IRRIGATION DISTRICT OPERATIONAL METRICS

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ABSTRACT

Oakdale Irrigation District (OID), located in the upper portion of the San Joaquin Valley, provides irrigation and domestic water service to rural northeastern Stanislaus County. The OID's service area is comprised of 72,345 acres of which approximately 55,000 acres are irrigated farmland. Within that service area are 40 miles of main canals inclusive of 23 hard and soft rock tunnels, 330 miles of laterals and pipelines, 110 miles of drains, 22 deep wells and 43 reclamation pump systems. Within the irrigated portion of the service area OID's agricultural customers grow a variety of crops, inclusive of pasture, almonds, walnuts, corn and rice. OID is also part owner of the Tri Dam Project with its sister district South San Joaquin Irrigation District. Tri Dam consists of three dam structures and four hydro-electric generating plants on the Stanislaus River.

The district had for many decades been a hand-to-mouth district until recently, where through some fortunate economic events; retirement of long term debt in 2002 and a renegotiated wholesale power contract in 2004, has acquired the financial means to begin replacing and modernizing its aged infrastructure. Prior to those events the district had been evaluating its performances in all aspects of daily operations to find ways to improve its operational efficiency and get the most out of its resources.

To reach that goal, early in 2002 the district set up some operation metrics to gage their performance. These metrics allowed the district to find areas of potential improvement and to measure change as change was implemented. This paper will discuss some of the operational metrics used, some quite simple, and how those metrics were used to bring change to OID.

METRIC 1 — CAPITAL IMPROVEMENT BUDGETS

Capital Replacement versus Capital Improvement

Irrigation districts often refer to their Capital Improvement Budgets (CIP) in the generic sense as it relates to their construction budget. District Managers should not lose sight of the two tiered aspects of a CIP budget; (1) to replace, rebuild and rehabilitate existing infrastructure to maintain system reliability; and (2) to build new infrastructure to meet modernization requirements brought on by changes in customer service demands or regulatory requirements to better manage its water resources. Both are essential elements in keeping our water systems functioning properly and at an acceptable level of serviceability and delivery efficiency.

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Balance in both elements is important and will largely be dictated by the availability of capital funding. Between the two categories of a CIP budget; CIP funds to replace old infrastructure or CIP funds to build new infrastructure, preference should dictate that replacement needs should have priority over the latter. It makes little economic sense to put old earth lined canals in pipelines when you have existing pipelines in your district leaking from age and deterioration.

In order to insure balance in a CIP program an irrigation district needs to understand what their system's lifecycle replacement needs are for its existing infrastructure. A lifecycle replacement analysis is a simple process, assuming one has an existing infrastructure/facilities inventory. The analysis will help determine if your CIP program is focused on its most important areas. If your organization lacks a facilities inventory of its system, it is suggested that one be done. Assigning a couple of employees to spend the winter offseason systematically counting the parts and pieces of your water and drainage systems is a worthwhile and essential expenditure of time. Once this data is known, it can be assembled into a simple spreadsheet; facility lifecycles assigned; annual replacement costs and project costs applied. The outcome will be a "replacement" budget for your existing system.

OID Example

In preparation of its 2004 budget OID took an existing facilities inventory and applied the methodology discussed above. The results are shown in Table 1. The exercise showed that OID had an annual lifecycle replacement budget requirement of about $4 million. OID looked back to its 2002 and 2003 budgets and noted the following;

1. Both the 2002 and 2003 CIP budgets were in the $2 million dollar range. An eye opening realization that showed that replacement needs were sorely underfunded by 100%.
2. Both the 2002 and 2003 CIP budgets showed CIP spending for "new" facilities to be 60% of the budget and funding for "replacement" facilities at 40% of the budget. Again, not too surprising, but a dangerous trend if continued.

Change in Focus

The importance of this exercise for district managers has multiple benefits. One is to educate the Board and the public on the replacement needs of your existing irrigation and drainage systems. There is no greater need for your CIP budget dollars than to invest in replacing your existing infrastructure before it meets its lifecycle term. Not recognizing that need; not addressing that need; and not getting a handle on meeting that need could put your district in a reactionary replacement mode. Replacements of facilities under failure mode will add 30-40% to the end cost. Not an efficient expenditure of constituent monies.

For OID, finding out it needed to be spending $4 million instead of $2 million a year was an eye opening exercise which brought to the forefront numerous questions, none of which had good answers. Like, how can we fund such an increase in expenses? How

Table 1. Estimated 2004 Capital Replacement Budget Needs

Asset Type	No.	Units	Life Cycle (years)	Replacement Needs (Annual)	Cost per Unit (Est.)	Budget
Shotcrete Canals	90	miles	45	2.0	$475,200	$950,400
Pipelines	100	miles	50	2.0	$450,000	$900,000
Pressure Boxes	481	each	60	8.0	$20,000	$160,333
Flumes	8	each	60	0.1	$100,000	$13,333
Turnouts	2,504	each	60	41.7	$5,000	$208,667
Turnout Gates	2,504	each	20	125.2	$1,500	$187,800
District Fence Gates	136	each	50	2.7	$1,000	$2,720
Culverts	623	each	60	10.4	$15,000	$155,750
Lateral Weir Headings	481	each	60	8.0	$45,000	$360,750
Drain Inlet Structures	322	each	60	5.4	$7,000	$37,567
Pumps	75	each	60	1.3	$150,000	$187,500
Access Reclamation	480	miles	50	9.6	$80,000	$768,000
Bridges	143	each	50	2.9	$35,000	$100,100
Annual Budget Requirement						$4,032,920

much can OID afford to do in-house (force account) and how much needs to be contracted out? Analysis showed that OID construction crews could do about $1 million of construction a year. More than that meant outside contractors would be needed. That fact raised subsequent issues; one being, OID did not have the in-house staff necessary to design, manage, inspect and control more than $1 million in outside contracts. That revelation raised further questions about adding staff to do the job which brought back budgeting and financing issues.

The end result was an investment in a Master Water Resources Plan that tied water conservation to water transfers to generate revenues to rebuild and modernize an old irrigation/drainage system with minimal economic impact to its current water customers.

METRIC 2 — WORKER'S COMPENSATION

Worker Safety in the Workplace

There is great value in a proactive safety program, both to the workers it protects and to the bottom line of an irrigation district. Safety is one of those things that can be easily taken for granted and it shouldn't be. However, after a number of years of multiple employee injuries (fortunately, none too serious) and significant lost work time from

injured workers, it became evident that OID's safety program was broken and needed fixing. To begin that process OID did three things; (1) it called OSHA Consultation Service and requested onsite inspections, training and a written safety program review. This action gave OID short term protection from compliance protections against citations; (2) it contacted its Workers Comp provider and asked for help in restructuring its safety program; (3) it appointed a skilled and committed in-house employee to work full time with both OSHA and its Workers Comp provider to insure improvements and that change happened.

Reasons for and Cost of Poor Safety Practices

The reasons for such repetitive injuries were outlined by OID's Worker Comp Insurance providers at a management meeting held at OID's request in late 2003. Simply put, worker injuries result from a number of factors, inclusive of the following;

1. A poor safety program.
2. Employees who didn't care or practice safe work practices.
3. Poor supervision, in that safe work practices are not enforced by those with the job responsibilities to do so.
4. Poor management.

Safety and the practice of safety by employees is a workplace culture and workplace culture can take years to change, but the process needs to start in order to get there.

The Experience Modification (E-Mod) Ratio as used by Workers Comp Insurance providers is a measure of the workings of the district's safety programs. In the 2003-04 calendar year OID had an E-Mod of 1.48. OSHA states that any employer with an E-Mod over 1.25 is a "high hazard employer" and subject to additional scrutiny by OSHA, which is not a good thing.

The economics of a high E-Mod Ratio is simple to understand. The portion of the E-Mod over 1.0 is the percentage an organization pays above the average rate of those in their same insurance pool. For OID, with its E-Mod Ratio at 1.48, it meant OID was paying 48% more than the average organization in its same insurance pool. In dollars, OID paid $378,424 in 2004 for Workers Comp coverage.

The Pay Back

Today OID has an E-Mod of 0.91 with a goal of getting to 0.60. It has taken OID nearly 4 years of incremental change but the return has been impressive. In 2008, OID's Worker Comp Insurance premiums were $160,836, a savings of nearly $218,000 a year from its 2004 rate. While these are direct cost savings, the indirect cost savings for such a program change are easily multiples of this number. Savings in overtime pay, improvement in worker productivity and moral, reduced administrative time for tracking and management can easily triple this savings.

Philosophical Business Change

To instill this change OID adopted a new philosophical approach to safety. Wherein the past OID expected injuries as part of their work culture, now a "target zero" approach prevailed to any and all injuries. Changed too was the responsibility of making safety someone else's job to making it a team effort. The Team does well, the employees do well incentives were established. The Target Zero philosophy has been articulated from the Board of Directors to the end of the organization chart and back. OID's Board commitment is shown through their support of safety BBQ's, safety incentive pay, purchase of modern equipment, etc. all geared to providing a safer work environment.

The OID Board, Management and Staff all take pride in their safety accomplishments. The implemented safety programs, the change in safety culture, the proactive response to addressing hazards in the workplace and a Safety Counsel made up of employees dedicated to worker safety were all contributing factors to this effort.

METRIC 3 — HEAVY EQUIPMENT UTILIZATION

Setting the Utilization Parameters

Equipment management and its utilization in the workplace can be a large cost item in an irrigation district's budget. With knowledge of your workforce and equipment capabilities, simple metrics can be put together that can improve equipment utilization through better planning and scheduling. The key is in setting the bar from which to measure these parameters.

The total time available to operate heavy equipment is a simple function of the number of operators within your organization. Most managers know that there are 2,080 hours in a work year for hourly paid employees. Hourly employees generally get a 30-minute unpaid lunch, which does not count against the 8-hour work day, and two 15-minute breaks that do count against the 8-hour day. Assuming 45 minutes lost to the morning line-up, driving to the job site, equipment check and warm-up and safety walk around, and another 45 minutes at the end of the day to the drive back to the yard in the afternoon and filling out the time card, the productive 8 hour work day is down to a potential of 6-hours of productive equipment time (restroom breaks are included in these times). That's a 25% inherent efficiency loss for a workday.

Caterpillar, in their Performance Handbooks, rates their equipment productivity based on a 52 minute hour of operator output on a machine. That is 15% inefficiency and likely includes the work day starting when the operator gets to the job site, as is typical for union laborers. With that said, the best one could expect on equipment utilization is around 75-85%.

Measuring Performance

Performance measurement is simple. Each piece of heavy equipment has an hour meter on the engine. For the meter to register the engine needs to run above the idle speed. At

the end of a year period (preferred period of measurement), the organization totals up the number of equipment hours on all heavy equipment and compares that to the number of hours of operator time made available during the same year.

OID Example

OID did this in 2002 to get a handle on its equipment utilization. At the time OID had 6 full time operators generating an available work hour pool of 12,480 hours (6 workers X 2,080 hours/work year). At the end of 2002 OID's equipment utilization for all equipment operated by its heavy equipment operators totaled 4,266 hours. With those numbers the utilization rate for OID's heavy equipment was 34% (4,266/12,480). If 75% utilization was the best one could expect, the 34% represented a significant deficiency.

Upon evaluation, the two culprits in the low utilization numbers were unexpressed expectations of performance to employees and poor scheduling by supervisors. Both these parameters were addressed in the subsequent two years and the results and progress are shown in Table 2.

Once employees found out management cared about equipment hours and were looking at hours as a measure of performance, performance improved. Once supervisors realized that coordinating the scheduling of jobs by areas as opposed to date received helped tremendously in reducing the travel time of equipment from job to job, resulting in more operating hours for the equipment. Once both these groups realized that if they coordinated better amongst themselves, both could show betterment.

Equipment Production

All heavy equipment has been rated for productivity by their manufacturer. Productivity units are generally expressed in cubic yards per hour. Measuring equipment (i.e. operator) productivity is an intermittent management process necessary to insure both equipment and operators are being productive.

Ditch cleaning using an excavator or backhoe to pull out sediment and stack it on the adjacent canal or drain banks is a very common irrigation district maintenance operation. Where good lengths of the system are scheduled for cleaning, tracking equipment move-in and move-out dates, length of excavation and spoil generated are all measurable units to arrive at cubic yards produced over time (cubic yards per hour). Comparing that

Table 2. Heavy Equipment Usage Improvements 2002-2004

Equip #	Year	Description	Purchase Date	OID Age (Yrs)	Begin (Hrs)	Hours 1/1/02	Hours 1/1/03	Hours 1/1/04	Hours 1/1/05	Avg. Use Pre-2002	Use 2002	Use 2003	Use 2004
873	2000	Skid Steer Loader	May-00	5.1	15	254	389	541	650	121	135	152	109
331X	1999	Mini- Excavator	Oct-99	5.7	4	988	1390	1792	2057	366	402	402	265
C 12G	1986	Motor Grader	Nov-86	18.7	3	4694	5067	5754	6239	299	373	687	485
C 215	1986	Excavator	Oct-86	18.8	4	8239	8959	9865	Sold	521	720	906	Sold
SK 250	2001	Excavator	Jun-01	4.0	5	500	1354	2036	2535	500	854	682	499
C420D	2001	Loader- Backhoe	Jun-01	4.0	2	403	1152	1750	2197	403	749	598	447
C 426	1985	Loader- Backhoe	Jul-86	19.1	3	6506	6797	6941	Sold	404	291	144	Sold
C 613B	1979	Self-Load Scraper	Feb-96	8.3	Mtr. Chg.	1112	1163	1501	1666	210	51	338	165
C 920	1979	Loader	Jan-79	26.5	2	1853	1962	2053	2086	79	109	91	33
C 950B	1986	Loader	Nov-86	18.7	3	4201	4673	4850	5176	268	472	177	326
C D5B	1984	Dozer- Rippers	Mar-84	24.3	3	5750	5928	Sold	0	270	178	Sold	0
C D5H	1986	Dozer-Winch	Nov-86	18.7	2	5211	5492	5810	5963	332	281	318	153
C D6H	1986	Dozer- Rippers	Dec-97	7.6	1,191	2220	2679	2997	3518	483	459	318	521

OID Equipment Hours	4,255	5,074	4,813	3,003
Rental Equipment Hours	0	0	1,417	3,833
Total Annual Hours of Usage	4,255	5,074	6,230	6,836
Percent Increase in Equip Utilization		19%	46%	60%

calculated number to the equipment productivity rates in the owner's manual will determine if one is getting the most out of the machine and the operator.

After a month or so, and the spoil dries down, the follow-up operation is to bring a dozer in to knock down the spoil and reconstruct the road by back-dragging. From the canal/drain cleaning operation done by the excavator, the cubic yards sitting on the ditch bank are known; hence the same review of dozer productivity can be repeated.

METRIC 4 —MEASURING MATERIAL CONSUMPTION

Measuring Material Consumption

OID has a stores warehouse (Stores) whereby consumable goods such as, cement, nails, lumber, nuts and bolts, pipe, gates, etc. are inventoried in and out of stock for work to be done at the district. At OID work crews receive "job set-up forms" detailing their work assignment(s) for the day(s); they check out that material necessary for the job from Stores; and do the job.

It is that consumable inventory which moves into and out of the Stores that is a metric indicator of work done. It is also a measure of the productivity of work crews, supervisor scheduling abilities and even morale. For OID this change has been dramatic. Table 3 shows the change in Stores inventory over recent time.

Table 3. Inventory Through and In Stores Warehouse

Year	Inventory Through Stores	Inventory In Stores (yr. end)
1999	$85,434	$59,678
2000	$67,097	$64,541
2001	$70,828	$70,697
2002	$119,098	$96,991
2003	$153,332	$120,345
2004	$104,824	$121,501
2005	$354,790	$398,088
2006	$993,535	$407,328
2007	$196,050	$271,414
2008	$234,563	$272,258

Throughout the period 1999-2008 the number of personnel assigned to do work has remained relatively unchanged. OID maintains a year-round 10-person workforce for construction and maintenance work. After water season OID moves all 23 Distribution System Operators (ditchtenders) to the Construction and Maintenance Section (C&M) for

winter assignment. On a weighted basis, the available workforce to do C&M activities on an annual basis is about 20 workers.

Analyzing the Change

Table 3 illustrates the changes in Stores inventory beginning in 2002 and continuing through 2008. The substantial changes in 2005 and 2006 were due to two factors. Pipe replacement projects driven by failing infrastructure being one factor and a pipe shortage brought on by Hurricane Katrina being the other. This combination of events drove OID to stockpile pipe in its Stores for later use. However, 2007 and 2008 are indicative of a current leveling off of consumed inventory.

Consumed inventory goes to two areas, construction projects and maintenance projects. Generally construction projects have a higher materials/transportation cost to labor cost for a given job. Maintenance work is generally the opposite, little cost towards materials/transportation and high labor costs. OID's next metric will be in determining and arriving at the unit cost of projects, both construction and maintenance, to further look for advantages.

SUMMARY

This paper discussed some of the operational metrics established at OID to measure both the efficiency and productivity of work. As can be seen by some of the examples; not all changes to improve work output results in lower costs. Higher equipment utilization increases fuel consumption. Higher worker productivity increases both materials consumption and transportation costs, and some of these costs can be substantial.

Change at OID is attributable to numerous factors; a change in management and management expectations; placement of key personnel in charge of day-to-day activities who know how to schedule jobs, equipment, and labor to get work done; supervisors who challenge their employees and most importantly, employees who stepped up to the challenge, address these changes and become partners in advancing the needs of an irrigation district.

Whether you are a district with money or not; the establishment of business metrics is important. Organizations, regardless of financial position, should be managed to attain the highest productivity and utilization of their available assets, whether they be financial assets, equipment, labor or resource assets. Irrigation district management needs to develop forward thinking strategies to meet the challenges and changes of our business if sustainability is the goal for our organizations.