Synergy Program in San Diego, California

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The city of San Diego (California) Street Maintenance Division developed the Synergy Program to improve working methods and employee responsibilities, track performance measures, maintain inventories, and implement new technologies. As changes took place, the need for an effective and integrated inventory and work management system became critical. To develop a new system for inventory and work management, an enterprise resource planning system proposed by SAP America was chosen. The proposed system provided full inventory and work management functionality and required reengineering business practices to use the "best practices" proven by major organizations. An SAP/geographical information system (GIS) browser was developed that allowed data in the SAP system to be viewed spatially using GIS. Employees assigned to the project were assisted by implementation consultants and became the experts on the software and on business process reengineering. They were instructed to make decisions that were "directionally correct" (i.e., that kept the division moving in the right general direction) and to keep the project as simple as possible. As a result, the project went into production in record time and within budget. The implementation proceeded in three phases: scoping, initial implementation, and system expansion. The fourth phase, currently under way, is a process of adding inventories and improving the system based on observations made during the first year of operation.

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The city of San Diego Street Maintenance Division maintains all of the streets, alleys, sidewalks, street trees, storm drain systems, street lights, traffic signals, traffic signs, pavement stripes and markings, marked curbs, fences, guardrails, and bridges for a city of 1.2 million people who live in an area of 1041 km^2 (402 mi^2); the region—including the adjacent and similarly sized city of Tijuana, Mexico—is home to 4 million residents. San Diego's Street Division also provides services such as street sweeping, emergency response to hazards, and storm water pollution control management and enforcement.

From the mid-1970s to mid-1990s, the city experienced major growth without any changes in the management structures and information systems of the maintenance division. The traditional method of passing all operational information verbally from supervisor to employee and then promoting that employee was no longer feasible. What had worked for a city of 700,000 inhabitants with 2400 km (1,500 mi) of streets no longer was effective with 4800 km (3,000 mi) of streets, 18,000 intersections, and more than 1 million people. The systems could not meet current-day expectations and did not provide resources that were competitive with private service providers.

The Street Division was faced with a major challenge. The primary request-tracking system was limited and overloaded. There were more than a million separate items to maintain and 363 employees to manage, as well as their equipment and materials. Numerous maintenance contracts were in process, new technologies were being evaluated, and an annual budget of $42 million had to be developed and managed. A goal was set to complete a major new service tracking, work management, inventory management, and management information system within 1 year. To achieve this goal within budget and on schedule seemed an impossible task, especially within the constraints of working in the public sector.

Surprisingly, when the year was over, the division had done better than that. More had been accomplished than originally planned, and the project had been completed on time and on budget. In this paper, we describe the process used to implement this system, the methods used to improve the work management practices of the division, and the system itself.

WORK MANAGEMENT AND INVENTORY SYSTEM

The division had an immediate need for an effective and economical work management system. Different sections within the division used different inventory and request-tracking systems. These systems were not compatible and varied from handwritten records with no inventory to computer files in Paradox, Quattro Pro, and mainframe systems.

The largest of these request-tracking systems had no geographical basis and no ability to measure actual work done. This system kept track of requests received and their completion but maintained no centralized record of routine work processes. The mainframe system, designed when the city had a population under 750,000, had significant problems during the heavy rains in the spring of 1998. It was unable to process the number of requests received each day for much of the spring, requiring the use of pen and paper to track many thousands of requests.

There also was a long-term need for improved management information to measure the work performed and associated costs; these measurements had been collected manually and summarized. The method led to variations in the measurements and the inability to individually audit the work done in each category. This need was not only expected by the public and the elected representatives but also a crucial comparative measure as part of a citywide "competition program" whereby services provided by city staff were bid directly against private service providers.

To determine the division's needs, a business case was drafted to define what a new system should provide and could achieve. Needs included tracking all items maintained and all work performed to allow an increase in planned maintenance in lieu of reactive maintenance; providing an improved level of service to the public by tracking customers, their requests, and the results of those requests; and especially improving work efficiency. One common complaint by field units was that their time was wasted responding to locations that did not exist, locations where the item to be repaired did not exist, locations where the work requested had already been completed, or locations where the work to be done conflicted with work planned by others. Time also was nonproductive when one crew was assigned to coordinate work with another crew. Often, one crew would attempt to start work before the other crew was ready, or the follow-up work was never completed. When work was not completed, a normally scheduled task suddenly became a high priority, displacing planned work and reducing productivity. A study of more than 6,000 requests found that 18 percent of the responses were nonproductive. Determining repeat requests, conflicting work, and the existence of specific maintenance items at a location was especially difficult to handle by conventional methods. The use of geographical information for all data was determined to be the best method to address these problems.

Another major concern to municipalities is liability. A work management system can address liability issues in two ways. The first is by aggressively tracking and coordinating all work. If the work is done properly and in a timely manner, the possibility of damage or injury leading to liability is reduced. The second method is by having a comprehensive record of all requests and routine repairs made to a street element. When presented in court, these records give the jury the knowledge of the effort and completeness of the work actually done. With the previous system, this lack of information gave the impression of incompetence and unreliability.

Five possible ways to proceed were identified:

- Upgrading one or more of the existing mainframe applications currently in use,
- Creating a unique client-server–based system,
- Modifying an existing client-server–based system under development from another city department,
- Purchasing an existing public works package, and
- Using an enterprise resource planning (ERP) system and creating a link to a geographical information system (GIS) package.

The first three options (upgrading, creating, or modifying a system) would require extensive needs analysis, design, prototyping, and programming. The most optimistic time frames for these processes were more than a year and likely would have required several years to full implementation. In addition, on completion, these systems would be static; only with additional direct expenditures of effort and money would they be able to expand to address new needs or to use the rapidly advancing improvements in communications.

On the basis of the city's immediate needs and concerns regarding the time frame and cost of developing a customized system, commercially available systems were considered. The two viable alternatives were purchasing a package designed specifically for public works organizations and purchasing and configuring an ERP system. Three vendors responded to a request for proposals: two public works–specific packages and one ERP system. The demonstration and evaluation of both public works packages raised concerns about the stability of the software and its capability to handle the number of workstations and the database size proposed. However, SAP America's ERP R/3 software demonstrated the capacity to handle a large system with the many users and the large volume of data that the city required, and it was chosen. The proposal called for only a small portion of the full enterprise system to be implemented, including the plant maintenance and service management modules.

A major factor in this decision was that the system is configured—not programmed—for a business operation. This configuration had two major positive effects. First, it forced the division to rethink its operations and to choose the best work process for the entire operation, not simply recreate the dysfunctional methods from the old systems in the new one. Second, in-house operational employees—not consultants or information technology specialists—would control the implementation process. Division staff would not only make the important process decisions but also enter this information into the system, and they would have the knowledge and ability to make needed changes even after all the outside "experts" were long gone. Because the division was already in the process of considering additional process changes, the implementation of the computer system was integrated into and became central to the overall change process.

Another part of this decision was the need to tie R/3 to a GIS so that the locations could be found, managed, and reported on spatially. The answer came from Environmental Systems Research Institute (ESRI), the city's standard GIS provider, which was in the process of developing a connection to the SAP R/3 system. ESRI made a commitment to make the system functional and was able to provide the full set of tools necessary to enter, maintain, display, analyze, and translate data simultaneously in the ERP and GIS systems.

Other benefits seen in choosing the ERP system were the ongoing support and software development done by SAP that would be available to improve and expand the system in the future. Also highly desirable were the ability to easily reconfigure the system as crews and functions were added or changed in the future, and the built-in functionality in areas such as personnel tracking and materials and project management that were already available in the system. These and other functions could be turned on in the system by the necessary configuration and would fully integrate with the work management system. The support available for SAP systems (by SAP and its numerous consultants and partners) also strengthened the city's belief that this choice would be a long-term investment that would not need replacement in the foreseeable future.

So far, these beliefs have proven correct. Recent releases will add the ability to use low-cost personal handheld units with the systems as well as give system connectability to the Internet.

Change Processes

To complete the project on schedule and within budget, certain commitments were made at the top levels and passed down to the entire staff. Most important, the best and brightest formal and informal leaders were assigned to the project: three experienced first- and second-level supervisors and one engineer were relieved of their normal duties to work on the project; their normal work was absorbed by colleagues.

The information technology staff handled the hardware and network portions of the project. The entire project team was housed in a single location on the same site as most of the operations of the division to allow easy face-to-face discussions of critical subjects as needed throughout the process. The project manager and the division head were at the same location and met informally with the team at least once a day and were available when needed.

One important part of getting the system up and running quickly was to make decisions quickly and at the lowest possible level. It was made clear to involved staff that all decisions that kept the division moving in the right general direction would be supported. We found that the few instances when decisions had to be reversed and tasks redone were far less damaging than the potential time wasted waiting for approvals. The "directionally correct" concept maintained the project's momentum.

Another critical element in getting the project completed on time was to keep the project as simple as possible. The decision was made to get the system working as soon as possible. The idea was to make it work (get the basic functionality operating), then make it right (ensure that the information and process were accurate by providing high levels of support and quick corrections at the turn-on of each phase). The third phase, make it better (develop the full functionality), came later. Needs were documented, temporary work-arounds were developed, and improvements could compete for inclusion in future phases. Sometimes, "better" meant restoring functionality lost from previous systems. However, with time, most of these needs were either replaced by a new functionality or eliminated as unnecessary. Thus, many of the requests did not have long-term utility and never had to be developed.

A strong commitment toward making the necessary operational changes was necessary to improve operations and put the system in place. The system purchased did not always replicate or support existing practices; it was chosen to force the division to improve and standardize processes. Former functionality was abandoned and operational changes were accepted in some functional areas in favor of processes that better served the entire organization. It was important to avoid demands to make everything work similar to or as simply as the former systems. The overall function of the overall organization was given first priority. Resistance to reengineering is always strong, and the availability of high-level software systems may give the impression that a simple software fix will solve the staff's concerns. To have tried to make everyone fully comfortable with the new system probably would have not only put the implementation behind schedule and over budget but also would have deviated from the original goal of improving the operation.

The project team was instructed to maintain a positive mind set. No one was ever allowed to say why something couldn't be done. Instead, they were required to identify what it would take to make it work, regardless of how impossible. Then, the feasibility of the work-around plans—many of which were extremely expensive or required a declaration by the President or such—was evaluated. The process led to a positive approach to problem solving. Although the work-arounds were seldom implemented, the team found other new methods and were excited at the prospect of solving an impossible puzzle, as opposed to being depressed from listening to what absolutely could not be done.

Concurrent with the development of the work management system, several activities affected the whole division. Ongoing training outside of the normal software user classes were developed and held for supervisors, crew leaders, and administrative and technical staff. The training centered on basic information and normal skills relating to the city's structure and form of government, administrative processes, customer service, working with and leading others, and legal requirements. Work also began on reengineering business processes. Each program in the division worked with an assigned member of the implementation team to discuss plans, needs, and issues. Numerous meetings and other forms of contact began to occur. The entire program was explained at a kick-off meeting. All employees were instructed to participate aggressively and to follow the project's progress. They were each made responsible for asking questions, participating, and understanding what was going to happen as well as responsible for the success of the project in their area; if they did not participate in the process, they would forfeit all rights to complain later.

Changes in employee responsibility led to the development of a new job description and responsibilities for the first-level supervisors. The program changed their primary work responsibilities from directing work tasks to the overall management of an operational area. A new position was created, and all of the existing field supervisors and other candidates competed for placement in the new jobs.

Restructuring also was necessary to address the additional data needs of the system, especially in direct contact with customers. A call center was developed to handle the customer contact processes that involved major changes to customer service, dispatch, and clerical functions.

IMPLEMENTATION

After the decision was made to use SAP as the work management system, a request for quotes went out to implementation consultants for the scoping analysis. The scoping defined the city's business requirements and which SAP modules were going to be implemented. Before beginning of the scoping analysis, the city's implementation team spent 1 week attending training on the Plant Maintenance module of SAP's R/3 system at a remote location. This training both provided an introduction to the software and served as a team-building exercise. The city team was prepared to participate in the scoping analysis, working directly with the consultants.

The scoping analysis was a 7-week effort that included the conversion and use of existing GIS data. The selected implementation firm, Bureau Van Dijk [now Conley, Canitano & Associates, Inc. (CCAI)], dedicated three consultants to the project. They worked with the division's team to determine the specific needs of the project and designed the implementation. CCAI then developed a project plan together with ESRI, who would be developing the inventory, or GIS, portion of the project. From this plan, deliverables were specified, and a quote and time line for the SAP implementation were developed.

With the quote in hand, the decision was made to move forward with project implementation. To have a system available to begin configuration, the city moved ahead with the infrastructure part of the project—sizing, purchasing, and installing the servers and clients; system administration; software purchases; and employee training.

The implementation process, typically done in-house with the assistance of certified consultants, would entail selecting and implementing new business practices. These decisions and the actual configuration of the system would be handled by existing operational employees who were familiar with the day-to-day needs of the operation rather than by information technology specialists. With the assistance of the consultants, this in-house team would develop and conduct the training programs and would become experts on the reengineering, the new business practices, and the software.

The time line of the project defied normal standards for government projects. The scoping took place over 7 weeks from June to August 1998. The three-phase implementation started in September. The first phase, which included service notification functions and the conversion of base GIS street layers, went into production in February 1999. The second phase, which included the conversion of two of existing Street Division GIS layers (traffic signals and street lights) and the ability to maintain those objects, went into production in May 1999. The third phase, which included work order creation and preventative maintenance, went into production in June 1999. System upgrades and improvements continue in the fourth phase, as does the establishment of inventories for the remaining street assets.

What the System Does

The system has all of the normal functions of a work management system. It tracks inventory and work performed, schedules work manually and with capacity restraints, manages projects, identifies crew productivity, captures information to be used in generating billing statements, measures efficiency, and records all requests. Reports on work pending and work completed are easily generated. In addition to the normal functionality, the system also tracks customers as discrete entities and allocates all inventory and associated work by its spatial location. It allows users to see where work is planned or was done, assign or coordinate work in an area, define work areas and assignments, and develop routings for requests and routine work.

The division can create spatial maps (rather than simply provide lists of streets) for communities that show where work has been done or is planned to be done in their neighborhood. For example, one community wanted to use low-wattage bulbs in streetlights to save energy. The division provided maps of all the streetlights in the community, and the community was able to determine which bulbs were going to be changed and thus estimate the costs of the project.

The system provides very powerful reporting and management information tools. These tools are very flexible and do not require special design or programming. Especially useful is the manager's ability to "drill-down" into information, to see overall information and then all the details. For example, when a summary of all work performed on storm drains is displayed, double clicking on a storm drain number will list all the storm drain requests by crew that did the work. The information then can be drilled-down to month of work and actual jobs done. The factors that can be selected and their order can be changed and preset for each individual manager. This functionality is especially useful when data on a certain function seem to vary from what was expected. By drilling down to lower levels to see which work group, tasks, and actual jobs were involved, the manager can understand quickly what caused the unusual results.

Of special interest is a browser that ties both SAP and the GIS data together. It allows online viewing of current requests as well as the creation and update of requests found spatially. This powerful tool provides significant information and edit capabilities to the day-to-day users with a simple, understandable interface.

The Future

The fourth phase of the project, now under way, includes enhancements in three areas. The first area is the development of an interface tool for each of the remaining Street Division inventories, which were not included in the first three phases. This effort covers not only the identification of a data collection tool for each of the inventories but also the Street Division's responsibility to collect the data and enter it into SAP.

The second area is enhancements to the existing system. Some of those enhancements include the automatic updating of inventory items through confirmation of work done, increased browser functionality for creating reports and maps, training for advanced custom report development, and an evaluation of field computing technologies to be used by working crews.

The third area is a system upgrade from version 4.0 to version 4.6. In keeping with the initial decision to choose SAP for its continuing expandability, we plan to complete the system upgrade with the assistance of the consultants so that in the future, division forces can upgrade the system independently.

Along with these development efforts, a support group will be developed that will be responsible for qualifying progress, connecting the system to others in the city who are part of the division's work flow, and providing ongoing training and product support. Some future developments might include web-enabling the system to allow customers to view their requests via the Internet and to allow forces to update work from the field.

Conclusion

The success of San Diego's Street Maintenance Division's project proved that the right combination of people, products, and strong commitment can make major changes in operations and implement a complicated software system, all in a short time frame. With many major activities happening simultaneously, it was a tribute to the dedication of all involved parties that the project not only succeeded on time and within budget but also implemented more than was originally planned.

The parties (CCAI, ESRI, and the city) all had a vested interest in the success of this project. Fortunately, the entire team was highly skilled, motivated, and dedicated as well as compatible. Part of the success was due to an early decision that all work would occur in one building. The building itself, a mostly abandoned storage building surrounded by garbage truck parking, was inexpensively brought up to just below decent working conditions. But the challenges of the building and the joint challenges seemed to create a "skunk works" atmosphere that made it clear that little could not be conquered.