Role of Integrating ABC and VCA Through The Use of Supply Chain Management in Improving Potable Water Tariff in Iraq

A case study in Al-Najaf Al-Ashraf Water Directorate

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***Abstract*— This study examines the relationship between cost management tools and pricing policies to improve the price of potable water which helps cover production costs on the one hand and rationalize the consumption of the product on the other. This is done by utilizing the Activity-Based Costing (ABC) and Value Chain Analysis (VCA) to fix cost and price of potable water at Al-Najaf Al-Ashraf Water Directorate based on information collected from documents and reports pertaining to the Directorate, as well as field visits and face-to-face interviews with a number of officials in the departments of water purification projects. The study designs the Activity-Based Costing (ABC) and integrates its output with value chain analysis to improve the tariff of potable water in Al-Najaf Al-Ashraf Water Directorate takes into account the different social and consumption level of citizens on one hand and covering the cost of the institution and reduction of consumption on the other hand. Themes and subthemes are based on definitions of cost management tools and pricing policies in government institutions are adapted and quoted from various scientific sources. The basic findings of the study highlighted that the system used by the Al-Najaf Al-Ashraf Water Directorate to fix potable water price according to the number of rooms does not give an accurate picture of actual consumption and costs for each product, as the Directorate has two products: pure water and (Reverse Osmosis RO). The total cost used to calculating and distributing production costs for both products with equal loading for both products without taking into account the cost of activities consumed in the production of each product separately, while the pricing of pure water using the value chain is consistent with consumer needs and their financial ability as they represent different segments of the society, through pricing to recover part of the costs represented by the value chain links according to segments of society.**

Keywords*— *Cost management tools, Activity Based Costing, Value Chain Analysis, pricing policies, water tariff, Supply chain management.

1. Introduction

Integration is frequently mentioned as a key characteristic of supply chain management. The government units in Iraq generally rely on allocations of the general budget to finance their activities and programs without relying on advanced cost systems to fix the costs of these activities and programs or to matching them with achieved revenues, especially government institutions such as electricity and water departments where these units are to cover the costs of their activities and services by collection fees according to the tariff that should be based on a precise cost calculation for consumption units and the tariff structure should take into account the country's economic conditions and the provision of government support to low-income groups of society or low consumers and encourage consumption rationalization.

Under the deterioration of the economic conditions in Iraq competent units to ensure better services for all segments of society, this research has been conducted to help these units to escort with developments in regard to cost reduction and fixing t, especially, concerning water scarcity, high consumption, low collection, and within the efforts of the most appropriate prices. The research was carried out through the adoption of modern cost tools to determine the cost of water purification and delivered it to citizens at appropriate prices to encourage them to pay fees and rationalize consumption, so, the both of government unit and citizen can achieve their interests.

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The application of cost accounting is difficult for the service industries due to its unique characteristics; however, the cost remains the predominant basis in the pricing of services. Therefore, the interest of many Iraqi and Arabic studies was generally devoted to applied cost management tools in the field of pricing products and achieves the competitive advantage in industrial companies[1-3]. Where studies on the application of cost management tools in the service industries were limited to service industries that have business characteristics in order to achieve a competitive advantage that enables them to remain in the market of competition such as the banking sector or the health sector [4-8], without interest in the application of cost management tools to improve pricing decisions in government service institutions that may operate in a monopolistic environment. The goal of this study is therefore to examine various aspects of integration in order to structure and define the concept of supply chain management and integration of ABC and VCA in improving potable water tariff in Iraq. Among the aims of the present study are:

1- Recognize the importance of using cost management tools in providing useful information for making pricing decisions.
2- Identify the objectives and motives of pricing decisions in government institutions.
3- Evaluating the effect of the relationship between cost management tools and pricing decisions in improving the price of potable water which can be considered as both a public product and service for the governmental institution.

In order to achieve these aims, the research was presented through the following headings:

1- The theoretical basis of research - cost management tools, pricing in government institutions.
2- Research application methodology - A case study of the role of cost management tools in improving potable water tariff.
3- Research Conclusion

2. Brand Personality The theoretical basis of research

2.1. Cost Management Tools

The development and complexity of the economic, social and technological fields draw a new picture opposite the economic institutions and introduced them into new challenges, namely cost, time, quality and innovation to reach the objectives of the institution in maintaining its position and continuing in the market and achieve future returns. Therefore, the economic institution needs precise information on costs and external environment in order to make appropriate decisions for purchasing, manufacturing, pricing and making appropriate policy accordingly.

But as [9] highlighted "the information and the accounting systems themselves do not cost management. Unfortunately, that term has no uniform definition. We use cost management to describe the approaches and activities of managers to use resources to increase value to customers and to achieve organizational goals. Cost management decisions include decisions such as whether to enter new markets, implement new organizational processes, and change product designs. Cost management has a broad focus and is not only about the reduction in costs. Cost management includes decisions to incur additional costs, for example, to improve customer satisfaction and quality and to develop new products, with the goal of enhancing revenues and profits."

Among the most prominent cost management tools dealt with by the various managerial and cost accounting literary works are the following:

2.1.1. Activity Based Costing (ABC)

The ABC approach as "a more accurate way of calculating product costs because the links between performing particular activities and the demands those activities make on the organization's resources" [10, 11]. It defines "the core activities and cost orientation of each cost allocation activity as an approach that deals with indirect industrial costs as costs incurred by activities in the enterprise and is considered an alternative to the total cost method" [12-15]

ABC is a cost reporting technique, but to make the information of this technique useful for management to make strategic plans and decisions, Activity-based management (ABM) has been initiated. ABM makes the cost information useful

to management by providing cost drivers and performance measures that support planning and decision making by providing information that helps management to make long-term strategic decisions and helps product design by analyzing the costs in different ways in the production process. ABM encouraging continuous improvement by allowing managers to consider the strategic impact of activities and to plan the incentives which would encourage operational teams to achieve the desired strategy [16]. (ABM) is the management of resources and activities to improve the value of products or services to customers, and by adopting the ABC information as a primary source it can increase the profitability and competitiveness of the company [17].

2.1.2. Target Cost (TC)

‘‘Is the estimated long-term cost of a product (or service) that, when sold at the target price, enables the company to achieve the target operating profit, i.e., the target cost is equal to the target price minus target operating profit” [18-20]

The target costing is usually a top-down approach conducted during a new product planning. It starts with the long-term price required to achieve the desired market share. From this price, the required return on investment (profit) is subtracted to derive a total target product cost; reverse the traditional approach for deriving standard costs is a bottom-up technique [21, 22]

2.1.3. Kaizen Costing (KC)

Kaizen is the Japanese term for making improvements to a process in small, incremental amounts rather than through large innovations. Kaizen is an incremental approach that tries appropriately since the products already exist in the manufacturing process, to minimize continuously and gradually the unnecessary steps in the production activities over successive time periods to achieve savings that contribute to cost reduction. The goal is to ensure that the product meets or exceeds customer requirements for quality and prices [23]. The KC system has been focusing on reducing costs during the manufacturing process through improvements to the production process gradually and continuously to reduce costs as it is difficult to achieve significant improvements in production as well as to ensure that the requirements of customers are met in terms of quality and price [24].

2.1.4. Just In Time (JIT)

(JIT) is “a system to control the material to arrive the production process exactly when it is needed” [25]. In a JIT plant, production and demand are synchronized as a result of production doesn't begin until an order is received. Products are pulled through the factory by client orders, rather than pushed through a master production schedule designed to keep the plant operating at full capacity. The goal of a JIT plant manager is to scale back the time the product spends within the plant. There aren't any intermediate work-in-process inventories and create it zero [26].

2.1.5. Value Chain Analysis (VCA)

Each link in the value chain represents a particular activity. All of the activities will lead to a cost. Ideally, each link should add value to the product, making the product more valuable to the customer. Any links in the chain that fail to add value should be examined very critically. The purpose of this examination is to assess whether the particular link could be eliminated completely or, at least, have its cost reduction [27].

The VCA tool enables the organization to identify current and potential competitive advantages by examining opportunities that add value and highlight areas where costs can be reduced [28]. Figure 1 shows value chain links:

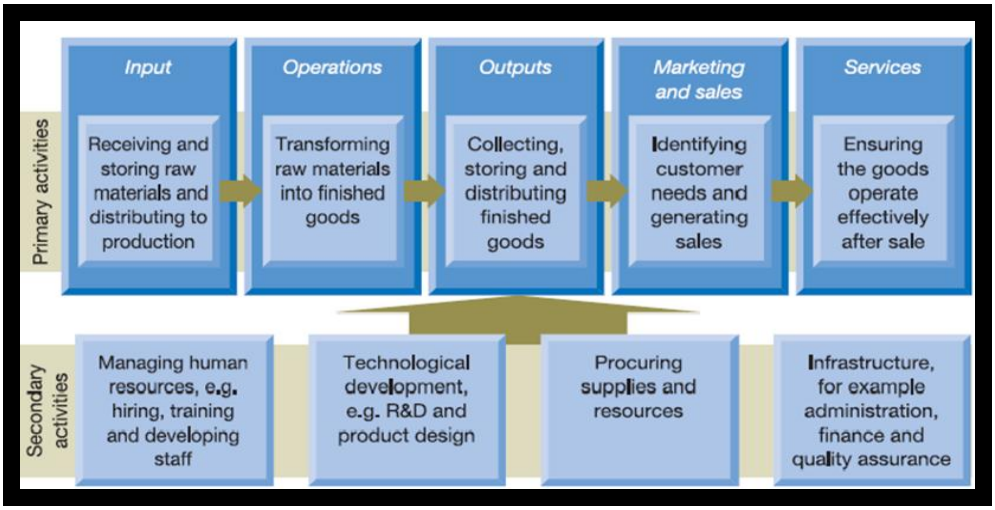

Figure 1. Value chain pattern

2.1.6. Product Life Cycle Costing (PLCC)

Product lifecycle is simply the time a product exists, from conception to abandonment. In [30] refer to total-life-cycle costing (TLCC) as the approach companies now use to understand and manage all costs incurred in product design and development, through manufacturing, marketing, distribution, maintenance, service, and, finally, disposal. Managing the lifecycle costs are also known as managing costs 'from the cradle to the grave'.

2.1.7. Theory of Constraints (TOC)

A production bottleneck (or constraint) is a point in the manufacturing process where the demand for the company's product exceeds the capability in accordance with produce the product. The theory of constraints (TOC) is a manufacturing strategy as focuses on lowering the effect on bottlenecks concerning production processes [31].

The theory of constraints depends on the essentials of distinguishing bottleneck operations and working just on those. The theory is that enhancing operations that are not the bottleneck won't enhance your throughput, and along these lines not expand sales or revenues. Subsequently, a throughput change can just happen if the bottleneck operation is improved. Any and all processes have a bottleneck activity [32].

2.1.8. Total Quality Management (TQM)

Total quality management (TQM) is a method by which management develops policies and practices to guarantee that the company's products and services surpass clients' desires. This methodology incorporates expanded product functionality, reliability, durability, and serviceability. Cost management is utilized to dissect the cost results of various design choices for TQM and to measure and report many aspects of quality including, for instance, production breakdowns and production defects, wasted labour or raw materials [33].

2.1.9. Benchmarking

Benchmarking is an activity – usually a continuing one – where business, or one of its divisions, seeks to emulate a successful business or division and so achieve a similar level of success. The successful business or division provides a benchmark against which the business can measure its own performance [33].

Benchmarking is the name given to the process of measuring the organization's operations, products and services against those of competitors recognized as market leaders, in order to establish targets which will provide a competitive advantage [34].

2.1.10. Re-engineering business processes

Business process re-engineering involves a dramatic re-design of business processes, organization structures and use of technology to achieve breakthroughs in business competitiveness. The benefits claimed are that operations can be streamlined, and consequently, costs can be cut [35].

As business operations consist of a set of activities that are linked together in a coordinated manner to achieve a specific goal, the re-engineering process involves examining and redesigning these processes to achieve the organization's goals of cost reduction, quality improvement and customer satisfaction [36].

2.1.11. Balanced Scorecard (BSC)

A balanced scorecard translates the strategy into a plan of action that identifies specific objectives and performance drivers to help determine if the organization is moving in the right direction [37].

This approach uses both financial and nonfinancial measures to evaluate all aspects of a company's operations in an integrated fashion. Performance measures are linked in a cause-and-effect fashion to ensure that they all tie to the company's overall objectives [38].

In the light of the reviewed above on cost management tools, it can be concluded that all of these tools somehow reduce costs, which is the primary objective of all economic units, whether they are profit-making or non-profit, governmental or non-governmental. However, each cost management tool may vary in its focus and attention at a certain stage of the product lifecycle. For example, the target cost determines competitive market prices and makes it the basis for the design and produce a competing product. This cost is calculated and reduced at the stage of design and development before starting the production of goods and services in order to enable the economic unit to reach the target cost or less after completion of production. While tools such as just in time production, value chain or activity-based costing contribute to reducing costs during the production phase by focusing on activities necessary to produce and eliminate activities that do not add value. Whereas tools such as Balanced Scorecard or Benchmarking help management evaluate performance and give feedback on whether it has achieved its objectives or it needs continuous improvement.

Accordingly, it is possible to evaluate the cost management tools and highlight their importance and impact on the overall management decisions, including pricing. The table (1) summarizes the potential impact of each tool on the pricing decision:

Table 1. Cost management tools and their impact on pricing decisions

No.	Cost tool	How to influence the price decision
1.	Activity Based Costing (ABC)	"Nonmanufacturing as well as manufacturing costs may be assigned to products, but only on a cause-and-effect basis". This makes the cost measurement more accurate and the management decision based on provided data more precision.
2.	Target Cost (TC)	"Describes the costs that are expected to be incurred to meet market prices and the survival of profitable products or services", so its importance lies in enabling managers to rationalize pricing decisions and achieve competitive advantage.
3.	Kaizen Costing (KC)	"Makes a slight and continuous improvement in the current cost compared to before, resulting in a greater improvement in the future", and is, therefore, more relevant to the strategic vision and decisions in the long term.
4.	(JIT) Just In Time	"Reduces the costs needed by companies to purchase, store and transport inventories", thereby helping to create conditions for increased efficiency and improved product quality consistent with decisions in a competitive environment.
5.	VCA) (Value Chain Analysis	"Carefully considers each step of operations and its contribution to profitability and competitive advantage". Its impact is manifested in the decisions of improving the value of products or services as it helps to achieve the goal of cost reduction while maintaining quality.
6.	Product Life Cycle Costing	"Seeks to focus the administration's interest on reviewing the product

	(PLCC)	or service through the life cycle in three stages to reach the total costs: pre-production, production, and post-production", thereby contributing to improving managerial decision-making throughout the product lifecycle.
7.	Theory of Constraints (TOC)	"Deals with bottlenecks and accumulation of material in the processing stages". This helps management make decisions to improve efficiency and optimize resource utilization.
8.	Total Quality Management (TQM)	"TQM encompasses both improving the tangible aspects of product quality and enhancing the efficiency of the organization. Managers; therefore, should report quality improvements for their importance in the profit and non-profit economic sectors". Hence, quality essential and linked to the decisions to achieve the objectives of growth, balance, and stability in the market.
9.	Benchmarking	"Improvement and development of activities whose performance is weak or less than the standard", so, it is based on external performance standards lean on a challenge and continuous development in the competitive market.
10.	Re-engineering Business Processes	"Substantial organizational change starts often from scratch and attempts to the bottom-to-top reconstruction of the organization". Hence are related to decisions to radically change organizational structures and processes to reduce costs and improve the quality of products and services provided to suit the needs and desires of customers.
11.	Balanced Scorecard (BSC)	"Measure the long-term performance of the organization by strengthening and improving non-financial indicators that demonstrate the future economic value of the organization". Hence it helps to build a vision of the organization and strategic decision-making.

2.2. Pricing decisions in government institutions

International standards have shaped the concept of government enterprises as institutions that carry out activities similar to those of the private sector. These institutions may provide goods and services to society without charge or with symbolic fees according to their obligations, although these organizations seek to profit. Therefore, these institutions are characterized by the following:

It has the powers of contracting under its name.

The financial and operational authority shall be delegated to it to carry out its business.

The nature of their business is the sale of goods and services for full-profit or full-cost recovery.

The continuity of these units depends on their revenues from the activity they exercise and not on government funding.

It shall be controlled by a public sector establishment.

From these characteristics, it is noted that cost is the main factor influencing pricing in these institutions. The primary purpose of the obligations as a government business unit is to provide goods and services to the society, so, pricing of the products and services of these institutions may require special considerations because it has a distinctive feature from the profit economic units. As it may be monopolistic of the market and subject to laws and regulations on the one hand, and it must balance between the goal of continuity and the survival and the goal of social responsibility on the other hand. Where, the pricing decisions are future decisions that should reflect the objectives of the economic unit which seeks to achieve it, from maximizing profits, expansion, and growth to survival and continuity in accord with social responsibility. Needles (2011:1188) notes that "maximizing profits remains the dominant factor in fixing prices, yet economic units are taking into account the social concerns and pricing policies in line with social responsibility".

In the fully monopoly market, when the government is the monopolistic, it may find satisfaction only in the price that covers costs, such as water and electricity institutions, or may raise a price to reduce consumption on such products, or, to achieving a moderate return for the survival and sustainability of the institution [39].

Since the price is "the amount of money charged for a product or service or the sum of all the values that customers concede in order to gain the benefits of having or using a product and service". [4] Therefore, it is necessary to consider the importance and value of water when making pricing decisions. God Almighty Has Prescribed the value of water and its ability to satisfy the desires of consumers in the Holy Quran, "From the water, we have created all living things."

When setting a price or the tariff for this important commodity and supplier, consideration should be given to the contribution of this price to water demand management, and to reduce excessive consumption and taking into consideration the recovery of part or all costs of production of this economic commodity. As the goals of pricing it must be derived from the goals of the economic unit and due to the nature of government institutions, the goal of social responsibility should be a priority, as the social level of customers differs and so is their ability to pay for the product. Therefore, the pricing of the products of government institutions is at a progressive tariff, to consider the social and consumption levels of the various classes of customers. It should as well take into account the cost of coverage on the one hand and reduce the consumption of the product on the other.

On that basis, we find that some Arab countries, with their different economic and social level, provide government support at various rates to cover the cost of potable water production as a basic commodity necessary for the population as well as other enterprises and institutions. For example, we find different pricing policies in the following countries:

Kuwait has adopted a progressive pricing for the residential sector, including four segments, while fixed prices have been adopted for industrial establishments, water filling stations, and other sectors. Government subsidies for potable water have reached more than 50% of the total cost.

Saudi Arabia has developed a progressive pricing that includes the residential and all commercial and industrial sectors divided into five segments. The government contributes to most of the cost of potable water production, with Saudi citizens accounting for only 5% of the total cost.

In the Arab Republic of Egypt, the consumption segments were divided into five sections to cover the operation and maintenance costs. The state subsidy is limited to 20% of the total cost, while a fixed and different pricing has been established according to the sector type of commercial, governmental, industrial and tourism sectors. Egypt uses a cost system, identifies cost centres and calculates cost at each stage of production to identify, develop and increase efficiency in areas that need to be developed and attempts to develop them and boost their efficiency.

Among these different experiences of Arab countries, it is not clear what basis these countries have adopted in determining the price of potable water and the proportion of government support, although both Egypt and Jordan have a cost system and the price covers specific items of operating costs.

So, there must be a cost system to calculate and fix the cost of production accurately according to different activities to be the basis in determining the proportion of government support and the proportion of cost coverage by consumers according to their living level and financial ability from one hand, and to rationalize consumption on the other hand. And, from the importance of using cost management tools in providing useful information for making pricing decisions as shown in the table (1) it is necessary to strengthen the cost system with some cost management tools to provide appropriate information to the management of the institution producing potable water to help in making the pricing decision to achieve those goals.

Therefore, the researchers establish that the management tools suitable for use by the Water Directorate in the province of Al-Najaf Al-Ashraf as a case study to assess the role of cost management tools in improving the tariffs of potable water prices in Iraq are as follows:

The activity-based costing method to assign indirect costs on products, since the Directorate has two products: Pure Water and Reverse Osmosis RO Water, for which the total cost is used to calculate and distribute production costs to these two products with an equal applied rate without taking into consideration the cost of activities consumed in the production of each product separately.

Value chain to analyze the activities of the production of pure water and fix the costs of each

activity and linking them to the level of water consumption as a way to develop a progressive price that helps cover production costs on the one hand and rationalize the consumption of the product on the other.

3. Research application methodology

A case study of the role of cost management tools in improving potable water tariff.

3.1. Study Data

The data for this case study was obtained from the financial statements of the Water Directorate in Al-Najaf Al-Ashraf Governorate for the year 2016. One of the researchers works in the accounting unit of this Directorate and she got approved from the senior administration to conduct this study to develop the cost accounting system and improve the tariff of potable water which is fixing not based on accurate cost data.

The significance of the Water Directorate in Al-Najaf Al-Ashraf lies in its production and distribution of two products: pure water and (RO) water to meet the consumers need for water in the whole Governorate. It provides production services to more than one and a half million people for 24 hours. The table (2) shows the quantity of water produced during the 2016 and the amount of water needed in the province:

Table 2. Production data for 2016

Details	Amount (m^3)*
Production of pure water	16640350
Production of (RO) water	3416450
Total water production	20056800
The annual need for water	21875820
Waste at water produced	2807952
Deficit at water produced	1819020
The proportion of produced water waste	14%
The proportion of produced water deficit	8.32%

The Directorate relies on two sources to obtain and liquidate the water is the Euphrates River and Artesian wells. The liquidation and sterilization activities in which each product goes through vary, as there are some joint activities, some of which are specific to each product.

Due to the importance that all segments of the province population have to obtain pure water and ensure the reduction of consumption to reduce waste and cover the deficiency in production. This study focuses on determining the cost of pure water and improving the price tariff currently adopt by the Directorate. The adopting tariff is determined on the basis of the number of rooms in each house in accordance with the instructions issued by the Ministry of Municipalities and Public Works No. 3452 on 28/4/2015 as shown in the table (3) below:

Table 3. Pricing by the number of rooms for the residential sector

Rooms #	Monthly consumption amount (m^3)	Cost in Dinar	Participation %
2 to 3	90	4920	11.73
4 to 5	120	9120	80.30
6 to 7	150	13320	7.95
8 or more	180	17520	0.0

As for the government and commercial sector, the stated instructions set a fixed price per cubic meter of pure water, which are 3000 dinars for the government sector, and 4500 dinars for the commercial sector according to the nature of the process of each sector, and different consumption amounts.

Note that the Directorate does not rely on the meter system to calculate the amount of consumption because of the unavailability of meters for all homes or other sectors throughout the province. It also depends on the total method of determining the cost of the product. It divides the annual costs on the quantity of production in full without extracting or separating the cost of each product according to the activities that add value to each product. The table (4) shows the cost of cubic meters of water produced in 2016:

Table 4. The cost of 1 m3 according to the total method in 2016

Details	Amounts
Total cost (ID)	20554467557
Total Water Product (m^3)	20056800
Cost per 1 m^3 (ID)	1024.813

The total cost includes all the cost elements according to their functional classification; productive, marketing and administrative. The accounting system of the Directorate does not classify these costs as direct or indirect costs.

4. Applying ABC to determine the cost of each product

To determine the cost per m3 of indirect costs for each product in 2016, the following ABC four steps were adopted:

1. Identify and classify the activities involved in the manufacture of specific products, and allocate overhead to cost pools.
2. Identify the cost driver that has a strong correlation to costs accumulated in the cost pool.
3. Compute the activity-based overhead rate for each cost driver.
4. Assign overhead costs to products, using the overhead rates determined for each cost pool (costs per driver).

5. Identify and Classify Activities and Allocate Overhead to Cost Pools(Step 1)

The second objective of this research applied approach is to use the output of ABC as a basis for value chain analysis; therefore, this analysis should use the expanding definition of overhead to include all indirect costs manufacturing and non-manufacturing to identify all resource-consuming activities. It requires documenting every activity undertaken to accomplish the task, and then, the system assigns overhead cost directly to the appropriate activity cost pool.

By the analysis of the operations experienced by each product in Al-Najaf Al-Ashraf Water Directorate, it is possible to determine the cost pools for activities that contribute to the production and distribution of each product, and then assign the indirect costs of each cost pools either by tracking them according to expenditure documents or allocating them through cost driver that has a direct cause-effect relationship with the resources consumed as shown in the table (5):

Table 5. Activity cost pools and the indirect cost in 2016

Activity Cost Pools	Indirect Costs (ID)
Drawing	2396178217
Sedimentation	1608477574
Filtering	1474662926
Testing	1171515225
Power generation	1835632157
Distribution	1598772772
Maintenance of water networks	2085795000
Management	1474411639
Total cost	13645445510

6. *Identify* Cost Drivers(Step 2)

The cost driver must accurately measure the actual consumption of the activity by various products. To achieve accurate costing, a high degree of correlation must exist between the cost driver and the actual consumption of the overhead costs in the cost pool.

Based on the nature of each of the activities specified in the table (5), it is possible to identify the cost drivers and their total use per activity cost pool during 2016 as shown in the table (6)

Table 6. Cost drivers and their use per activity in 2016

Activity Cost Pools	Cost Drivers	Use of Cost Drivers per Activity
Drawing	Number of drawings	2100 times
Sedimentation	The quantity of the sedimentation materials	39000 kg
Filtering	Number of filter hours	4350 hours
Testing	Number of tests	36720 tests
Power generation	Power used	9785000 KW
Distribution	The number of beneficiaries	1512545 beneficiaries
Maintenance of water networks	Number of maintenance times	624016 times
Management	working hours	1848 hours

7. Compute Activity-Based Overhead Rates (Step 3)

The activity-based overhead rate per cost driver computes by dividing overhead per activity as shown in the table (5) by the number of cost drivers used per activity, shown in the table (6). These computations are presented in the table (7).

Table 7. Computation of activity-based indirect cost rates in 2016

Activity Cost Pools	Indirect Costs (ID)	Use of Cost Drivers per Activity	Activity-Based Indirect Cost Rates (ID)
Drawing	2396178217	2100 times	1141037.246
Sedimentation	1608477574	39000 kg	41243.015
Filtering	1474662926	4350 hours	339002.971
Testing	1171515225	36720 tests	31904.009
Power generation	1835632157	9785000 KW	187.597
Distribution	1598772772	1512545 beneficiaries	1057.008
Maintenance of water networks	2085795000	624016 times	3342.535
Management	1474411639	1848 hours	797841.796

8. Assign overhead costs to products (Step 4)

In assigning overhead costs, it is necessary to know the use of cost drivers for each product, shown in the table (8)

Table8. Use of cost drivers per product in 2016

Activity Cost Pools	Cost drivers	Use of cost drivers per activity	Use of cost drivers per product	
			Pure water	RO water
Drawing	Number of drawings	2100 times	1742	358
Sedimentation	The quantity of the sedimentation materials	39000 kg	32370	6630
Filtering	Number of filter hours	4350 hours	3609	741
Testing	Number of tests	36720 tests	29078	7642
Power generation	Power used	9785000 KW	8121550	1663450
Distribution	The number of beneficiaries	1512545 beneficiaries	1315412	197133
Maintenance of water networks	Number of maintenance times	624016 times	500933	123083
Management	working hours	1848 hours	1634	214

To assign overhead costs to each product, the activity-based overhead rates per cost driver, shown in the table (7) multiplies by the number of cost drivers used per product is shown in the table (8). The table (9) shows the overhead cost assigned to each product.

Table 9. Assignment of activity cost pools to products in 2016

Activity cost pools	Pure water			RO water		
	Use of Cost Drivers per Product	Activity-Based Indirect cost Rates	Cost Assigned (ID)	Use of Cost Drivers per Product	Activity-Based Indirect cost Rates	Cost Assigned (ID)
Drawing	1742	1141037.246	1988016244	358	1141037.246	408161973
Sedimentation	32370	41243.015	1335036386	6630	41243.015	273441188
Filtering	3609	339002.971	1223470704	741	339002.971	251192222
Testing	29078	31904.009	927704785	7642	31904.009	243810440
Power generation	8121550	187.597	1523574690	1663450	187.597	312057467
Distribution	1315412	1057.008	1390401535	197133	1057.008	208371237
Maintenance of water networks	500933	3342.535	1674385828	123083	3342.535	411409172
Management	1634	797841.796	1303673495	214	797841.796	170738144
Total cost assigned			11366263667			2279181843
Units Produced			16640350			3416450
Unit Cost			054. 683			120.667

9. Computation of the Unit Cost

Table (10) shows the total unit cost of each product after adding the direct costs which represent the cost of the activities that belong to each product separately to the indirect costs as shown in the table (9). The table also shows a comparison with the unit cost calculated by the Directorate in accordance with the table (4)

Table 10. Computation of the Unit Cost for each product in 2016

	Pure water	RO water
Total direct costs	3,792,168,011	3116854037
Units Produced	16640350	3416450
Unit direct cost	227.890	912.308
Unit indirect cost	683.054	667.120
Unit total cost	910.944	1579.428
Unit total cost of the Directorate	1024.813	1024.813
Increase / decrease	- 113.969	+ 554.615

The comparison in the table (10) shows that the product unit cost calculated by the Directorate according to the total cost method is inaccurate due to the failure to separate the direct costs from the indirect ones and assuming the applying of the costs equally for each unit of two products. Whereas separating the costs and the adoption of activity pools to assign the indirect costs according to the application of (ABC), show the decrease in the unit cost of pure water and increase in the unit cost of (RO) water, which will, in turn, reflect on the price fixing of each product.

10. Applying the Value Chain (VC) to Improve the Pure Water Tariff

According to the value chain pattern in Figure (1), activities that add value to the pure water can be linked in a value chain, and the cost of activity in each link can be determined according to the output of the ABC application. All of the activities will lead to a pure water cost, which makes the product more valuable to the consumer who will contributing to cover the costs of part of the activity links of the product according to his ability to pay, and does not pay for getting potable water on the basis of the number of rooms in the house that he inhabited as the Directorate is currently determining the price tariff. The figure (2) illustrates the value chain pattern for the production of pure water in Al-Najaf Al-Ashraf Water Directorate.

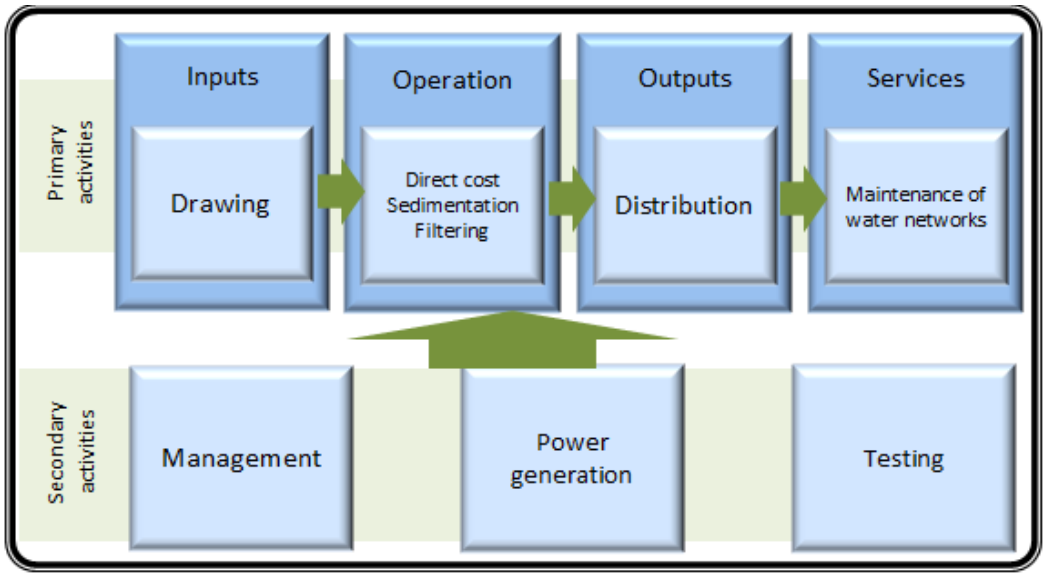

Figure 2. The value chain pattern for pure water production

From the results of (ABC) application in tables (9) and (10), the cost of product unit for each activity of value chain primary and secondary activities can be determined as shown in the table (11)

Table11. The price of 1m3 of pure water according to value chain activities in 2016

Value chain activities	Activity cost (ID)	Produced units (m^3)	Product unit cost (ID)
Primary activities			
Input	1988016244	16640350	119.470
Operations	6350675101	16640350	381.643
Output	1390401535	16640350	83.556
Services	1674385828	16640350	100.622
Total unit cost of primary value chain activities			685.291
Secondary activities			
Management	1303673495	16640350	78.344
Power generation	1523574690	16640350	91.560
Testing	927704785	16640350	55.750
Total unit cost of secondary value chain activities			225.654
Total assigned cost	15158431678	16640350	910.945

According to the table (3), the basis used in pricing water tariff classifies consumers into four categories, in which each of the quantity of consumption and the total price per category is estimated on the basis of the number of rooms in each house. However, it is not clear whether these estimates were based on sound cost system information. The table (12) shows the price per cubic meter for each category, and the ratio of this price to the unit cost calculated in Al-Najaf Al-Ashraf Water Directorate, which is 1024.813 (ID) as in the table (4).

Table 12. The price of 1 m3 pure water according to rooms during 2016

Rooms #	Monthly consumption (m^3) 1	Total price (ID) 2	Price per m^3 (ID) 3=2÷1	The ratio of the price to the directorate unit cost 4 = 3 ÷1024.813
2 - 3	90	4920	55	5.4%
4 - 5	120	9120	76	7.4%
6 - 7	150	13320	89	8.7%
≥ 8	180	17520	97	9.5%
Public sector	-	-	3000	292.7%
Private sector	-	-	4500	439%

As shown in the table (12) the adoption of a specific consumption level in each category without taking into account the actual consumption gives a false result of the potable water unit price paid by the consumer in each category and the proportion of government support for them. For example, the first category, which represents low-income people, do not pay 55 dinars per consumed unit; they pay the total price of 4920 dinars regardless of the actual level of consumption. Hence, if the actual level of consumption is 10 m3, the actual price paid for each unit would be 492 dinars with a contribution to cover 48% of the unit cost rather than 5.4%. Consequently, the level of government support for the same category will vary according to actual consumption. This does not represent social justice, and does not give the incentive for consumers to reduce consumption as they have an exaggerated amount of potable water consumption up to 90 m3 at the same price, and so is the case for the rest of the selected categories.

Therefore, reasonable limits should be set for the level of consumption for each category and a fixed price for the product unit should be determined, representing the ratio of the citizen's contribution to the cost of production. If we link the four categories of consumption with production costs according to the value chain pattern (Table

10), the first low-income category if contribute at least to cover the cost of inputs, the price should have been 119,470 dinars or 13% of the assigned unit cost (119.470 ÷ 910.945). If the second category being the largest category of the fair-income category of society contributes at least to cover the total cost of the output, the price should have been 584.669 dinars (119.470+ 381,643+ 83.556), which represents 64% of the assigned unit cost (584.669 ÷ 910.945) i.e., government support is 36%. Thus, the same for the other two categories contribute to cover the costs of secondary activities as they represent the high-income class in society and have to pay a higher price or reduce consumption, where, on the other hand should be a link between the tariff and the amount of consumption, and the total price per category should not be fixed as assigned by the Directorate due to not using the meter system to calculate the amount of consumption. Each category can reduce the total price paid if they reduced the amount of consumption. The same is true for the government or commercial sector, The Directorate has set a fixed price and a specific consumption level for each sector.

The table (13) illustrates a proposal to improve the price tariff linking between the level of consumption and cost refund according to the value chain, taking into consideration the following goals:

1. Achieving social justice by setting prices that enable low-income groups to meet basic consumption needs.
2. Achieving economic efficiency by adopting higher prices for higher consumption categories to encourage consumers to reduce consumption and water conservation.
3. Distinguish between different consumption categories of citizens or business sectors, governmental or private.
4. Adopting meters' system to measure the actual consumption of each category, which necessitates the Directorate to provide consumers with a special meter.

Table 13. The proposed escalation tariff by consumption categories and activities cost within the value chain

Monthly Consumption m^3	Household Consumption	Public Sector	Business Sectors		
			Commercial	Industrial	Touristic
1-15	119.470[1]	-	-	-	-
16-30	584.669[2]	685.291[5]	584.669[8]	-	-
31-45	685.291	763.635[6]	685.291	[9]685.291	685.291
46-60	855.195[3]	855.195	855.195	855.195	855.195
61-74	910.945	910.945	910.945	910.945	910.945
≥ 75	1366.418[4]	1821.890[7]	182.188	2732.835	3643.78[10]

1Equals inputs cost only to enable low-income groups to meet basic consumption needs and to encourage the second category to reduce consumption to achieve significant cost savings.

2Equals the total cost of output i.e. = input cost + operations cost + output cost.

3Equals the cost of primary activities+ management cost+ Power generation cost.

4Equals 150% of the total cost as a target price and can be increased according to the policy of encouraging consumption reduction which the Directorate should update in the medium term every 3 - 5 years.

5Equals the primary activities cost minimally to the price of the first category in the public sector at the second level of consumption due to increase water consumption in this sector compared to the household sector and to encourage this sector to reduce consumption as it operates within limited resources budget allocations.

6Equals the cost of primary activities + management cost.

7Equal to 200% of the total cost as a target price to contribute to recovering part of the costs that are not be recovered in the first, second and third categories. It can be increased by the policy of encouraging the reduction of consumption, which the Directorate should update in the medium term every 3 - 5 years.

8Equals the output total cost as the minimal price of the first category in the commercial sector at the second level of consumption, since a large proportion of this sector, includes small and medium enterprises, which have a lower consumption rate than the public sector and encourage this sector to reduce its expenses and reduce water consumption.

9Equals the primary activities cost as the minimally to the first category in the industrial sector at the third level of consumption due to increase water consumption of this sector comparing from the public and commercial sectors and have to pay for the services provided to it as it consumes more water. So, the last category will be 300% to encourage this sector to reduce water consumption.

10Equals 400% of the total cost as a target price, as the tourism sector is one of the most water consuming sectors.

11. Research Conclusion

There is an essential relationship between cost management tools and pricing decisions by providing the most appropriate and accurate information on the cost of products and services, whether for economic units or government service institutions, such as water directorates in Iraq, to pricing potable water in an escalating tariff. Where, the accounting information that resulted from the case study when applied the Activities Based Costing (ABC) and Value Chain (VC) in Al-Najaf Al-Ashraf Water Directorate played a significant positive role in improving the tariff of potable water prices for the Directorate. The proposed tariff model represented the social level and level of consumption of different categories of citizens, the public sector and various business sectors, each of them, in addition to government support, contributes to cost recovery and rationalization of consumption.

It is, therefore, necessary for the Ministry of Municipalities and Public Works as an Iraqi government authority to review the potable water pricing strategy it adopts, which gives a false representation of the price of the unit produced of the potable water paid by the consumer in each category and the rate of government support. The method currently used by the Ministry to determine the potable water price according to the number of rooms does not give an accurate picture of the actual consumption that is supposed to determine the total price paid from each category. Moreover, the use of the total cost in the calculation and distribution of production costs without taking into account the cost of activities consumed in the production of each product does not give accurate figures on the unit cost per product. Therefore, the price based on this cost is non-realistic; particularly the cost is the main factor affecting pricing in these institutions which has to balance the objective of continuity and survival of the unit and the goal of achieving social justice. The determination of the price of potable water in an escalating tariff complies with social and consumption levels of different categories, and also takes into account covering the costs of the institution on the one hand and reduces consumption of this important resource on the second hand.

The practical results of case study, based on the cost and production data of Al-Najaf Al-Ashraf Water Directorate, proved that the Activities Based Costing (ABC) helps to allocate indirect costs appropriately to its products by adopting different cost drivers depending on the cause and effect relationship with resources and activities, which, help identification in a more accurate of the pure water unit cost, and gave information on the costs of the activities which in turn helped to develop a value chain pattern for this product and determine the costs of activities in each link in the chain, which in total amounted the pure water cost. This makes a product more valuable to the consumer as he contributes to covering the costs of part of the links of the value chain of the product, taking into account its ability to pay within the category of the escalation tariff as suggested in this research, and does not pay for potable water based on the number of rooms in his house. The ministry should oblige its directorates in the provinces to work according to the meters system to calculate the actual consumption of each consumer and encourage them to reduce consumption to achieve savings in payment and helps to reduce the rate of waste and fill the water deficit.

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