the organization. This serves as the starting point for digital transformation and data analytics. This step also reveals where organizational changes need to occur to eliminate barriers to cross-functional engagement. The Step 2 Baselining activities typically take from four to six months and should start once the Project Charter (in Step 1) is completed and signed.

Also described as a “needs” assessment, the purpose of this step of the digital transformation roadmap is to define the future state of the organization. This future state is one that the organization can realize and is not intended to merely be a vision.

Workshops with executive and mid-level management staff are held to discuss why effective decision making is important and what it takes to improve the organization’s decision making and data analytics capabilities. The workshops explore what the organization can do more effectively and efficiently, and how data analytics and digital transformation can aid in meeting the defined future state.

The answers to these questions must come from inside the organization. Once the organization commits to the path of using data to make more informed decisions, there are numerous options for implementation. Interactive workshops with key decision makers and staff throughout the organization are used to define the organization’s future. Needs are not only identified but ranked so that a thoughtful implementation process can be developed.

The result of the Defining the Future step includes an implementation plan with priority activities defined, estimates for resources, and timelines to complete the activities. This step, which can be started while Step 2 Baselining is still underway, can be completed in three to six months, given availability of management staff and the timeliness of agency decisions needed to complete the implementation plan. To maintain focus and commitment across the organization to the transformation process, it is important that Steps 2 and 3 be completed within 12 months following completion of Step 1 Agency Commitment.

DEFINING THE FUTURE

IMPLEMENTATION

The actual activities needed for Step 4 Implementation of the digital transformation roadmap process depend on the outcomes from Steps 2 and 3. However, there are several key requirements that all implementation programs must include. First, executive management must recognize the project champion(s) and provide the individual(s) with the authority and responsibility to implement all actions necessary for digital transformation. A system of accountability needs to be established. Management will need to approve the implementation plan and commit the necessary resources to ensure timely execution. In addition, the organization must acknowledge the changes to staff's traditional roles during the transformation. New skills may be needed and, if so, training is paramount during the Implementation step. Communication is also key to a successful implementation program. Staff turnover must be anticipated during this step, and preparations made to assign new project leaders and champions to maintain program continuity.

It is important to acknowledge that implementation of projects and activities needed to complete digital transformation will take considerable time and resources. The implementation plan should include projects or activities that can be accomplished quickly so that the organization maintains staff momentum to complete the implementation. If all projects take multiple years to complete, then management and staff may lose interest in the program. One of the challenges that utilities may face during implementation is making a decision to move forward with a solution knowing that technology is changing. For instance, a decision maker may think that by waiting six months, a newer technology will be available. However, always deploying the latest and greatest in technology does not necessarily lead to a better solution. Implementation is about much more than just new technology, it includes staff training, updating policies and procedures, and organizational changes. These activities need to be underway at the same time or before the technology is in place.

TAMPA BAY WATER CASE HISTORY

Introduction

Tampa Bay Water is Florida's largest wholesale public water provider. The agency is a special district created by the Florida Legislature in 1974. The mission of Tampa Bay Water is to reliably provide its members high-quality water, meeting present and future needs in an environmentally and economically sound manner. The heart of Tampa Bay Water's current water supply system is its groundwater wellfields which are operated as an integrated system utilizing a set of optimization-simulation models giving priority to minimization of environmental impacts while reliably meeting demands.

The area served by Tampa Bay Water includes Hillsborough, Pasco and Pinellas counties located in west-central Florida. Tampa Bay Water and its member governments – Hillsborough, Pasco, Pinellas counties and the cities of New Port Richey and Tampa – provide approximately 260 million gallons per day (mgd) of drinking water to meet the needs of over 2.4 million residents in this tri-county area.

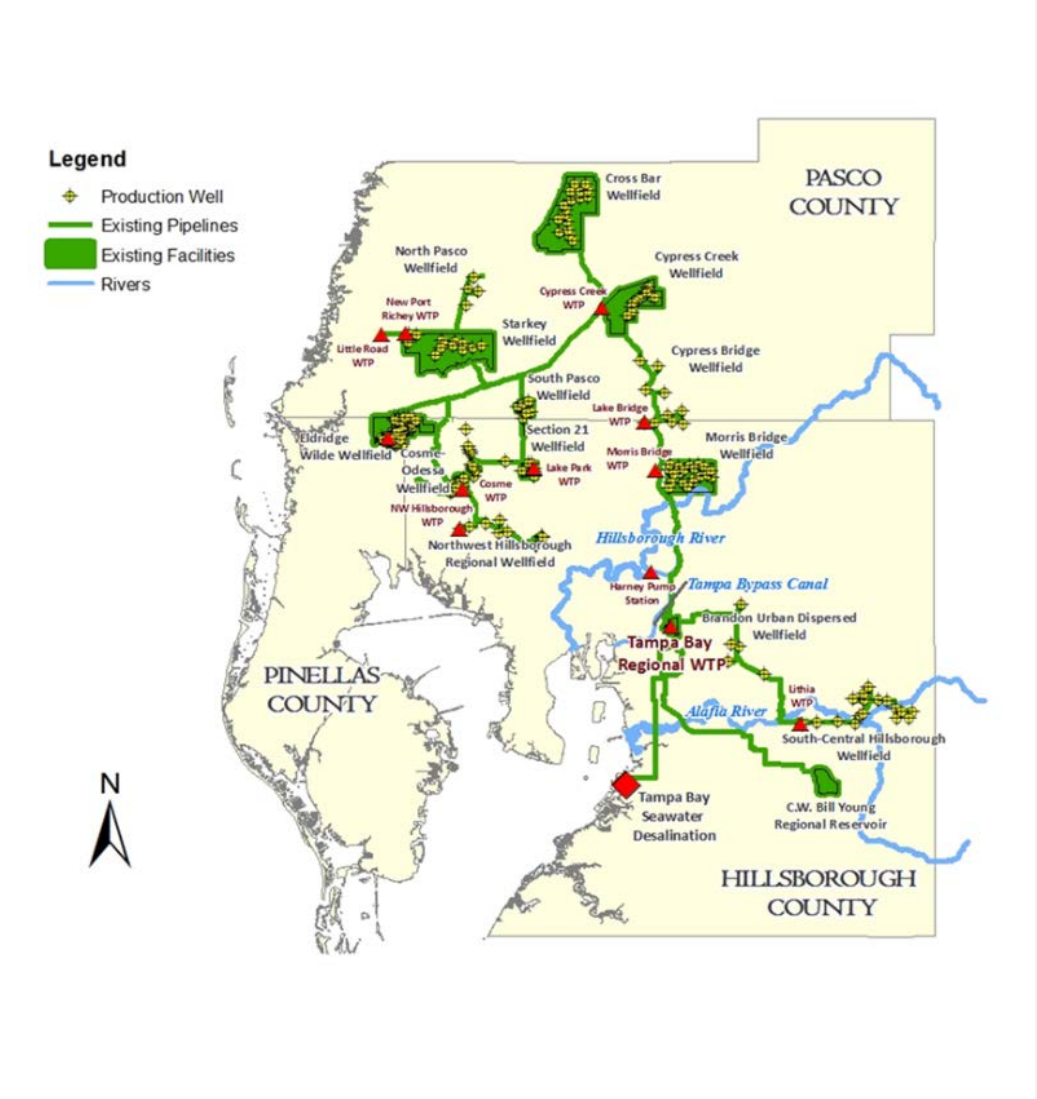
The remainder of this white paper is a case history on developing a decision support system (DSS) for Tampa Bay Water. This work started in 2001.

DRIVING FACTORS

In the mid-1990s extensive litigation occurred over environmental impacts to wetlands and lakes caused by pumping groundwater from the Floridan Aquifer system in the Tampa Bay region. A negotiated resolution required Tampa Bay Water to reduce its reliance on this groundwater system by incorporating other sources of water into its regional distribution system. Tampa Bay Water developed a Master Water Supply Plan (Plan) which identified sources needed to replace lost groundwater capacity and additional supplies needed to meet demand due to growth. With the first groundwater cutbacks due to occur in 2003, development of new supplies occurred quickly. Over a 10-year period, Tampa Bay Water developed a 120 mgd surface water treatment plant, two river intake structures, a 15.5 billion-gallon storage reservoir and a 25 mgd desalination plant to replace the lost groundwater. In addition, during 2003, Tampa Bay Water completed conversion of its regional distribution system from a mix of raw water and free chlorine to a completely potable distribution system using chloramination. All the operating water supply facilities are shown on Figure 06. The makeover for Tampa Bay Water required an investment of $1.25 billion.

The expansion and diversity of Tampa Bay Water's regional supply system was a challenge to manage without some improvement in how data was collected, stored, and used by agency staff. During this time frame, the agency had no centralized database, no standard QA/QC protocols, and data was stored on individual personal computers often in Excel spreadsheets or written reports stored in the Records Department. Operationally, the Agency's SCADA system was used for industrial control and gathering of operational data; however, only manual methods existed to obtain this data for planning purposes.

FIGURE 06



INTERA

TAMPA BAY WATER NEEDED...

01

Better Planning

Tampa Bay Water needed to make operational planning more efficient by reducing costs.

02

Create Knowledge

Tampa Bay Water needed to make the data more usable by turning it into information to support decision making at all levels.

03

Ensure Regulatory Compliance

Tampa Bay Water needed to reduce costs of regulatory compliance through improved data collection and automated data reporting.

04

Smarter Real-Time Responses

Tampa Bay Water needed to respond to changing water supply conditions rapidly by improving data analytics.

05

Collaborative Communication

Tampa Bay Water needed transparency for collaborative communications.

INTERA

THE ROADMAP IN ACTION

Tampa Bay Water's Journey to Smarter Operations and Planning

01 Agency Commitment

The Agency's commitment to digital transformation and development of a Decision Support System (DSS) was formalized during Team chartering which resulted in a consensus on goals, project vision statement and user engagement process.

02 Baselining

Documented an understanding of the current data systems and analytical tools in use by Tampa Bay Water and an assessment of current business and operations systems and processes. Identified deficiencies in the current data bases and use of data.

03 Defining the Future

Staff defined and prioritized the agency's needs and selected a DSS approach. The functionality of the DSS was defined. A prioritized list of projects and activities was created along with a budget and schedule for implementation.

04 Plan Implementation

Go to work. Successfully completed development of an Enterprise Database System with all necessary protocols, Successfully converted a key modeling tool to windows environmental. All regulatory reporting and data transfers are automated.

FIGURE 07

TAMPA BAY WATER

INTERA

In 2001, senior management and key staff recognized the need to develop a digital transformation plan as part of an overall strategy to enable real time decisions for source management and planning.

The end product of digital transformation for Tampa Bay Water is a Decision Support System (DSS) that ties together agency data, data analytics and a graphical user interface to enable rapid decision making required by agency staff. To digitally transform, the agency organized the roadmap into four steps: Step 1 Agency Commitment through team chartering, Step 2 Baselining the existing data collection system, analytical tools, and business processes used within the agency, Step 3 Defining the Future which included defining and prioritizing agency needs, defining the functionality of a decision support system, and developing a plan with budget and timeline to develop the decision support system and Step 4 Implementation of the plan for digital transformation. These steps are shown in Figure 7 along with the major outcomes.

The agency's commitment to digital transformation and the development of the DSS was formalized during a team chartering session that resulted in a charter with project vision and goals. The project vision and goals were stated as follows:

"Identification and prioritization of the agency needs to enable the development of a comprehensive DSS that the Board endorses, which integrates agency functions and enhances the current Optimized Regional Operations Plan (OROP) to optimize the management of current and future water resources in support of the agency's mission."

01

TAMPA BAY WATER

AGENCY COMMITMENT

The overall benefits identified via internal discussions were determined to be:

- Increase effectiveness in planning for and increased efficiency in operating new supply sources
- Improve the agency's data collection, storage, and retrieval process to maximize environmental and cost benefits
- Ensure regulatory compliance
- Provide for timely and informed decision making under dynamic conditions
- Improve communications to interested parties regarding agency operations

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02

TAMPA BAY WATER

BASELINING

Tampa Bay Water required data of various types, from a variety of sources and locations to support the agency's water supply mandate, facilitate the production of regulatory reports, and facilitate monitoring and control of the supply facilities under Tampa Bay Water's management.

Data collection mainly occurred in the following ways:

- Real-time (SCADA) collection
- Real-time (wireless) collection
- Manual collection using both recording equipment and staff readings
- Obtaining data from outside agencies or third parties.

At the time this project started, Tampa Bay Water collected data at over 1,000 hydrologic and ecological monitoring sites and nearly 2,500 SCADA collection points. Over a 10-year period, the SCADA system grew due to the diversity and addition of new supplies to 22,500 collection points. The baselining of the data collection and database systems identified some deficiencies regarding data collection and quality control (QC) practices.

A series of workshops revealed the inefficiencies Tampa Bay Water was experiencing with storing and retrieving data form the two principal Microsoft® SQL Server databases. Limited documentation regarding the overall database design coupled with a lack of an automated synchronization process between master tables and duplicate copies posed serious integrity issues. In addition, automatic QC processes needed to be incorporated into the database. A duplicate ORACLE database had been established for use with the agency's Optimized Regional Operations Plan (OROP). No automated synchronization process existed between the agency's SQL Server database and OROP's Oracle database, which presented potential regulatory issues. A re-design of the agency databases was determined to be necessary.

Through a series of workshops, staff also identified and mapped how data was collected, stored, and used within the agency to make decisions. A review of existing tools and processes identified deficiencies in how data was being used and the analytical needs required to provide decision support.

INTERA

02

TAMPA BAY WATER

BASELINING

Tampa Bay Water $1.25b Conversion to a Diverse and Robust Water Utility

From just groundwater to groundwater, surface water and desalinization facility

	1998	2013
Supply Sources	Groundwater	Groundwater, Surface Water, Desalinated Seawater
Number of Delivery Points	9	19
Production Wells	207	171
Water Plants	2	12
Pumping/Booster Stations	4	14
Transmission Lines – Miles	160	240
Horsepower	28,000	106,025
Pumps	228	259
Chemical Feed Systems	14	37
Ground Storage Tanks	5	10
Reservoir Storage – BG	0	15.5
Monitoring/Control Nodes	92	428
SCADA I/O Points	1000	22,500
Communication Lines	20	65
Major Permits	6	21

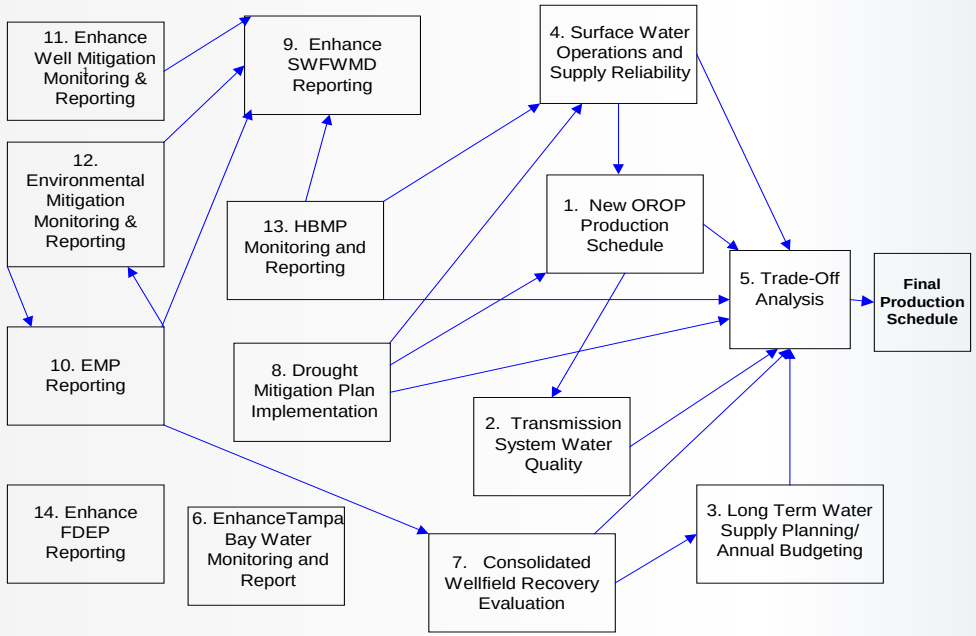
INTERA

A major component of the digital transformation was defining the agency's needs for a DSS. Working committees and workshops comprised of agency staff and consultants identified the agency's functional areas and the inter-dependencies among the staff and work efforts.

These were then assembled into the list of 14 decision support requirements shown in Figure 08. In a workshop with the management committee, the 14 requirements were discussed, refined, and scored. The process helped to define the path forward for developing the DSS.

FIGURE 08

Requirements Functional Relationships Diagram



TAMPA BAY WATER

DEFINING THE FUTURE

03

The next activity was to define the DSS functionality.

The following key DSS development strategies were selected as a result of detailed investigations and evaluations.

- Develop additional analytical tools as needed (e.g., hydrodynamic flow models)
- Develop an enterprise-wide DSS database
- Establish a standard approach to be used for time series functionality (standard statistical method to develop and analyze time series data, e.g., water levels)
- Convert OROP to a Windows environment
- Develop and implement a DSS manager application
- Implement identified SCADA improvements to meet resource management and operational control needs for the increased amount of data collected, as well as the need for enhanced data timeliness, quality, and collection efficiency.

INTERA

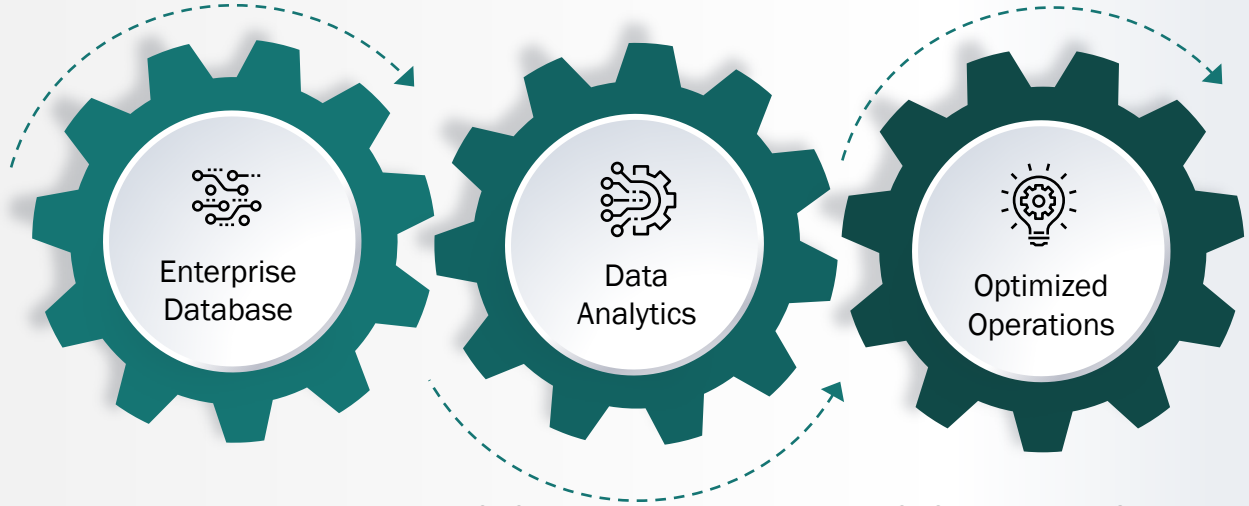
FIGURE 09

Figure 09 illustrates the functionality of Tampa Bay Water's DSS. The prioritization of the agency requirements was the driving mechanism for determining the implementation scheduled to create the DSS and its components. Based on the top four priorities, the agency decided that the DSS would revolve around demand/supply forecasting and optimization to facilitate operating the geographically-dispersed supply system. The agency had a growing need for reliable information and decision support regarding short-term demand and supply needs, and to monitoring regulatory compliance issues such as required reductions in groundwater pumping.

Once we have all the numbers in place...

...we can turn them into actionable information...

...which allows us to make smarter decisions now and in the future.



- SCADA
- Manual
- Laboratory System
- Other Sources

- OROP
- IHM Hydrologic Model
- Demand Forecasting
- Surface Water Models
- Trade-off Analysis Model

- OROP Production Schedule
- Data Analysis & Evaluation
- Reporting
- Queries
- Model Simulations

03

TAMPA BAY WATER

DEFINING THE FUTURE

The Purpose of DSS

The purpose of the DSS database is to provide a common structure for data collection, manipulation, and retrieval to support Tampa Bay Water staff, contractors, regulators, member governments, consultants, and models in the Tampa Bay Water decision making processes. DSS data requirements include storage, retrieval, and archiving support of model, data analysis, and reporting applications. Data sources include legacy data from existing systems, SCADA data, model output, manually-collected data, and data received from external organizations. The database contains links to other databases and/or applications that exist outside the DSS and is maintained/enhanced by other groups within Tampa Bay Water. The solution for meeting Tampa Bay Water's future water management challenges was development of a database system to support user requirements and be compatible with the agency's IT strategic plan.

INTERA

Modeling and analytical tools are important components of the DSS (Figure 09) and are critical to its success. These models and tools are used to analyze data and provide decision support in the operation of Tampa Bay Water's regional water supply system. They provide the ability to respond to water supply and demand changes and to predict the impact of those changes so that system operations can be forward-looking and not just reactionary.

Models and analytical tools in three distinct categories were identified as necessary for development of a comprehensive DSS: existing models and analytical tools; models under development; and enhancements to OROP. Existing models and models under development were reviewed and changes, as necessary, were identified. These models included the OROP, Integrated Hydrologic Model (IHM), and short-term and long-term demand forecasting models. The OROP is the agency's key model used to schedule production from over 150 groundwater wells in an environmentally responsible manner and, with incorporation of weekly forecast of surface water availability and availability of desalinated water, routes and provides water to member government demands at 11 delivery points. Prior to initiating the DSS program, the OROP was maintained using computer technology that did not conform to the agency's IT standards and the model used a standalone database that was not part of the agency's primary database system. One of the most important findings of Step 3, Defining the Future, was the need to convert the OROP operating platform to a Windows®-based environment to facilitate maintenance and upgrades of the software application and to link the program directly to the agency's enterprise database. The principal objective was to create an application that could be used by the agency's operation's staff.

As Tampa Bay Water added additional water resources to its supply mix, it was anticipated that new models may be needed to facilitate the planning and operation of these facilities. The dynamic nature of DSS development and the changing needs of Tampa Bay Water resulted in a list of new models and analytical tools; each of which can be linked to one of the agency requirements.

03

TAMPA BAY WATER

DEFINING THE FUTURE

The use of technologies powered by Intel greatly enhanced the power of the data systems and analytical tools developed as part of the DSS.

Specifically, Steps 2 & 3 Include the Following Tasks:

1. Assessing current business and operations systems, processes, and staffing relevant to the agency current operational decision processes
2. Gathering and analyzing business and operations process requirements for the DSS
3. Assessing the integration of the DSS into future infrastructure and water production changes
4. Developing a proposed integrated DSS solution for Implementation
5. Developing a plan for implementing the DSS

INTERA

04

TAMPA BAY WATER

IMPLEMENTATION BUDGET & SCHEDULE

Task Implementation

DSS implementation required execution of a variety of projects and tasks. Projects were grouped into five priorities to accommodate needs, logical sequencing and dependencies between individual projects, and agency funding priorities. Budget estimates for each sequence of projects were developed as shown in Table 1. Development of the DSS database and analytical tools, including models, was estimated to cost $6.7 million while the improvements to the SCADA system were estimated at $8.8 million. Approximately $1.2 million was spent on the first three steps: Agency Commitment, Baselining and Defining the Future. The total estimated program cost of $16,770,000 (including SCADA improvements and Steps 1-3) to operate and manage new water supplies represents approximately one percent of Tampa Bay Water's $1.24b infrastructure investment.

TABLE 01

Digital Transformation & DSS Budget Projections by Priority Group and Fiscal Year

Projects	FY 2002	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	Total
Priority A	$750,000	$2,694,776	$-	$-	$-	$-	$3,444,776
Priority B	$-	$475,000	$-	$-	$-	$-	$475,000
Priority C	$-	$-	$1,750,000	$-	$-	$-	$1,750,000
Priority D	$-	$-	$-	$1,070,000	$-	$-	$1,070,000
Priority E	$-	$340,000	$2,245,000	$2,565,000	$1,840,000	$1,840,000	$8,830,000
Total	$750,000	$3,509,776	$3,995,000	$3,635,000	$1,840,000	$1,840,000	$15,569,776

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Steps 1 - 3

$1 Million
over 9 months

01
Agency
Commitment

02
Baselining

03
Defining
the Future

04
Plan
Implementation

Step 4

$15.5 Million
over many months

Cost of the Journey

1% OF $1.25 BILLION INFRASTRUCTURE INVESTMENT

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BIG RESULTS

Tampa Bay Water successfully developed and implemented: a new enterprise database system (still in use today); QA/QC protocols; a DSS management tool; and several new analytical tools and reports. All regulatory reports and data transfers are now completed automated. The conversion of the OROP model to a Windows®-based environment was also successfully completed. The goal to have operational staff run the OROP and implement its results was realized. Improvements and upgrades to the SCADA system have been made. The Agency recently completed a new SCADA master plan. While Tampa Bay Water is well on its way to digital transformation, the process is never complete. As new technology and work processes are developed, the need to continue transforming remains. It is a goal of the agency to continue the use of this technology to maintain a streamlined organization.

Tampa Bay Water's Digital Transformation

The addition of new water supply facilities has increased the complexity of the agency's water supply management approach which demanded that Tampa Bay Water digitally transform. This resulted in the development and implementation of a DSS for TBW's source management and planning activities that helps the agency accomplish its mission and offers immediate benefits.

TBW now employs an adaptive management approach for planning and operating their water supply facilities.

The key feature of this approach is the use of feedback from operational decisions to planning decisions which leads to periodic re-evaluation of goals, objectives, needs, and actions. Tampa Bay Water's DSS facilitates this source management strategy by providing information and knowledge in a more responsive and effective manner. The DSS provides for a user-focused data management process. This allows the user to transform raw data into information that supports decisions and improves user knowledge. The DSS environment documents the process steps selected by the user, automatically stores the raw data and transformational processes uses, and produces reports. The process is repeatable and efficient.

WATER BENEFITS REALIZED

01 Better Plans

Tampa Bay Water improved operational and long-range planning through development of a decision support system which streamlined data collection and usages and by developing data analytics tools which led to smart decisions.

02 Created Knowledge

Tampa Bay Water increased efficiencies by improving skills and knowledge through implementation of the decision support system and data analytic tools.

03 Ensured Regulatory Compliance

Tampa Bay Water reduced cost for regulatory compliance by building an enterprise database system, which streamlined data collection, storage, usage and reporting.

04 Smarter Real-Time Responses

Tampa Bay Water improved operational reliability through implementation of the decision support system and data analytics which resulted in smart decisions.

05 Collaborative Communication

Tampa Bay Water improved internal collaboration and team building through the journey of developing a decision support system.

INTERA

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Dr. Adams, a nationally recognized expert in water utility resiliency, has developed the Digital Transformation Roadmap to assist water utilities in their efforts to enhance the resiliency of their system. As the Chief Technical Officer for Tampa Bay Water, one of the largest utilities in the State of Florida, Dr. Adams pioneered Tampa Bay Water's transformation to resiliency through the development and execution of a data driven Decision Support System. In addition, Dr. Adams led the agency's development of an asset management program, referred to as RISE (Resilient Infrastructure Systems and Employees). Her lessons learned form the basis for the Digital Transformation Roadmap for Water Utilities.