Role of Time-Driven Resource-Consumption Accounting in Strategic Cost Reduction and Support of Supply Chain Management

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***Abstract*-The study aims to develop Resource-Consumption Accounting (RCA) by transforming the activities embodied in this approach from the rigid multiple drivers to a flexible unique time-driven driver by support pf supply chain management (SCM). This development is intended to overcome the criticisms directed at RCA, activating its role firstly in real cost reduction according to the production capacity mechanism and, secondly, in supply chain management support. The study adopts a theoretical descriptive approach, conceiving the positives of RCA, Time-Driven Activity-Based Costing in an attempt to create a new approach that integrates the advantages of both approaches in order to reduce cost. It is concluded that Time-Driven Resource-Consumption Accounting (TDRCA) can lead to a real cost reduction and at the same time support supply chain management.**

***Keywords*-*Resource Consumption Accounting, Time-Driven Resource-Consumption Accounting, Cost Reduction, Production Capacity, supply chain management*.

1. Introduction

Many business organizations embrace different management tools and strategic approaches to help them create value for their products and services at the lowest possible cost. In this regard, Supply chain Management is considered one of the most widely used management approaches to meet the challenges faced by business organizations in terms of realizing customer satisfaction with innovative products in short time and without high cost [3]. Waste elimination and maximization of customer value as a primary goal of supply chain management require directing management functions towards the paths of value stream. The determination of these paths require restructuring of the organization in a series of value streams classified into three groups, i.e. value streams of order fulfilment of existing products and customers, value streams of new product, and value streams of marketing and sales [28]. The management of value streams reflects a different methodology for planning, directing and controlling activities and processes, and measuring results as per the value that can be provided to the customer [8].

According to [41], the implementation of supply chain management enterprises need a significant change by all project personnel including management accountants, who should become members of a crucial teamwork, to deliver value to the customer rather than focusing on the tasks of supporting limited success. The role of management accounting in a supply chain enterprise is to direct all its practices and tools, particularly the cost approach, to focus on three important points that reflect the goal and core of supply

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chain management: i.e. value provided to customer, reduction of waste, and continuous improvements.

Supply chain management requires cost information on the activities, processes and resources of the value stream in a specific way and with certain characteristics that support maximizing customer value, waste reduction, and continuous improvements – i.e. characteristics that traditional cost approaches have failed to provide due to their lacking of contain supply chain principles. Despite the density of the information it provides, ABC fails in that respect, too (Jonson, 2006; 17]. Although supply chain accounting has gone towards indirect cost reduction by moving cost purpose from final product to value stream, cost data become meaningless when products vary widely in the value stream, the value stream does not include all product processes and activities, if the value stream includes many activities, processes and resources for which special data are needed, and/or when decision maker needs detailed information on the value stream [41]. This, in turn, requires a cost approach that is capable of solving the dilemma of providing accurate and detailed information about activities and processes in case of multiple products and services for value stream or when decision maker needs information beyond total cost of value stream and at the same time keeping allocation simplicity.

As regards costing approaches, accounting thought gave rise to many criticisms of the traditional cost management approaches during the 1980s, as emerged from the practice on basis of advances in the management thought that embraced the strategic trend in planning, directing, supervising and controlling various administrative processes and activities. These advances fostered changes in production and manufacturing methods and practices that had a direct impact on cost structure. The criticisms themselves turned out to bea key motivation for cost accounting researchers and professionals to come up with new practices, tools and approaches to cost management that are more adaptable tochanges in management thought and production art, leading to emergence of several new approaches, notably Resource-Consumption Accounting (RCA).

RCA premise is based on integration of concepts of *Grenzplankostenrechnung*(GKP) and Activity-Based Costing (ABC) with an aim to obtain detailed operational information[1].Cost behaviour is explained in terms of causality and responsiveness(which are inherent in GKP)as well as the ABC guided work principle in a highly disciplined form, though. Activities are used only when resource drivers are inadequate or when additional information is needed on the drivers of resource consumption in resource pools. The employed activity drivers should be known quantitatively to be able to generate information on capacity consumption rates [48]. Thus, unlike all conventional costing approaches and even ABC, RCA provides vital data by creating an idle capacity visible to managers so that they can avoid allocating cost of these capacities on cost purposes [38]. However, despite RCA theoretical supremacy and its widespread utilization in business organizations, there are many problems associated with its application and may limit its strategic benefits, most notably:

1. On the one hand, it is difficult to explain the cost behaviour in the case of multiple cost centre outputs and multiple output users without a large number of resource consumption relationships[10]. On the other hand, the diversity of the nature of the resources and their heterogeneity push the cost system to work with a large number of resource pools, which in turn undermines the practical feasibility of this approach [17].
2. The determination of the fixed cost allocation rates according to the theoretical capacity of resources, and the exclusion of all fixed costs that cannot be justified for cost purposes on a rational basis render this approach inadequate for decision-making processes that are intended to go beyond the short term purposes[40], [17][10].
3. The determination of a standard rate for the allocation of fixed costs based on the planned theoretical capacity and the allocation according to planned mixture volume at the beginning of the period is not suitable for short product life cycle, particularly in high-tech products, which may not exceed the productive life cycle of a few months of the financial period [51].

4. Data dependent on RCA allocation methodology do not support reporting requirements that stipulate for full cost absorption [4].
5. RCA's inclusion of ABC has by default included all ABC negatives, most importantly the limited accuracy at detail levels, problems of updating activity models in a dynamic business environment, and the inadequacy of the quantitative definition of the resource consumption according to ABC in case of inability to interpret it according to input-output relationship. Therefore, the models based on this approach need much cost and time at construction, and are characterized by inflexibility and inability to absorb developments in organization's work environment [5, 16].

The above-mentioned issuescan be addressed by shifting RCA focus fromproviding information onthe amount of resources consumed to the provision of information about the mechanism and methods of resource consumption. This can be done in a way that (a) makes it easy to deal with fixed costs and allocate them to cost purposes logically, (b) addresses the problems ofthe large number of resource pools, (c) overcomes ABC complexities in themodel, and (d) generates appropriateness of supply chain management on basis of simplicity and value stream. All this can be achieved by simplifying activities model (included in RCA) and directing it towards resources using consumption-based quantitative relationships. The simplification and directing of activities model in RCA can be done in a similar way to [26] in TDABC, depending on time drivers to explain the consumption of resources for which causality cannot be established with resource pool outputs. Thus, we can generate a dual approach to resource consumption that can be called TDRCA. It combines the advantages of both TDABC and RCA, and offers a new approach capable of allocating costs based on both volume and resource-driven activities on one hand and capable of supporting supply chain management in a way that enables enterprise to reduce cost while at the same time keeping the value offered to costumer, on the other hand. This study attempts to explain the concept of this new approach and clarify its role in achieving strategic cost reduction from an analytical perspective. The subject is addressed in respect of four dimensions: (i) definition of TDRCA, (ii) the concept of strategic cost reduction, (iii)TDRCA mechanism in achieving cost reduction ,and (iv) its role in supporting supply chain management.

2. TDRCA Concept

TDRCA can be considered an upgraded version of RCA in which the focus of activities has been shifted from the multi-cost drivers to a single driver, i.e. time –seen as a measure of capacity. It identifies multiple time consumption drivers by building consumption equations for each resource consumed by the activities in a manner consistent with TDABC. Thus, like RCA, TDRCA presents an explanation of cost from a resource perspective, considering that resources are cost driver, resources have capacity, and so access to capacity is the cost driver. Nevertheless, TDRCA exceeds RCA with respect to fixed costs: if RCA is unable to establish a relationship between resources and outputs of the resource pool, TDRCA attempts to create artificial change in fixed costs by converting them into expendable capacities through the activities that contribute to the generation of these outputs.

This role by TDRCA may reduce the number of resources pools of RCA because the allocation of capacity resources on cost purposes can be done on the level of each resource within the pool. Besides, TDRCA directly considers capacity consumption quantities when measuring cost, as cost dollars follow these quantities but are not be included in the resource consumption relationship. The cost measurement according to the quantitative perspective of capacity leads to the possibility of separating the idle capacities on one hand and the realization of more accurate measurement of the various cost purposes on the other hand. This ,in turn, provides accurate information on the quantities consumed by cost purposes and on the consumption behaviour according to both purposes and activities, thus creating significant opportunities to support strategic cost reduction through a special methodology related to production capacity, and this can be described as the production capacity methodology.

3. TDRCA and Strategic Cost Reduction

The determination of TDRCA contributions in strategic cost reduction requires a definition of cost reduction concepts on the one hand and cost reduction methodology in the framework of this approach on the other, in order to develop a general perception of the role this approach plays in achieving strategic cost reduction.

3.1Cost reduction concepts

A proper understanding of costs and cost drivers is the cornerstone of the reduction process and the main determinant of its dimensions and areas. Cost is defined as a set of resources sacrificed to achieve a specific goal [21]. It is also expressed as the resources consumed by enterprise to achieve its objectives[7]. American Society of Certified Public Accountants (AICPA) and American Accounting Association(AAA)emphasize on the definition of cost as resources used to achieve specific objectives. Despite such emphasis that cost is nothing but resources spent, the volume-based costing approaches, such as ABC, do not interpret cost behaviour in terms of resource consumption due to their inability to track resource flows and to separate consumed from available resources. Thus, the definition of cost reduction is construed as a process of cost transition from a certain level to lower levels in the light of the project strategy, regardless of the impact of this transition on resources. This has narrowed the chances of cost reduction on the one hand, and turned the realized cost reduction into a kind of cost accounting recalculation on the other [30]. Even if RCA was ideal in terms of the definition of cost as consumed resources, it has remained captive tothe problem of accounting recalculation of uncaused fixed costs.

[48] thinks that as long as resource consumption is the primary cause of cost, it is important to understand the nature of resources and model it in a way that simplifies cost management and reduction. [30] asserts that real cost reduction should be linked to a reduction in the resources used. This, according to [9], requires a thorough analysis of two key elements: the intensity of resource use (i.e. the quantity and mix of capacities used) and the productivity and efficiency of resources. [50] adds that cost reduction is directly related to the efficient use of project resources. [34] confirmed that the tendency of cost management towards value makes it necessary to pay attention to the resources that have created this value and to control cost-effectiveness at the resource level. [42]identifies that the problem of cost reduction in terms of the use of measures to guide the reduction is not related to the provision of resources.

Based on the above, and in the light of the concepts of cost reduction established in the costing thought [39],[30],[36], strategic cost reduction can be defined as a continuous and comprehensive process for all areas of the project and its organizational and behavioural dimensions in order to reduce the resources required to implement the project strategy.

TDRCA-based cost reduction mechanism supports the concept of cost reduction from the perspective of resource consumption, as this mechanism provides a rigorous methodology to track and reduce the capacities of resources by measuring and isolating unused capacities, and identifying the value-added and non-value-added capacities in the light of analysis of firm value chain and demonstration of the impact of potential reciprocal relationships between resources. The following section provides a detailed explanation of this methodology, which can be described as the production capacity methodology.

3.2Cost reduction in the context of TDRCA

TDRCA deals with resource capacities directly and seeks to reduce cost by cutting down those capacities, classified by the Consortium for Advanced Manufacturing - International (CAM-I) in three groups. These groups are (i) productive capacities (used for the production and supply of services), (ii) non-productive capacities (that support production, e.g. in maintenance, preparation, coaching, training and administrative activities), and (iii) idle capacities (i.e. reflecting the non-employed capacities) [48].

The production capacity methodology began cost-reduction by measuring and identifying idle capacities, and then excluding them from allocation and reporting them to management to deal with them in order to support the relevant overall reduction. Eventually, these idle capacities are removed or transformed into productive capacities[9],[42].The non-productive capacities that are always associated with non-value-adding activities are then analysed, the non-essential activities are removed, and the necessary capacities are reduced. Ultimately, this methodology tries to improve the efficiency of productive capacities by reducing the capacities required for value-adding activities. The following paragraphs provide a detailed explanation of this cost reduction in the framework of the TDRCA production capacity methodology:

a) Exclusion of idle capacities from allocation:

The productive capacities of business organizations are determined by several factors, the most important of which are the quantity and utilization efficiency of resources available, the ability to strike balance and consistency among these resources, as well as the methods used in resource management. [29] see that the problem faced by management with regard to productive capacity is not the availability of such resources as much as it is with how to manage them and work incessantly on the elimination of idle capacities so that final cost purposes do not have to absorb the costs of these capacities. Given that what cannot be measured cannot be managed, efficient project resource management requires a costing approach that is capable of accurate measurement of utilized resources, allocation of these resources to cost purposes, and exclusion of the costs of idle capacities. Traditional costing approaches and ABC often allocate resource costs based on the assumption of full capacity utilization. Even if it may be consistent with the nature of resources with undetermined capacities, this hypothesis is not appropriate for the resources of determined capacities [48]. Besides, even if these approaches recognize the unemployed capacities, such recognition takes the form of percentage estimates that make management able to hide these capacities by controlling the percentages of resources allocated [26].

The addressing of allocation of idle capacities creates perfect and high quality conditions for TDRCA compared to other approaches. That is because TDRCA recognizes idle resources and determines them according to the levels of activity on basis of output volume and at the level of each resource– or a homogeneous resource group – by moving from total resource capacity analysis to individual resource pool analysis. In addition, it provides guidance on how to deal with idle capacities either by full capacity exclusion if the resources are not mandatory or by directing the costs of these capacities away from the final cost purposes if they are not consumed by activities that have generated the outputs.

In order to identify idle capacities, TDRCA uses the backward allocation method, and starts with cost purposes, first identifying directly consumable resources on basis of causality and relativity, and then searching for direct consumption of these purposes by putting activities at the centre of the measurement of quantities of resource consumption and showing the impact of mutual relations of activities on resource consumption. This ,in turn ,makes the relationship between changes in output volume and resource volume and costs clearer on the one hand, and creates visible idle capacity estimated by resources that have not been utilized by cost purposes on the other hand.

The measurement of idle capacities and their exclusion from allocation is the first step to cost reduction on basis of production capacity methodology, subsequently affecting the following steps related to reducing the capacities required for the value chain activities. This reduction will be reflected in the form of idle capacities that should be accurately measured and efficiently managed until the real cost reduction is achieved.

b) Improvement of the efficiency of utilized capacities:

From a cost perspective, efficiency improvement – i.e. knowledge as a relationship between inputs and

outputs –is related to reducing the resources needed to produce the same output volume within organization's strategy but without any adverse effects on the value provided to the customer [43].This reduction requires the development of business processes to identify and remove all non-value adding capacities and improve the value adding ones. As long as capacities are consumed in the performance of operations' activities, it is necessary to have tools capable of managing activities and analysing the value they add and the capacities they consume. In this regard, the value chain analysis – proposed by Porter and developed by Gorindarjan& Shank – is considered as one of the most prominent strategic thinking tools used to analyse the impact of activities on value and cost from a strategic perspective [14]. Hurailoat (2011) asserts that resource management in the context of a cost-leadership strategy requires an analysis of the value chain that links resources to the value generated for the customer.

Although value chain analysis is important as an ideal tool for analysing activities from a value perspective and a sound start to reduce costs [33], the management of activity to achieve real cost reduction requires the integration of three core components: activity value analysis, activity cost analysis, and cost-factor analysis[6].Thus, the lack of a costing approach capable of measuring activity cost may render the value chain analysis useless. [12] emphasize that the achievement of the value chain objectives in cost reduction is dependent on the costing approach capacity to provide information about the real chain activities drivers. The focus of traditional approaches to cost analysis on functions and sections represented the most significant constraint on strategic cost reduction due to its contributions limited to budget control [33].Despite its capacity to provide important information on tracking the costs of activities and excluding non-value-adding ones, ABC failed to provide appropriate information on how to reduce the cost of value-adding activities [46]. That is because of the rigidity of the transaction drivers on which this approach is based and the difficulty of reducing activity drivers volume on the one hand and of connecting these drivers directly to costs whose structure is dominated by fixed costs that cannot be affected, on the other hand. This, in turn, means that the impact on the costs of activities requires a definition of real cost drivers that are flexible and capable enough to make a change in fixed costs.

In this regard ,Hintchinson(2007)points out that the only thing that can be controlled and reduced is the time required to perform activity –being the most important measures of capacity – which is the real cost driver. [14] adds that the reduction in the cost of value chain activities must be from the perspective of the resources consumed by these activities, which implies that the costs of value chain activities should be linked to time, being the driver capable of generating a change in the resources consumed by these activities. A return to the objective of value chain analysis can reveal why many costing approaches are not feasible with regard to achieving strategic cost reduction. The objective of value chain analysis is basically to ensure that all completed activities contribute to the formation of the value provided to the customer either directly or indirectly, emphasizing that this value to the customer has been achieved at the lowest possible cost [44].

The dilemma in the above-mentioned objective of value chain analysis is that the determination of the lowest possible cost is practically impossible with costing approaches that deal with fixed costs as binding resources, and cannot afford to create flexibility in these costs. Cost is thus recognized always as a liability that cannot be improved or reduced. Besides, such approaches attempt to reduce such cost from an operational standpoint that does not affect the business strategic perspective, i.e. the reduction defined in terms of the value provided to the customer. The strategic cost reduction requires an approach that is able, first, to define cost from the perspective of the value provided to the customer and, second, to achieve a change in the fixed costs associated with this value. This goal can only be achieved through a costing approach that defines cost from a resource perspective, and can manage resources in line with the project strategy and the value provided to the customer.

Based on above, it can be emphasized that TDRCA has the necessary requirements to achieve the strategic cost reduction

because of its ability to redraft the value addition in the form of capacities and then, firstly, maximize the capacity produced (known by [37] as the part of capacity that provides the customer with the value of practical capacity) and, secondly, classify the rest of the capacities in to necessary non-productive capacities (namely, those necessary non-value adding activities) and non-productive and non-essential practical capacities. Thus, cost reduction by improving efficiency of resources through value chain analysis methodology in the context of a productivity capacity method can be as follows:

- Reduction of non-productive capacities: These are classified as non-productive and non-essential. The activities that consume them are removed, and the necessary non-productive capacities are reduced.
- Improvement of the efficiency of productive capacities: This feature ensures supremacy of TDRCA over other approaches, and is a result of the double definition of cost drivers within TDRCA model activities. Cost is identified in accordance with a clear causal relationship and, in the absence of this relationship, time –which is a basic measure of capacity – becomes the cost driver and contains many drivers for each activity. Therefore, resource efficiency improvement for the purpose of cost reduction occurs in two phases. The first phase is concerned with management of the causal relationship between the quantity of outputs and inputs in order to produce the same amount of outputs using fewer inputs. The second phase, which is more important, focuses on the management of time drivers, prompting reduction efforts to shift focus from reduction of drivers(which may be difficult and may have negative effects on the value provided to customer) to reduction of capacity consumed by each driver. This way simplifies the process of cost reduction of value-adding activities and supports trends of capacity efficiency improvement through:

- Reduction of the time required to perform activities, avoiding to waste time on fruitless cost reduction efforts. Here, TDRCA provides accurate information on the times required to perform activities and classifies them to times amenable to pressure and improvement and times that are fixed and difficult to modify[31],[32].
- Identification of the extent and scope of the impact of efficiency improvement of productive capacities through the study and analysis of time drivers, classifying them in a way that reveals the extent and scope of impact on cost reduction, as shown in the following table:

Time consumption drivers and the extent and scope of their impact

Type of Driver		Extent and Scope of Impact
Organizational time drivers	Structural time drivers	Strategic and limited to future cost
	Executive time drivers	Strategic and operational, and have temporary and future implications on cost
Operational time drivers		Operational, and have temporary and rapid implications

- Adjustment and management of constraints within the value chain: TDRCA provides information on the amount of resources required to achieve a certain volume of outputs of each resource pool. This information is provided in a double way through the causal relationship that links inputs to outputs and is contained in GPK and then through a time-driven approach. Therefore, it is possible to provide a methodology for the analysis of activities within the value chain, and determine costs. In addition, this methodology can provide comprehensive information on any activity that may constitute a constraint on the chain by identifying amounts of capacity needed by this activity to accomplish a given volume of production and the amount of resources allocated to this activity. It can also classify value adding activities on this basis as bottle neck activities and non-bottleneck activities. Thus, TDRCA contributes to reducing waiting times resulting from constraints by identifying constraints – often associated with activities with limited resources – and working to

overcome this constraint or to schedule resources for activities within the limits of restricted activity resources. TDRCA-based constraint management methodology surpasses the constraint theory methodology (which seeks to search for overall constraint that affects the performance of the system as a whole). It aims to identify the bottlenecks of each process or group of homogeneous processes and thus find a set of bottlenecks within the system to be arranged in terms of their impact on the performance of the enterprise and the optimization resulting from the exploitation of resources. This level of analysis gives a deeper and more effective dimension to the constraint analysis and provides processing solutions that the constraint theory may not provide[49].

- Management of linkages between value chain activities: The efficient use of available resources is influenced by the project management's knowledge of relationships and linkages within the value chain, given their importance in highlighting opportunities for efficiency improvement of produced capacities and maximizing value to customers [19]. Here, TDRCA provides the concept of drivers' interactions – available in TDABC methodology - and refers to the effect of one of the time drivers on another driver [15] – as an integrated approach to the management of linkages and relationships between value chain activities in a way that supports the reduction of consuming capacity.

4. Role of TDRCA in support of supply chain management

TDRCA can be introduced as a cost approach capable of providing detailed information and at the same time can be directed to measure value stream as a final goal of cost. In this way, TDRCA can provide two types of data: general data related to the measurement of value stream cost on basis of supply chain management; and detailed data related to the measurement of the cost of activities and processes, resource tracking and analysis of activities from the perspective of the value provided to the customer to achieve the objectives of supply chain management in support of value provided to the customer, waste elimination, and continuous improvement. Thus, TDRCA can play a prominent role in supporting supply chain management in addition to cost reduction, as follows:

4.1Support value provided to customer

[22] see that the focus of supply chain management on efficiency of processes and quality is concentrated in two points: orderly waste elimination and disposal of non-value adding activities. When talking about value-adding and non-value-adding activities, the value chain cannot be ignored, being one of the most important analyses that determine activities from the perspective of the value provided to customer. As long as the value chain analysis is applied, it is necessary to have a cost approach capable of working in harmony with this approach. In this regard, [2] emphasizes that RCA is one of the best cost approaches to integrate the concept of value chain .This integration is also inherited by TDRCA. As indicated in the third dimension of this study, TDRCA measures all the energies consumed on these non-value adding activities and expresses them in the form of energy determined by input quantity and cost expressed in cash unit. In addition, TDRCA quantifies the amount of resources consumed on value-adding and value-supporting activities and provides multiple drivers that illustrate how resources are consumed by these activities. Thus, management can obtain several suggestions on how to reduce the amount of energy consumed on these activities, and this ultimately maximizes value provided to customer at the lowest possible cost[27].

4.2Accuracy, reliability and diversity of cost information

The intense competition in the modern business environment has prompted business organizations to offer a wide range of products and services. The level of detail of cost information must therefore be at the level of diversity of these products and services [41]. For its part, supply chain management considers cost measurement to be simple and can be done by dividing the cost of value stream on the total stream outputs. This method flattens the measurement and produces misleading information

in the case of product diversity and variability within the value stream. It may also lead to proposing waste removal initiatives and improvements that may harm the lowest-cost or higher-profit product. TDRCA can support the value stream approach for measuring the cost of stream's products and services from the perspective of consumed resources while at the same time provide more accurate and reliable information on these products and services for the purposes of profitability and decision-making analyses. Thus, two levels of information can be obtained on the cost of each product or service within the stream. The first is general at the stream level and is used for the purposes of preparing the stream value income statement. The second is detailed at the product or service level and is used for operational decisions related to removal of waste and improvements and for strategic decisions related to the product or service.

4.3Support for long-term decisions

[13] believes that the preparation of the income statement according to value stream approach that deals with all costs as variables within the stream is the most important task of cost accounting in the supply chain management environment. Contribution margin analyses at the value stream level are indeed very useful in the short term; however, long-term decisions require comprehensive, detailed and accurate information. Such information can be provided by TDRCA as an addition when it is necessary to take into account the long-term effects of decisions associated with the value stream.

4.4Resource routing within value stream:

Value streams combine the resources of producing a homogeneous product or family of products into a path consisting of a set of productive cells. TDRCA, in turn, gathers the resources of the value stream within homogenous pools based on the outputs of the pools, while middling the singular time-driven activities in the absence of such a relationship. Thus, additional information is provided on the causes of resource consumption, where consumption is made, and what activities are most resource intensive within the value stream. This information leads to rationalization of resource consumption and reduction of waste, and supports continuous improvement initiatives[24],[25].

4.5Throughput costing and production mix decisions

When resources are constrained within the value stream, it is necessary to consider throughput as well as the contribution of each product to achieving this throughput [41].All this requires analysis of the cost per unit of restricted resources that cannot be calculated using the simple method of unit cost for the value stream due to its concern with the macro level. TDRCA provides this level of information and supports the maximizing of productivity of restricted resources by accurately and simply measuring the costs of resources restricted throughout the entire value stream. Cost will be expressed in resources measured by a predefined power unit (often the time). Besides, product consumption for each resource energy is also determined by a certain number of resource power units (all within the production capacity approach). By comparing the quantities of energy consumed from the resource, we can weigh one product on the other depending on what it consumes compared to the value it will add. Throughput will be measured at detailed levels of resources, which TDRCA can deliver at the level of each resource within the stream.

4.6Employee Empowerment Support

Employee empowerment is a principle of supply chain management. It requires timely and understandable information for the employee with reference to cost and achievement, as well as performance monitoring and evaluation systems that support motivation. Through technological integration, TDRCA provides the aspect of real-time information. Cost is expressed in the form of consumables, which makes TDRCA capable of generating reports appropriate to different levels

of management, including detailed information for operational levels in a simple and useful frame work that encourages cost perception culture and makes discussion and decision-making a daily event based on real figures. Thus, an employee can simply and quickly estimate in advance the results of any initiative s/he undertakes. With regard to performance monitoring and evaluation, TDRCA supports the interactive use of control systems, and this is positively reflected in the development and dissemination of organizational capacity, which [20] considers event-based resources that arise when individuals' skills are coordinated in replicable work patterns. This interactive use of control systems is achieved by identifying a team responsible for a resource pool with all its outputs and related activities or even on the entire value stream on one hand, and finding a kind of self-censorship that emanate from the engagement of individuals in the development and ongoing adjustment of evaluation criteria on the other hand. Therefore, TDRCA shifts accountability from a monitoring and evaluation system to a system of motivation and creativity which supports the achievement of competitive advantages that contribute to creating value for the organization[23].

4.7Support for waste elimination initiatives

The support for waste elimination and continuous improvement initiatives requires three aspects in the costing approach:

- Appropriate performance measures:

[35] determine three types of benchmarks needed to support the success of waste elimination and continuous improvement initiatives, summed up in "Box Score". These are operation metrics, energy metrics, and financial metrics. These three types are provided by TDRCA at the required level of measurement. At the operational level, TDRCA provides an enormous number of operational metrics through the time drivers contained in this approach. TDRCA offers three energy measurements at the level of each resource pool within the value stream: i.e. available practical energy, energy produced(used),and idle energy. Financial metrics for resource costs and conversion costs are available for each value stream and directly relate to each specific product in a simple and understandable manner.

- Technological integration and predictive capability:

Technological integration refers to the ability of the approach to collect multiple data with different characteristics and generate information for various purposes easily and quickly. The predictive capability means that the expectations set by the cost approach solicit specific and precise circumstances that match what actually will happen. In terms of technological integration, RCA has a high degree of integration with information technology, particularly with ERP [2]. This integration is also inherited by TDRCA, enabling this approach to compile data on all resources easily and quickly. Therefore, it provides timely information on the volume of resources consumed and the idle capacities and causes of consumption of these capacities. With regard to predictive capability, the direct causal relationships provided by this approach between resource quantities and output volumes as well as indirect causal relationships of ABC lead to improved accuracy of activity-based budget estimates, providing a comprehensive view of the reduction in resources that proposed initiatives can achieve prior to implementation. [47] believes that a deep understanding of cost as resource flows evokes predictability of the results of supply chain management initiatives without having to wait until these results emerge and it becomes difficult to rectify these initiatives. The evident causal relations of capacity consumption in TDRCA provide a new perception of continuous improvement from the perspective of capacity consumed as these relationships direct the efforts within each resource complex towards generating the same amount of output using the less resource capacities on the one hand, and with less activity drivers or less amount of capacity consumed by these drivers – in the absence of direct input-output causal relations – on the other hand. The technological integration and predictive capability lead to the provision of accurate, reliable and relevant information not only about the real causes of waste and the premises of improvement, but also the results of all initiatives to

eliminate such waste and the results of continuous improvement initiatives.

- Availability of quantitative and financial information:

Lack of quantitative and financial information on waste and waste elimination initiatives is one of the most important gaps in supply chain management. TDRCA can fill these gaps by, firstly, defining all factors affecting the quantities of capacity used, secondly linking the financial results of the behaviour of these factors in a simple and concise manner, and thirdly providing a clear causal relationship between inputs and outputs.

4.8 Maximizing net cash flow

The primary goal of supply chain management initiatives is to make maximum possible cost reduction while also maximizing the cash flowing from these costs [45]. All traditional cost approaches fail to maximize the cash flow generated by cost and this, according to Lee (2016), is due to that these approaches are a poor proxy for cash flow. Achieving the previous goal requires an improvement in output capacity, which cannot be achieved without determining a causal relationship between capacity of input and demand on outputs [30]. This, in turn, cannot be carried out at the level of value stream because there are multiple drivers of resource consumption that cannot be detected by the surface value flow analysis. TDRCA provides a clear picture of how resource capacity affects cash flow through a model input-output relationship defined by the quantity produced. Therefore, preliminary estimates can be made about the amount of resources required to generate the cash flow that can be achieved. Thus, any quantities of surplus resources that can be disposed of, maximizing cash flows or investing them in generating additional cash flows whenever possible and as previously indicated in the presentation of the role of the production capacity approach in cost reduction[11][18].

5. Conclusions

TDRCA is considered a new development of RCA, integrating the time-driven approach (which is the basis of TDABC) to the activity analysis methodology of RCA. This development has enhanced TDRCA ability to manage and analyse resources through a double view of resource consumption. Resources are consumed through a clear causality between outputs and inputs in each resource pool. In the absence of such causality, the time-driven approach creates an indirect relationship between inputs and outputs by channelling activities as a fixed resource capacity consumer. This channelling of time-driven activities– as a measure of capacity – creates an artificial change in the fixed costs dealt with by RCA as period costs. This, in turn, provides more accurate data on resources consumed and consumption drivers, and opens up a wide range of cost reduction depending on the production capacity consumed.

Depending on the production capacity mechanism, real cost reduction can be achieved from the perspective of consumed resources. This reduction can be realized, firstly, by measuring and isolating idle capacities associated with non-value-adding activities and the non-produced and non-essential capacities and regarding them all as idle capacities. The second step is to attempt to improve the efficiency of the produced capacities (which are directly associated with the resource pool outputs or the value-adding activities)as well as the essential non-produced capacities(associated with non-value-adding, essential and binding activities). All this takes place relying on TDRCA capabilities to determine the time consumption drivers – being a capacity measure – for each activity and determine also the amount of capacity needed for the various time drivers. The capacity of TDRCA to realize such strategic reduction in accordance with the production capacity mechanism are highly compatible with the supply chain management approach, due to the foundation both are based on in their definitions of cost. While supply chain management assumes that waste is the cost cause and determines it in seven aspects that are closely related to efficient resource utilization, TDRCA defines cost as expendable resources. Cost reduction will therefore be achieved by reducing the amount of resources utilized, with supply chain management determining the waste and the waste elimination initiatives, mechanisms for continuous improvement, and clarification by TDRCA as to

where the waste exists as well as the opportunities for improvement and the results of supply chain management initiatives.

6. Limitations and Further Research

The inability to obtain data from business organizations in developing countries is one of the most important constraints affecting the transformation of ideas and theoretical analysis studies into applied practical studies that benefit business organizations and researchers and reveal the validity of theoretical analysis. In this sense, this study may open new horizons for future theoretical studies to investigate the validity of the ideas presented here, develop and add to these ideas, endeavour to translate these ideas into practice in business organizations, and/or conduct surveys to show the attitudes of cost and managerial accountants to these ideas.

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