UNDERSTANDING COST ANALYSIS

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There are a variety of different costs that public works programs incur and it is important for a Public Works Director or Project Manager to understand how cost analysis can help in determining the feasibility of a new or enhanced recycling program. The following paragraphs highlight some of the major cost categories and how they impact a specific cost analysis for a program.

Table 1. Types of Costs

Category	Examples in Agency Budgets
Fixed	Salaried employees Rent Depreciation expense
Variable	Hourly employees Benefits Utilities Fuel Maintenance Landfill tipping charges
Overhead	Human resources, legal, payroll, purchasing and similar administrative costs for organization Internal phone and mail system Security Management information system Billing services Copier lease Technology and equipment
Capital	Debt service for loans and bonds Lease payments Capital improvements

Direct and Indirect Costs

In the world of cost analysis, if a cost can be directly linked to a particular recycling service provided by a community or agency, then is usually considered a "direct cost". These are usually classified into major categories such as labor, equipment, and materials.

To illustrate, a recycling center or composting site will have hourly employees to operate these facilities, will require utilities such as electricity and fuel, will incur routine maintenance costs and possible facility and equipment rental, and will have public information materials to educate the public about the facility's operations. Further, the typical benefits paid to the employees are

also considered a direct cost because they can be tied "directly" to the employees working at the facility.

However, salaried employees are treated differently. For example, if the Public Works Director splits his or her time among various operations of the department. Let's say there are four different areas that time are spent. If the Director spends approximately 25 percent of his total time between recycling, landfill, collection, and code enforcement, then 25 percent of his salary would be allocated as a direct cost to the each respective program.

"Indirect costs" are those costs which cannot be easily linked to the particular new program or service. Typically, these are costs where it is usually or too time consuming for the analyst to link to the new service. Figure 1 provides some typical indirect costs, which can be found in most municipal budgets.

Fixed or Variable Costs

Fixed costs are those which remain constant regardless of the level of service. For example, salaried employees are typically not eligible for overtime pay in most municipal and private agencies. Consequently, their pay does not increase even if they work additional hours in a week on a project, or if recycling tonnages increase dramatically. Rental of a space or piece of equipment is also a fixed cost – at least during the term of the lease agreement. Similarly, the depreciation expense for equipment or vehicles does not usually vary as the level of recycling increases.

In comparison, variable costs change as the volume or activity level increases. Fuel for machinery or vehicles is a good example. As operations ramp-up, hourly employees may need to work longer shifts or be paid overtime, both of which represent a variable cost. Maintenance of machinery and equipment is also a significant variable cost that should be accounted for.

Marginal Costs or Savings

Marginal costs are an important concept in evaluating the cost-benefit of making a change in any public works program. Figure 1 illustrates a marginal cost evaluation conducted for a community that was considering a change from manual to automated collection of solid waste. In this case, a number of fixed costs were assumed not to change such as salaried and municipal overhead services. However, variable costs are assumed to change such as fuel, the time it is expected to drive between stops, and the number of potential insurance claims due to worker injuries with the move to automated vehicle collection. Based on this model, the marginal monthly homeowner savings with a change from manual to automated collection was projected to be $2.37, a significant savings.

	Number	Unit Cost	Subtotal	Annual	2008 Budget	Variance			
Labor									
ASL Drivers (III)	9.0	$ 47,706.66		$ 429,360					
REL Yard Waste Drivers (II)	4.0	$ 45,435.98		$ 181,744					
Residential Grapple Drivers (III)	6.0	$ 47,706.66		$ 286,240					
Swing Drivers (III)	3.0	$ 47,706.66		$ 143,120					
REL YW Crew (Collector)	8.0	$ 36,485.33		$ 291,883					
Swing Crew	2.0	$ 36,485.33		$ 72,971					
Subtotal	32.0			**$ 1,405,317**	2,539,943	(1,134,626)			
Equipment									
ASL Vehicles (front line)	9.0	$ 239,000.00	$ 2,151,000	$ 430,200					
ASL Vehicles (spares)	3.0	$ 239,000.00	$ 717,000	$ 143,400					
REL YW Vehicles (front line)	4.0	$ 197,146.00	$ 788,584	$ 112,655					
REL YW Vehicles (spares)	2.0	$ 197,146.00	$ 394,292	$ 56,327					
Grapple Vehicles	7.0	$ 106,349.00	$ 744,443	$ 106,349					
ASL Containers	43000	$ 45.00	$ 1,935,000	$ 193,500					
ASL Containers (spares)	2150	$ 45.00	$ 96,750	$ 13,821					
Subtotal			$ 6,827,069	**$ 1,056,253**	459,548	596,705			
Operating Costs									
Maintenance									
ASL	12.0	$ 2,744.80	$ 32,938	$ 395,251					
REL	6.0	$ 1,700.75	$ 10,205	$ 122,454					
Grapple	7.0	$ 1,220.00	$ 8,540	$ 102,480					
Subtotal				**$ 620,185**	654,622	(34,437)			
Fuel	25.0	$ 1,700.10	$ 42,503	**$ 510,031**	530,432	(20,401)			
Disposal	54519.00	$ 29.33	$ 1,599,042	**$ 1,599,042**	1,573,146	25,896			
Administration Allocations									
Residential				$ 1,426,204					
Grapple / Appliance				$ 253,421					
Administration allocation adjustment as provided by City				$ 167,553					
Potential Reduction in Self-Insurance Fund			-30%	$ (97,394)					
Subtotal				**$ 1,749,784**	2403783.44	(653,999)			
							current		
Total				**$ 6,940,612**	**$ 8,161,474**	**$ (1,220,862)**	$ 15.75	$ 2.30	$ 1,186,388
	Fully Loaded Administrative Costs (FY2009)			$ -					
Cost Per Household							Potential Savings		
Annual				$ 161.41	$ 189.80		savings	monthly	annual
Estimated Monthly Cost per Household:				$ 13.45	$ 15.82		$ (2.37)	$ (101,739)	$ (1,220,862)

Figure 1. Example of Marginal Cost Analysis Comparing Collection Program Changes

Time Value of Money

The economic concept of the time value of money is an important one to grasp because it allows the recycling coordinator or analyst to compare the feasibility of different solid waste program alternatives. Driven by interest and inflation, it boils down to one simple rule: a dollar invested tomorrow is worth less than a dollar received today.

To illustrate this concept, let's look at a typical example for a recycling project. If the income stream today from a MRF project is $500,000 a year, the agency could earn some interest on this cash income. At five percent interest, this cash income would earn about $25,000 a year or approximately $70 a day. So, at a five percent interest rate, the opportunity cost of receiving your $500,000 tomorrow rather than today is $70. The more the interest rate increases, the more the agency gains by deciding to take the cash flow today.

The time value of money concept plays out in many purchasing decisions such as making an investment such as purchasing new vehicles, baling equipment, a tub grinder, or public informational materials. Typically, the upfront investment for these expenditures are paid in today's dollars while the cash flows from the potential savings are paid in future dollars, which are worth less than today's dollars because of the time value of money.

Capital and Operating Costs

Capital costs are the big ticket expenditures for a public works program. These include such items as vehicles, equipment, and buildings, which have an expected life span of several years. In typical cash accounting systems, these expenditures will be recorded as the full expense for the first year and zero dollars for the remaining life of the item. Under accrual or full cost accounting, depreciation comes into play, which is a method of allocating these purchase costs over the useful life of the asset. Depreciation takes into account consideration of three different variables such as the initial purchase price of the asset, its expected useful life, and an estimated salvage value at the end of its life. There are several different depreciation methods dependent on potential tax code implications. However, the simplest is straight line depreciation which follows the following formula:

$$Depreciation = \frac{Cost - Salvage\ Value}{Life\ in\ Number\ of\ Periods}$$

In comparison, operating costs are the normal reoccurring costs that are used or consumed over a short period of time, typically less than one year. These include such budget items as wages and benefits, rent and lease payments, fuel, maintenance costs, and interest or debt service payments.

DETERMINING ECONOMIC FEASIBILITY

All of the economic concepts discussed in the paragraphs above can be used by the Public Works Director or Project Manager to help determine the economic feasibility of a particular recycling project. Most analysts utilize individual spreadsheets or linked spreadsheets to automate the feasibility process. These are briefly described using a few examples from the authors' consulting experience.

Simple Mathematical Analysis

Financial and economic analysis for project feasibility encompasses a range of tools from simple mathematical calculations to those using computer applications. These will be briefly discussed with a number of specific illustrations.

Breakeven Analysis

Breakeven analysis is defined as the point in a solid waste or recycling project when its total cost equals the money saved in such things as waste collection, transportation, and ultimate disposal costs. That is, the point in the project when there is zero loss. The usual formula for calculating the breakeven point is as follows:

$$Breakeven\ Level = \frac{Fixed\ Costs}{Revenue\ Per\ Item - Cost\ Per\ Item}$$

Typically, most recycling programs are designed to produce savings from solid waste disposal by diverting recyclables from the community's waste disposal containers. For example, consider the situation where a community implements a curbside recyclables collection program. Its collection contract with a private waste hauler is $1,000,000 per year. The materials collected go

to a regional MRF facility with a tipping fee of $50 a ton. This figure includes all disposal costs of the residue. The community receives an average revenue of $5 per ton. The cost to haul and process the materials is $10 per ton. The breakeven level for the community can be calculated as follows:

$$Breakeven\ Level = \frac{\$1{,}000{,}000}{\$50 + \$5 - \$10} = \frac{\$1{,}000{,}000}{\$45000} = 22{,}222\ tons$$

In this specific case, the recycling program will reduce the cost of the community's solid waste disposal if more than 22,222 tons are collected.

Payback Period

While breakeven analysis takes into account the number of units that must be recovered to return an investment, the payback period tells how soon this investment will be paid back. This is extremely important where there is a significant capital investment for a project and the cash flow revenue stream is extended over a long period of time.

There are numerous examples in recycling that utilize this concept. For example, a regional mall, which generates a significant amount of food waste, decides to evaluate the feasibility of installing a food waste composting unit. Their current cost of contracting with a private waste hauler is $3,400 a month in hauling and disposal charges. The monthly cost of the composting unit is quoted by the manufacturer at $2,100 with maintenance (wood chips and microorganism solution), electrical, and additional water use is $140. The payback period is less than two months.

$$Payback\ Period = \frac{Current\ Expense\ \ Per\ Period}{Alternative\ Expense\ Rate} = \frac{\$3{,}400}{\left(\frac{\$2{,}100}{mo} + \frac{\$140}{mo}\right)} = \frac{\$3{,}400}{\frac{\$2{,}240}{mo}} = 1.5\ mo$$

SUMMARY

Municipalities considering implementing a recycling program need not fear "wading into the waters." A wide variety of tools, from simple formulas to extended pro-forma models are at your disposal to help you make an informed and financially conservative decision. If your program can first form a solid assessment of revenues, interest rates, and fixed costs, variable costs, overhead costs, and capital costs, all framed in the overarching understanding of the *time value of money*, then the decision simply boils down to the numbers.

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