



*Integrating Projects, Quality and Management*

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## **CASE STUDY**



# **Quality Management In a Design Organization**

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## **Introduction**

This case study was prepared on a series of interviews with key engineers employed with the Los Angeles County Sanitation District. They agreed to participate in this case study at no expense to them, other than the interview time, providing the data and review of the case study for accuracy.

The objective of this case study is to present some important characteristics of how quality production is successfully achieved in one design organization. Quality program development, implementation and monitoring are critical to achieving substantial results in any organization. The reader should learn that one size doesn't fit all and if a successful quality program works for one organization, it may not work in another organization.

The following case study focuses on how one engineering organization has managed to keep their construction cost overruns consistently very low year after year. The discussion presents the Los Angeles County Sanitation District's business model, how they have established their culture over 80 years and the statistical data of significant metrics.

By no means does this case study suggest that there aren't other engineering organizations (agencies or private sector) that consistently produce similar or possibly even better results. As a matter of fact, one organization that was briefly interviewed uses a completely different business model that outsources the design development and achieves similar results. They perform only the management and contract out the technical development to private companies.

The next case study will focus on an agency that out-sources at least 50% of the design development to private company.

## Overview of LACSD

California's County Sanitation Districts Act of 1923 provided the vehicle to establish and finance the eight original districts and allow additional development to serve 500,000 people. Throughout the early years from 1923 to 1961 they constructed an outfall collection system and their first wastewater treatment plant, Bixby Treatment facility. The overall program continued to grow at a rate similar to the Los Angeles area population rate to service the area. In 1947 new laws allowed the district to operate solid waste facilities and by the early 60's the SD was operating five land fill sites.

Today, the Los Angeles County Sanitation Districts (LACSD) reports assets of 1,300 miles of main trunk sewers and 11 wastewater treatment plants convey and treat approximately 510 million gallons per day (mgd) of which 200 mgd has high level treatment for reuse in the dry Southern California climate. Three active sanitary landfills handle approximately 20,000 tons per day (tpd), of which 16,500 tpd are disposed (approximately forty percent of the County-wide disposal capacity) and 3,500 tpd are recycled. The agency also operates four landfill energy recovery facilities, two recycle centers, three materials recovery/transfer facilities, and participates in the operation of two refuse-to-energy facilities.

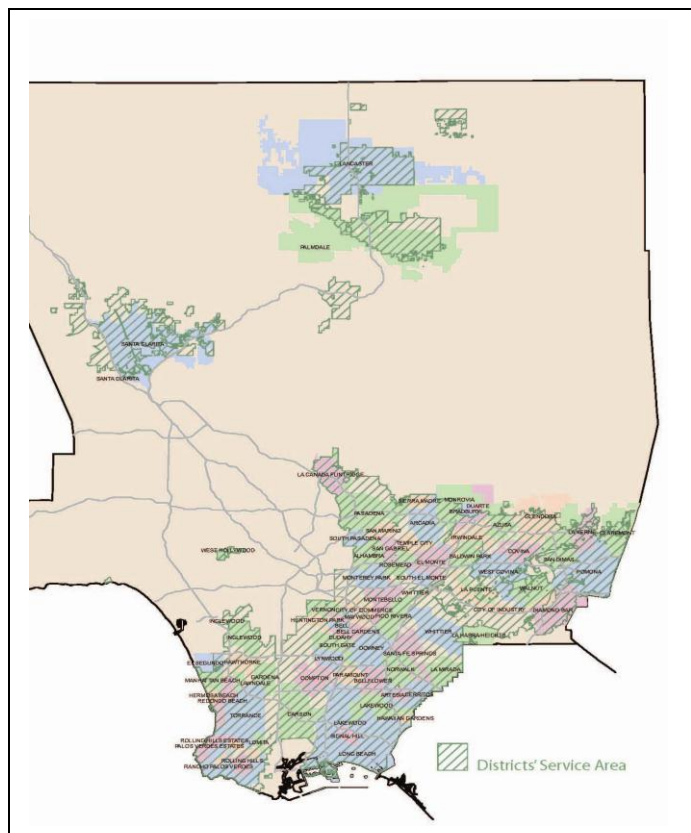
The Sanitation Districts' overall wastewater and solid waste management budgets for 2006-07 are \$622 million and \$274 million, respectively. Both systems provide these essential public services at some of the lowest rates in the country. The LACSD has 1900 employees of which 300 are engineers.

## Industry

There are thousands of sanitation agencies throughout the United States and each one operated with a different business model. However, they have one thing in common; they collect and treat the wastewater for their communities. The cost for collection and treatment vary considerably. LACSD has consistently provides this service for \$4 to 6 per MG per capita, which is well below the national average.

## Services & Area

The Sanitation Districts provide environmentally sound, cost effective wastewater and solid waste management services to approximately 5.2 million people in the Los Angeles County area. This area covers approximately 800 square miles encompassing 78 cities and unincorporated territory within the County. What others think of as waste is turned into resources such as reclaimed water, energy, and recycled materials.





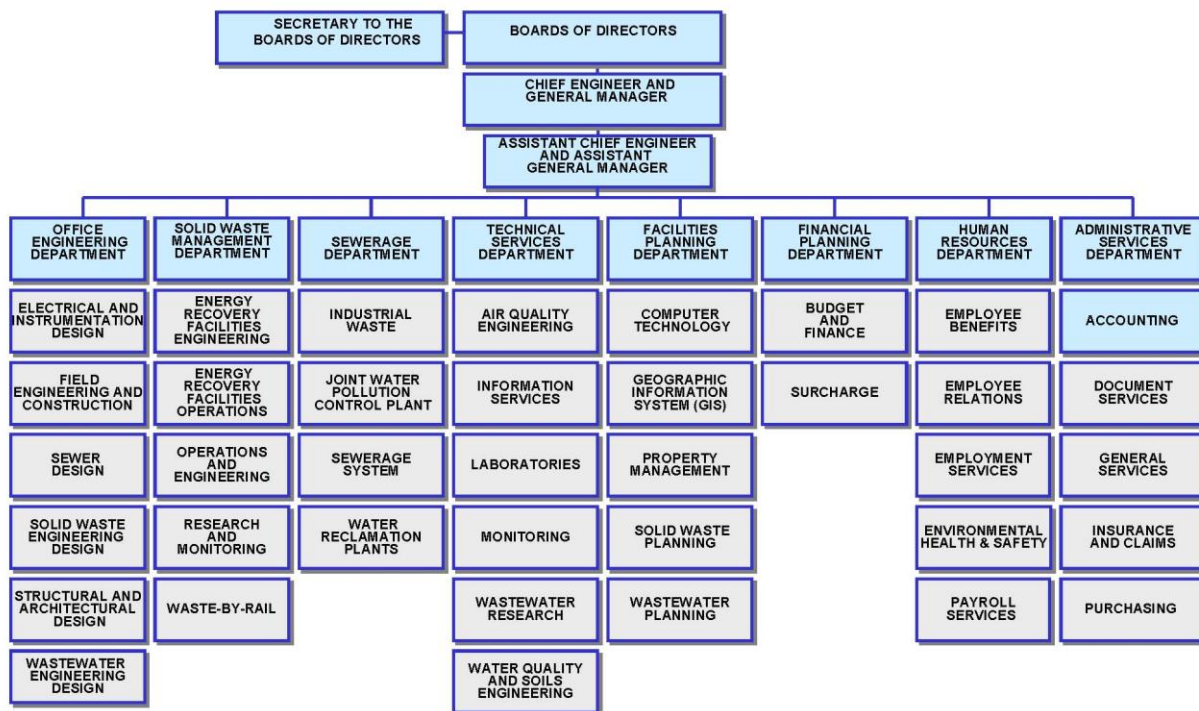
## Organization

The LACSD are a partnership of 24 independent special districts which is governed by Boards of Directors consisting of the mayors of each city within the Districts and the Chair of the Board of Supervisors for county unincorporated territory. These 24 districts work cooperatively with one administrative staff led by the Chief Engineer and General Manager and Assistant Chief Engineer and Assistant General Manager. The Board gives a lot of latitude to the Department and rarely do political issues drive decisions. They are organized into eight Departments with a number of specialized Sections in each Department. The organization chart identifies these Department and Sections as well as the structure of the agency.

The district works cooperatively under a joint Administration Agreement with one administrative staff headquarters near the City of Whittier. Each Sanitation District has a board of directors consisting of the mayor of each city within the District and the Chair of the Board of Supervisors for unincorporated territory. Each Sanitation District pays its proportional share of the joint administration.

The Sanitation District constructs, operates, and maintains facilities to collect, treat, recycle and dispose of wastewater and industrial wastes. Individual districts operate and maintain their own portions of the collection system. Local jurisdictions are responsible for the collection of wastewater through local sewers and the collection of solid waste. The agency also provides for the management of solid wastes including disposal, transfer operations, materials recovery and energy recovery.

**SANITATION DISTRICTS OF LOS ANGELES COUNTY ORGANIZATION CHART**





## Engineering Practice

"Doing the best job with the least resources" is the SD definition of good engineering practice which is embedded into their culture. They have stayed on the leading edge, pioneering innovative techniques to continuously improve their environmental engineering practice and service to their customers. They have won numerous "Excellence in Environmental Engineering" awards for innovations, wastewater reclamation, industrial waste and solid waste.

LACSD has a long standing commitment to public participation in project development to build consensus among stakeholders. They have always maintained an open forum to the public as decisions are made that may affect the services, which has instilled trust in the community and their customers.

The results of this sound and innovative engineering practice provides among the most economical service in the nation. They have had eight leaders of the organization with the title of Chief Engineers since 1923. They have maintained the prestige of the "Chief Engineer" title who also serves as the General Manager. This focus clearly distinguishes that this is an "Engineering Organization".

## Planning and Engineering Departments

### Facilities Planning Department

The facilities planning department is made up of engineers and responsible for long range planning, master planning, identifying the site location, systems, technology, conceptual engineering, environmental clearance, public outreach and media.

### Office Engineering

The design department has about 100 engineers and technicians that produce approximately \$100M of final design projects ready for construction each year. They initiate a project with a Preliminary Design Report (PDR). The PDR is a technical document that clearly defines the product to be designed, how the product was designed on previous projects, design criteria, standards, and guidelines that will be applied during design development and the environmental mitigation requirements. During the planning phase, the design and field engineering staff, that is expected to be integral to the project in the future, participates in the to incorporate design and construction risk mitigation issues from the beginning. The design staff implements the PDR at the design level. LACSD does not have design manuals but they do have standards and specifications that are applied to the design development. The design staff continues to work closely with construction management and operations engineers as the preliminary and final design progresses.

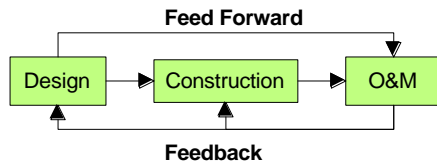
The design department self-performs approximately 90% (9 out of 10 projects) of the agency's total design work leaving 10% that is outsourced to private firms. They outsource very specialized work and short-term peak workload that exceeds their capacity. Some of the more specialized work like tunnels and the oxygenation plant is an example of projects that have been outsourced. The majority of the process design is accomplished by internal staff.

### Field Engineering and Construction

Field engineering assumes the project once the project bid has been awarded to the low bid contractor. Their responsibility is to assure that the project is constructed per the plans and specifications. The design staff continues to stay involved with the project until the facility is in service or when the project is turned over to Operations and Maintenance (O&M). They have formal and informal partnering with the contractors on each project. The engineering staff has the option to transfer between departments which allows departments, which allow them to follow a project from planning to design to construction and maintenance.

### Design Integration Model

The LACSD has an integration model that keeps planning, design, construction and operations and maintenance continuously aware of what works and what doesn't. Lessons learned from construction and O&M feedback to planning and design so problems don't reoccur. The engineers that prepare the concepts usually follow the project through completion.



The Integration Model continuously includes the planning, design, construction and operations throughout the project development process. These departments also feed information forward during planning and incorporate the feedback and lessons learned at all levels of projects development.

### Project Delivery Method

The LACSD delivers work as Design-Bid-Build. The projects are advertised and awarded to the low bidder quickly after the design is complete. They are constrained like other agencies in California due to legislation and do not allow them to deliver projects using Design-Build method. If Design Build was allowed, they may not use the delivery method since the design would fall under the constructor.

### Cost Ratios

Design and construction management cost as a percentage of the construction bid.

Discipline	Design	Construction Management
Wastewater Process	6-10%	5-10%
Solid Waste	4-5%	5-10%
Sewer	5-6%	5-10%

### Human Resources

The LACSD is an Engineering organization and the leaders in this organization are engineers. They have university alliances, recruit top talent from local and national universities, require advanced degrees, active in professional organizations, challenging projects, innovative culture, competitive salaries and good benefits.

#### Alliances

LACSD has alliances with universities across the United States with whom they share problems, finds solutions and advance technology to apply to environmental engineering. This institutional learning helps keep the agency on the cutting edge of solutions. These reciprocating alliances benefit very well from one another, since LACSD heavily recruit engineers from colleges such as Stanford, Berkeley, Purdue, Penn State, Manhattan, Illinois, North Carolina and Loyola Marymount.

#### Recruiting

LACSD requires high standards from the engineers they hire. Not only are they looking for top engineering students but they require a Masters of Engineering to qualify for a position. They will even help fund a potential hire with their *Master's Funding Program* in trade for 3 years of service to LACSD. Now the key is to keep their investments for the long term which they don't seem to have a problem doing.

#### Leadership & Training

LACSD encourages active participation in professional organizations, writing papers, public speaking and educating the community on what is involved in wastewater collection and treatment and solid waste collection and disposal. Engineers volunteer to provide "brown bag" lunch programs once per month to share complex problem and solution, lessons learned and brainstorm new ideas.



### Staff Retention

Most engineers that choose to join LACSD decide to stay there throughout their entire career. The average employee has 15 year of service and the average person that retires with the District ~~retires~~ has 25 years of service. Overall the District has 4.8% turnover per year. The design staff typically works forty hour per week but may vary depending on the demand.

### Benefits & Retirement

LACSD is a part of the CalPERS benefit program and have typical government holidays and benefits.

## Quality Management Program

LACSD does not have a written quality assurance and quality control manual nor do they have an extensive library of design manuals and guidelines. They rely on many years of experience of the design discipline leaders and interaction with field engineers and operations to produce high quality design documents. They carefully apply innovative approaches after studies and prototypes confirm results. The PDR development provides the design approach and addresses the following for each design component of the project:

- General – Description of the Scope of work and project objectives
- Existing Conditions – Project conditions and constraints
- Design Criteria – Hydraulic, effluent, units, sizes, target biology, etc
- Systems Description – Component descriptions, measures and controls

The construction documents are reviewed for accuracy at various levels of completion. The discipline leaders review for accuracy; documents are cross-checked between disciplines and departments; construction management performs the constructability reviews; and an operations reviews for O&M.

## Construction Results

Construction change orders are investigated in order to get to the "root cause" of the problem and they ask themselves "How can we prevent this in the future?" The findings are shared with others in the organization as part of their continuous improvement efforts. Every change order is accounted as a design error, design omission, differing field condition or owner initiated change. Ten year of data collected on all projects performed by the District have less than 2% construction cost overruns and accounted for as follow:

- |                               |      |
|-------------------------------|------|
| ▪ Design Errors and Omissions | 0.7% |
| ▪ Differing field conditions  | 1.1% |
| ▪ Owner initiated changes     | 0.2% |

The LACSD does not have a formal or an informal Quality Management, Quality Assurance or Quality Control Program. Quality delivery is inherent in their business model.

## Contributions

Special thanks to the LACSD for participating in this case study preparation and sharing their culture for the benefit of the engineering community and their customers.

## Disclaimer

The LACSD did participate and agrees with the accuracy of the facts presented in this case study. However, this does not mean that they endorse the preparer or PQM, Inc.