Total cost of ownership as a tool for inter-firm cost management: a case in the Belgian utilities industry

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Abstract

In today's environment, communicating what your products and services are worth to customers' business has never been more important. Customers increasingly look at purchasing as a way to increase profits and to reduce costs. To persuade customers to focus on the total costs rather than simply on acquisition price, a supplier must have an accurate understanding of what his customers value. In this case study, we demonstrate how a utility supplier performed a Total Cost of Ownership analysis for one of his customers. The case study offers insights in how an inter-firm Total Cost of Ownership analysis can be beneficial to the buyer as well as to the supplier by optimising and better coordinating the performance of operations across the value chain and by facilitating further initiatives to intensify the buyer-supplier relationship.

Introduction

Utility providers nowadays face a new and rapidly evolving environment which forces them to adopt new processes, relationships, information systems and people. Deregulation forces them to reassess their market and industry definition, as well as their perception of future skill and organizational requirements to compete. Ultimately, they will have to turn into globally competing multi-service firms. In particular, their relationship with customers has changed dramatically, no longer being the sole utility provider, and exposed to competitive market forces.

To survive, utility providers seek new ways to reach their customers. Therefore, utility companies have started questioning their traditional ways of providing services and the types of services they should be providing. Utility companies understand that key success elements in this competitive market are: a better understanding of the customers' needs and a better communication about their customer-value towards the customer. This will ultimately result in better business decisions, yielding improved processes, reducing the total costs.

To obtain these objectives, a more advanced and accurate management accounting information methodology is needed. Such a modern and more accurate approach is the Total Cost of Ownership (TCO) approach. The concept is often based on activity-based costing, which identifies specific cost drivers and allocates costs based on details on the facility's equipment, operation and product mix. In this case study, the Total Cost of Ownership methodology is applied to allocate utility costs in a manufacturing environment.

Inter-firm Cost Management and the use of TCO

Utility providers traditionally have large and small customers. Each customer group requires a different approach. Typical large customers are industrial sites of large enterprises. Because of the high volumes they purchase, special attention needs to be given to them. Traditionally, this special attention took the form of volume rebates.

In today's environment, communicating what your products and services are worth to customers' business has never been more important. Customers increasingly look at purchasing as a way to increase profits and to reduce costs and therefore prices. To persuade customers to focus on the total costs rather than simply on acquisition price, a supplier must have an accurate understanding of what his customers value. Many customers understand their own requirements but do not necessarily know what fulfilling those requirements is worth to them. To suppliers, this lack of understanding is an opportunity to demonstrate the value of what they provide and to help customers make smarter purchasing decisions. A small but growing number of suppliers draws on its knowledge of what customers value, to gain marketplace advantages over their less knowledgeable competitors[3].

As traditional management accounting practices are based on the internally oriented concept of value added, which hinders firms in taking advantage of the opportunities to coordinate interdependence in the value chain, other management accounting practices are needed. It has been argued that a fundamental problem of the value added concept is that it "starts too late and it stops too soon"[4]. By starting cost analysis at the point of purchase, possibilities to exploit linkages with suppliers are missed, and by stopping the cost analysis already at a completed sale, possibilities to exploit linkages with customers are missed. The value added perspective focuses on (maximizing) the difference between the firms purchasing price and selling price. Thereby it ignores linkages in the wider value chain, such as the causes of this purchasing price, the costs of activities related to the product, and the consequences of the product for the buyer's activities.

Accounting systems that also account for costs that are caused by buying from a certain supplier, such as costs of ordering, delivery, quality and administration, are called Total Cost of Ownership (TCO) systems[5]. The TCO concept attempts to quantify all of the costs related to the purchase of a given quantity of products or services from a given supplier[6]. Price, but also other costs generated by the supplier in the purchasing company’s value chain, are factors in the analysis. The idea of TCO determined on the grounds of activity-based costing can be summarized as following: determine all the activities related to external purchasing, secondly define factors which raise the cost of a given activity and thirdly identify which activities are caused by each individual supplier.

A clear understanding of the TCO is beneficial in many purchasing situations. Traditionally, the advantages of TCO have been regarded from the viewpoint of the buyer: TCO provides decision makers with an objective and easily understood argument for supporting and motivating a variety of purchasing decisions[7]. However, the cost and cost driver information resulting from the analysis can also be used to optimize and better coordinate the performance of activities across the supply chain. Cost driver analysis should not be limited to the activities carried out within the firm, but should also incorporate linkages with suppliers and customers. Cooperation along the value chain usually takes the form of sharing data, knowledge and decision. In the case study, a utility supplier performs a Total Cost of Ownership analysis for one of his customers, a large industrial site. Their common objective is to reduce costs across the supply chain. Suppliers can not only use the TCO information to inform and guide their own decision making, but also leverage this information as persuasive sales tools. They can document the cost savings that a customer receives from a supplier's market offering. TCO analyses can also become a service that suppliers offer as part of their consultative selling approach. In the remainder of this article, we will demonstrate how TCO information can be used as an inter-firm cost management tool resulting in benefits for the buyer as well as the supplier.

The ENERGY/CLIENT case

ENERGY (fictive name) is a major utility supplier, which up till recently operated in a monopolistic market. Because of deregulations in the utility sector, customers are intensely focused on their acquisition price, expecting it to drop substantially. ENERGY realized that in order to maintain its strong position in the market, the company would have to help its customers to understand the total cost of its services.

Therefore ENERGY decided to carry out a supplier-driven TCO analysis: ENERGY applied a TCO approach at CLIENT (fictive name) to identify all costs related to the procurement and utilization of utilities at a major site of CLIENT. CLIENT is a multinational that possesses different large industrial sites worldwide, which all consume large volumes of different types of energy on a daily basis. The TCO was calculated for one of the large industrial sites of this buyer. The so-called cost objects at CLIENT are the utility services. Purchased utilities are stored, transported, bundled, burnt to form secondary forms of energies and distributed to the end-user, where these different forms of energy are consumed. All these activities take place on the industrial site at CLIENT, causing different costs. To the end-user these forms of energy are utility services. In the analysis, the energies coming in are costs, and the utility services delivered to the end-users are cost objects.

Guideline for a TCO analysis in utilities

Exhibit 1 briefly summarizes the necessary steps when attempting to calculate and analyze the TCO of utility services. These four steps are used as a framework for analyzing and reporting the ENERGY/CLIENT case study.

Develop a cost/energy flow diagram
→ To determine:
- type of costs to include
- the utility services of interest (cost objects)
- the utility flow

Gather data
→ Engineering data on the processes resulting in an energy balance
→ Cost data on the cost types

Allocate the cost to the cost objects
→ Using the flow diagram, the energy balance and the cost data

Interpret the results
→ Carry out scenario analyses
→ Take joint buyer-supplier initiatives

Exhibit 1: a guideline for the calculation and analysis of the TCO of utility services

Step 1: Develop a cost/energy flow diagram

First, decisions need to be made on which costs to include in the analysis. At CLIENT, three major types of costs are identified: energy costs, maintenance costs and depreciation costs. The energy costs are costs of electricity, natural gas, water, nitrogen and chemicals supplied/purchased. Maintenance costs include wages, external services and materials. Depreciation costs of installations, machines and distribution networks are a third important cost.

Secondly, the relevant cost objects need to be identified. These are all the utility services that are consumed by an internal end-user. The cost objects in the ENERGY/CLIENT case study are heating water, cooling water, town water, softened water, electricity, nitrogen and natural gas. These seven cost objects are shown in Exhibit 2.

Finally, the utility flow needs to be analysed. At CLIENT, energy costs enter the site and pass through a distribution network towards storage buildings, boilers or other installations. Maintenance activities are performed all over the network and at all installations. Exhibit 2 shows the cost/energy flow diagram for CLIENT. In this diagram nine different operations can be distinguished. On the left hand side, the different energy costs are listed. The other two cost types, maintenance and depreciation costs, are shown at the bottom of the diagram. They appear in every operation, since every operation requires maintenance and since every operation is performed in a building or using machinery. Exhibit 3 briefly explains the operations taking place at the CLIENT site.

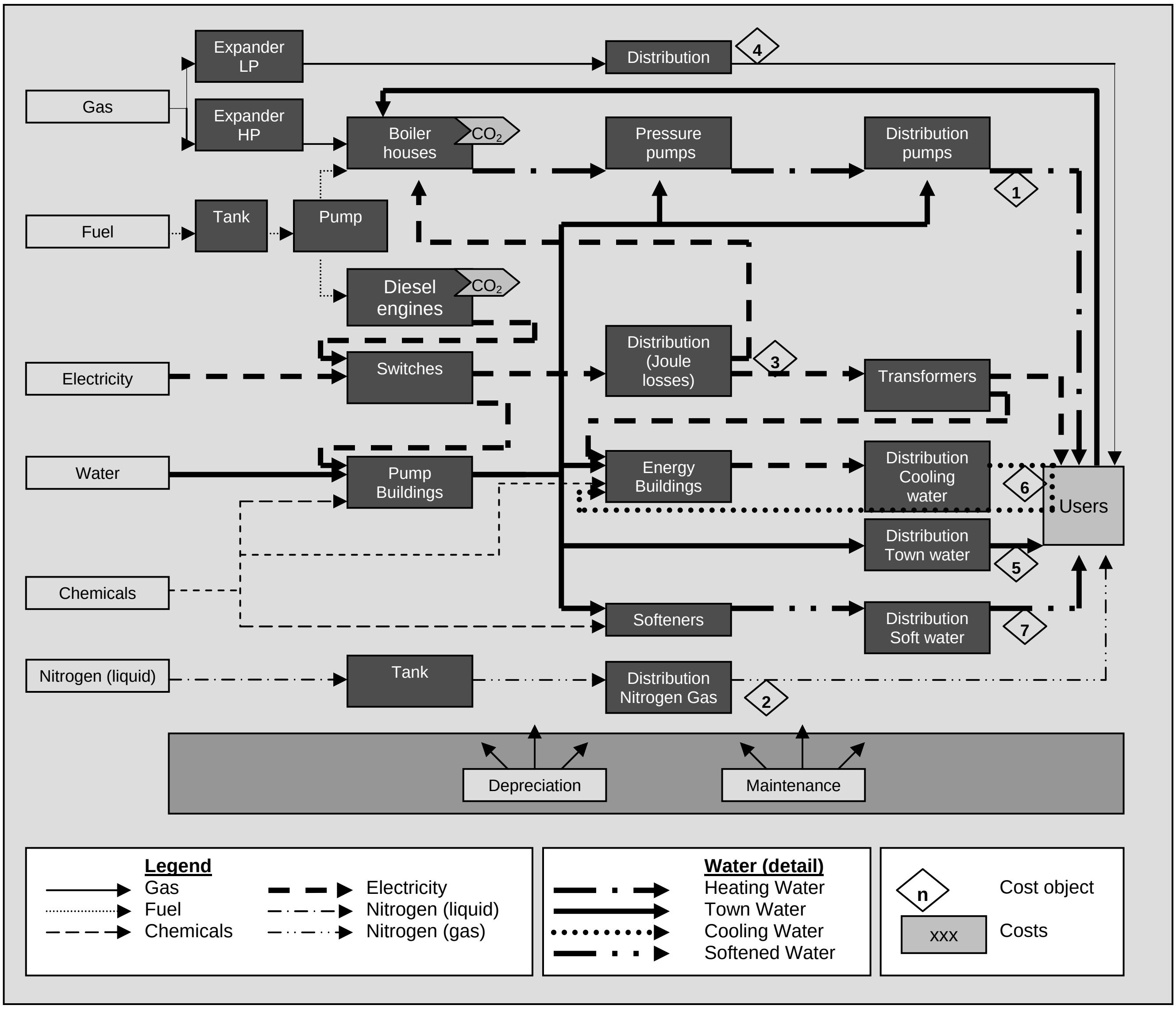

Exhibit 2: the cost/energy flow diagram at CLIENT

Operations overview:

Operation 1: Boiler houses. In the boilers, gas and/or fuel are burnt to heat water. The heated water stays in a closed circuit, consumers only use the heat carried by the water. The pressure pumps keep the water under the correct pressure and the distribution pumps push the heated water through the distribution network. Town water is needed to cool the pressure pumps and the distribution pumps. The resulting cost object is heated water, after distribution, but before entering the user's building (1).

Operation 2: Nitrogen installations. Liquid nitrogen is supplied and transformed in a tank to nitrogen gas and delivered to the users through the distribution network. The associated cost object is nitrogen after the distribution activity (2).

Operation 3: Electricity installation. Electricity is supplied by the external supplier ENERGY or by the internal Diesel engines. The electricity is distributed via a dispatch installation system. In the electricity wires, Joule-losses occur. As these losses are important, they need to be taken into account. The cost object is electricity before the transformers (3).

Operation 4: Fuel installation. There are two users of fuel: the Diesel engines and the boiler houses. Fuel is stored in huge tanks on site at CLIENT and distributed through fuel pumps. As fuel is completely used by the engines and the boilers, it has no real end-user; hence it was decided not to label it as a cost object.

Operation 5: Gas installations. Natural gas (medium pressure) is delivered through pipelines. Two expanders are needed to lower the pressure. The HP-expander lowers the pressure so that it can enter the boiler houses. The resulting cost object is gas arriving at the boiler houses. In the LP-expander, the pressure is reduced to feed the distribution network. The cost object is gas arriving at another building after distribution (4).

Operation 6: Diesel engines. The Diesel engines produce electricity. The Diesel engines serve two purposes. Their main purpose is 'peak-shaving', since CLIENT has to pay a fixed maximum capacity cost to the electricity supplier, it has every interest in topping off the monthly peak consumption. This way, the supplier's capacity requirements are moderated, and the fixed cost is lower. A second purpose is a secured power supply.

Operation 7: Town water installations. After adding chemicals in the pump buildings, town water is distributed to all users. The distribution cost accounts for a major part in the total cost. The cost object is town water after distribution (5).

Operation 8: Cooling water installations. The cooling water circuit is a closed circuit. The cooling water is produced in the "energy buildings". Town water, electricity and chemicals are needed in the cooling water installations. The cost object is cooling water that enters a consumer's building (6).

Operation 9: Softened water installation. Softened water uses town water and chemicals (NaCl). The cost object is softened water after distribution (7).

Exhibit 3: the different utility-operations at CLIENT

Step 2: Gathering data

Once the utility flow is developed, the next step is to label these flows with volumes. This step can be very time-consuming as large amounts of data need to be gathered: not only consumption figures, but also all cost data. The result of Step 2 consists of an energy balance on the one hand, and an overview of the costs and their amount on the other hand. These data will be the input for the allocation step.

The energy balance

Exhibit 4 depicts the energy balance at CLIENT. An energy balance outlines the utility flows. To perform a proper allocation of the costs to the different cost objects in Step 3, a clear picture of each utility flow is needed. This means that we need to know which utilities are entering the site and where these utilities are consumed. The sums of the arrows going in and out an operation have to be identical, e.g. for the “switches”:

1 535 937 kWh + 121 578 433 kWh = 1 230 726 kWh + 117 701 061 kWh

+ 2 705 211 kWh + 1 477 372 (Joule losses)

In the boiler houses and the Diesel engines, transformations occur, implying the outputted utility has a different form than the inputted utilities. As a consequence, the measuring unit of the inputted and outputted utilities will differ.

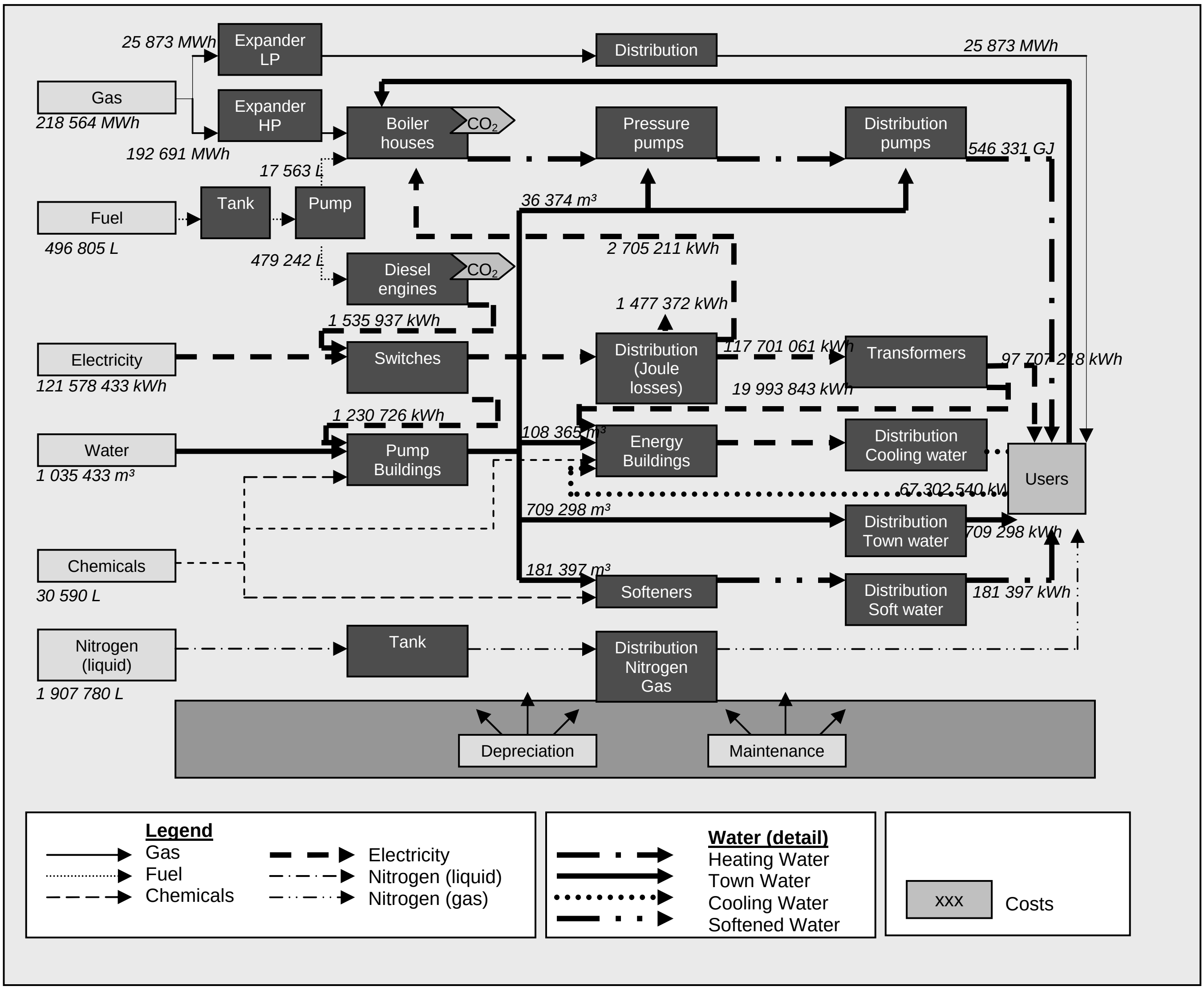

Exhibit 4: the energy balance at CLIENT

The costs

The *energy expenses* were based on the suppliers' invoices. Maintenance lists were analyzed to calculate the *maintenance costs*. These lists contain information on (1) the type of maintenance, (2) the location of the maintenance, and (3) the wages. *Depreciation expenses* were calculated based on the useful lifetime on the investments.

Step 3: Allocate the costs to cost objects

Once all data are gathered, the next step is to allocate the costs to the cost objects defined in Step 1. This allocation procedure is facilitated by the work performed in Step 1 and Step 2. The *energy costs* are allocated directly through the energy balance. The allocation of the maintenance and depreciation costs follows a stepwise procedure. In a first stage, maintenance and depreciation costs are allocated to an operation. This step is fairly straightforward at CLIENT, as the *maintenance* interventions are carefully recorded and the *depreciation costs* are closely related to an operation. The costs of the distribution network are assigned to the cost objects to the extent that they use the network. In a second step the costs of the operations are assigned to the cost object to the extent that they "use" this operation. The result of Step 3 is shown in Exhibit 5.

NITROGEN			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Nitrogen	118447		
Rent tanks			23038
Distribution			47780
Other		20421	1320
Subtotal	118447	20421	72138
Total cost	**211006**		

GAS (HP)			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Gas	3265235		
Expander			5257
Piping			6061
Maintenance		2138	
Subtotals	3265235	2138	11318
Total cost	**3278691**		

GAS (LP)			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Gas	507172		
Expander			5256
Piping			100738
Maintenance		16670	
Subtotals	507172	16670	105994
Total cost	**629836**		

FUEL			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Fuel	132455		
Maintenance		174	
Tanks			33200
Pumps			996
Subtotals	132455	174	34196
Total cost	**166823**		

ELECTRICITY FROM DIESELS			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Fuel	*160925*		
Engines			28635
Building			23345
Transformers			6100
Maintenance		82854	
Subtotals	160925	82854	58080
Total cost	**301859**		

ELECTRICITY			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Electricity	6069390		
Electr.Diesel	*301859*		
Switches		182693	363331
Distribution		33779	60424
Other		11210	477717
Subtotals	6371249	227682	901472
Total cost	**7500403**		

TOWN WATER			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Town water	765087		
Electricity	*74979*		
Chemicals	2289		
Pump Buildings		157976	144875
Distribution			154579
Other		71829	250916
Subtotals	842355	229805	550370
Total cost	**1622530**		

SOFTENED WATER			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Town water	*284248*		
Chemicals	17518		
Softeners		33917	281480
Waste cost	14504		
Subtotals	316270	33917	281480
Total cost	**631667**		

COOLING WATER			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Town water	*169808*		
Electricity	*1218070*		
Chemicals	42927		
Energy Buildings		505307	945408
Other		46772	427081
Distribution			141900
Collectors			35967
Subtotals	1430805	552079	1550356
Total cost	**3533240**		

HEATING WATER			
Costs	**Energy cost**	**Maintenance**	**Depreciation**
Gas HP	*3278691*		
Fuel	*5898*		
Electricity	*164808*		
Town water	*56998*		
Chemicals	171		
Boilerhouse		167240	140336
Pres. pumps		4226	996
Distr. pumps		66622	1992
Building		461202	203214
Distribution			152720
Collectors			49800
Subtotals	3506566	699290	549058
Total cost	**4754914**		

Exhibit 5: Detailed cost descriptions

Exhibit 5 summarizes the costs for each of the seven cost objects identified in Step 1. The three types of costs (energy costs, maintenance costs and depreciation costs) considered in this TCO analysis are assigned to the different cost objects. Besides these seven cost objects, three so-called *intermediate* cost object are also included in exhibit 5: “Fuel”, “Gas HP” and “Electricity from Diesel engines”. These intermediate cost objects are not directly consumed by the end-user, but “consumed” by other cost objects. These intermediate cost objects are also included in Exhibit 5 to obtain a clearer picture of how the costs are allocated internally. If an intermediate cost object is (partially) consumed by another cost object, the costs are assigned to the latter cost object and these costs are printed in *italics*. The costs of the intermediate cost objects are assigned to the other cost objects, proportionally to the consumption of the latter. For instance, from the energy balance in Exhibit 4 we see that fuel is consumed for heating water (3.4%) and for the production of electricity in the Diesel engines (96.6%). The total cost for fuel (€ 166 823) is assigned to these two definite cost objects in the same proportion.

The results of the TCO analysis are provided in Exhibit 6. This table gives an overview of the cost per unit, the production/consumption and the total cost for each of the seven cost objects. From this overview, it becomes clear that electricity, heating water and cooling water account for the majority of the costs. Natural gas at medium pressure also represents an important cost. The TCO of utility services amounts to € 18 883 656.

Cost object	**Price per unit**		**Consumption / Production**		**Total Cost (€)**
Nitrogen	0,1106	€/L	1 907 780	L	211 066
Gas LP	0,2755	€/Nm³	2 286 753	Nm³	629 836
Electricity	0,0609	€/kWh	123 114 370	KWh	7 500 403
Town water	1,5670	€/m³	1 035 433	m³	1 622 530
Softened water	3,4822	€/m³	181 397	m³	631 667
Cooling water	0,0525	€/kWh	67 302 540	kWh	3 533 240
Heating water	8,7034	€/GJ	546 331	GJ	4 754 914
Total costs					18 883 656

Exhibit 6: Total cost per cost object

Step 4: Interpretation of the results

We argued before that a TCO analysis could serve as a basis for performing inter-firm cost management. Exhibit 7 sums up the advantages of an inter-firm cost management analysis based on TCO.

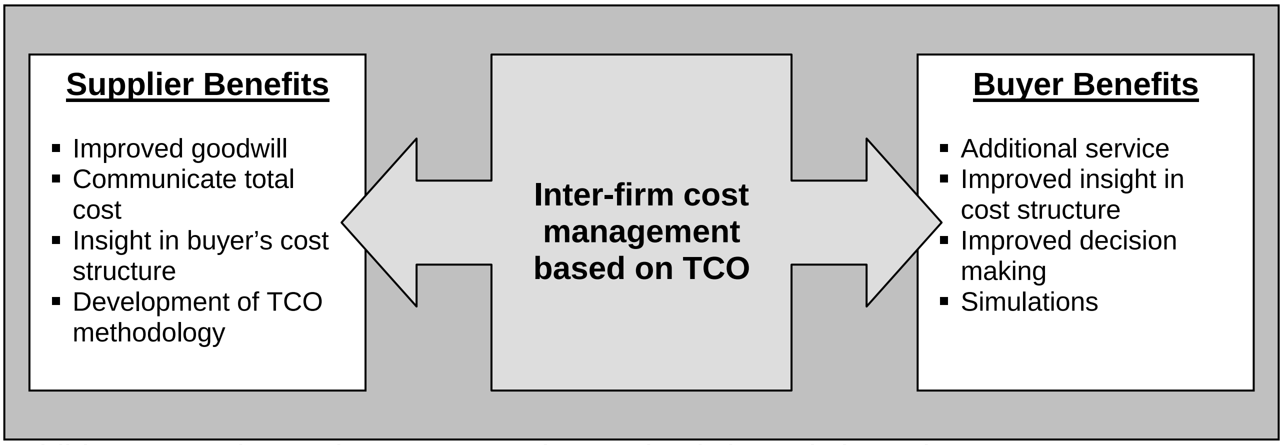

Exhibit 7: Benefits for buyer & supplier realised through inter-firm cost management based on TCO

The cost structure and cost information resulting from the analysis can be used to optimise and better coordinate the performance of operations across the value chain and facilitate further initiatives to intensify the buyer-supplier relationship. In the ENERGY/CLIENT case, the Diesel engines form a typical basis for inter-firm cooperation. Electricity generated in the Diesel engines is three times as expensive as electricity bought from the external supplier. Buyer and supplier can investigate whether cost reductions realized through peak-shaving offset the higher costs of the electricity produced through the Diesel engines. Such cooperative initiatives might trigger supplier action, resulting in reduced costs for the buyer and a competitive advantage for the supplier. From this example, it becomes clear that an inter-firm TCO exercise can yield advantages to both customer and supplier. In the following paragraphs some of the advantages for both supplier and customer in the

ENERGY/CLIENT case are summarized. These individual advantages can only be obtained through information sharing and intensive cooperation.

The supplier benefits from the analysis because offering a TCO service will positively affect goodwill towards the supplier as it provides an added value service, above normal energy-supply. Moreover, this cooperation through TCO allows the supplier to accurately communicate his value, through total cost, to the buyer. Being able to say that the use of his electricity costs 0.0609 €/kWh in total, gives the supplier major advantage compared to suppliers not being able to do this, or suppliers stressing they are cheap in price. Although the latter may be true, price still has limited information about cost or value. Insight in the customers' cost structure and cost drivers is also an important advantage for the supplier: the TCO analysis can serve as input for the supplier decision making. Another advantage of this pilot study is the development of a TCO-methodology that can serve as a benchmark at other sites of other customers.

Benefits for the customer are also obvious. For example, the TCO analysis enables the customer to compare the total unit price of electricity coming from the external supplier and the electricity generated internally by the Diesel engines. The figures clearly favour the external supplier, and may consequently influence future make-or-buy decision. A second example could be the boiler house. Heating water can be heated by burning either fuel or natural gas. Assuming that we would need the same energy by burning something, the buyer can easily calculate that the cost per kWh of warmth is 0.024€/kWh for fuel and 0.017 €/kWh for gas. Gas should be the preferred option, especially when we include CO_2 emission costs in the TCO calculation (see Exhibit 8). The repeated breakdown of the TCO of utility services until the lowest level can give indications as to where cost reductions are desirable. The extent of these reductions can be calculated through simulations. Discussion among the production site managers should indicate which reductions are technically feasible. For instance, distribution network costs are the main cost in the water network. A better site allocation of the installations could imply considerable cost reductions.

Environmental Cost Management: the cost of CO_2 emissions

When calculating the TCO of utility services, one should include all costs incurred in the process of providing them. At CLIENT, CO_2, carbon dioxide, is emitted in this process. Today, the emission of CO_2 gasses goes without punishment or some system of regulation for CLIENT, which is not to say that the emission of CO_2 has no cost. It has a cost, since it has been agreed that the emission of CO_2 damages the atmosphere and hence contributes to global warming. The emissions therefore represent a potential danger for both human and other life forms on the planet. This potential danger can be economically accounted for through the introduction of an *environmental cost*. The main challenge here lies within the determination of that cost.

A system that can go round this problem, is the system of emission rights. In this system, a free market for emission rights is created. The number of emission rights is limited by a pre-defined norm (e.g. the famous Kyoto protocol norms), and companies can only emit as much CO_2 as they are entitled to do according to the amount of emission rights they bought on the market. If the market is a free market, the price of an emission right will float and reach an optimum value. In this optimum, companies whose cost to reduce CO_2 emission exceeds the price of an emission right will buy the rights, and companies whose cost to reduce CO_2 emission does not exceed the price of an emission right will not buy them but reduce their output. Price will change when demand changes, or when technical innovations emerge.

This system is not in place yet, so estimations of the price of an emission right are all we can work with for the moment. These estimations range from € 1 to € 10 per ton CO_2 in the short term and from € 10 to € 20 in the long term. We set the price at € 11/ton, as that seems to be the most plausible figure at the moment. Since CLIENT emitted 84 939 tons of CO_2 in 2002, the TCO of utility services should be augmented by 51 168 ton * 11 €/ton = € 934 328. This is a considerable amount, which cannot be ignored.

The activity analysis carried out in this study, resulting in the flowchart of Figure 1, gives indications as to where the CO_2 gasses are emitted. This is important information for ABM decisions. Indeed, in the boiler house for instance, CO_2 is emitted when combusting fuel and gas. Incorporating the environmental cost in the TCO calculations, can change the decision on which energy to use. From Table 4, it can be seen that the cost per kWh of warmth is 0.024€/kWh for fuel and 0.017 €/kWh for gas. Since burning fuel emits 0.25kg/kWh of CO_2, and burning gas emits only 0.20kg/kWh of CO_2, CLIENT should in this case use as much natural gas as possible, regardless the price/cost of CO_2 emission.

Exhibit 8: the cost of CO_2 emissions

Conclusions

The rationale for performing this inter-firm TCO exercise at CLIENT was to be able to analyze the costs of activities in a utilities supply chain in order to reduce, to control and to better monitor costs. More specifically, by performing cost analyses for each of the utility operations it was expected that insights could be gained into the supply chain costs and interdependencies. These insights facilitate simulations, assessing the cost effects of changing supply chain activities, and ultimately improve strategic decision making in the supply chain. This initial cooperative TCO analysis lays out the tracks for further and intensified cooperation and value chain analyses.

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