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Article

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THE IMPACT OF THE MAGNITUDE OF OVERHEAD COSTS ON THE DIFFERENCE BETWEEN ABC AND TDABC SYSTEMS

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Abstract: The objective of this study is to investigate the impact of the magnitude of overhead costs on the results of ABC and TDABC differences. A quantitative research method was used and data were gathered through an extensive literature review. A total of 170 articles that included both ABC and TDABC were found and 37 were used because only 37 articles included both the application of the systems and the comparison of the results of the systems. Correlation analysis and regression analysis were used to test whether there is a relationship between overhead costs and the differences in the results of ABC and TDABC systems. The results indicated that there is a statistically significant relationship between the total amount of overhead cost and the differences in the results of ABC and TDABC systems. Accordingly, when the overhead costs are increased, the TDABC system produces more different results than ABC. Based on this finding, the practical implication of this study seems to portray that companies with high overhead costs using the TDABC system rather than the ABC have the advantage of ascertaining product costing differently, which are more accurate.

Keywords: activity-based costing system, advanced costing systems, correlation analysis, overhead, regression analysis, time-driven activity-based costing system.

JEL: M40, M41, M49.

1 Introduction

In today's world, organizations need modern and sophisticated costing systems to use resources more efficiently and effectively. Indeed, an advanced costing system plays a major role in organizations getting more accurate results. It is also essential for decision makers to avoid over-costing or under-costing (Ozyapici and Tanis, 2016).

Traditional costing systems (TCS), such as absorption costing, standard costing, and variable costing, are not capable of compensating for organizational requirements (Celik, 2016). Accordingly, in the mid-1980s, activity-based costing (ABC) system was developed as an alternative to TCS (Ozyapici and Tanis, 2017). Even though ABC is a more accurate system than TCS, it has some shortcomings such as it is costly to implement, maintain, and update (Kaplan and Anderson, 2004).

Accordingly, Kaplan and Anderson explored a new costing system called time-driven activity-based costing (TDABC) system to minimize and eliminate

the problems of the conventional ABC system (Abbeele, et al., 2014). In this regard, many studies (e.g., Everaert, et al., 2008a; Dalci, et al., 2010; Oker and Ozyapici, 2013) have been conducted to compare the differences between ABC and TDABC systems.

According to previous studies, a group of researchers (e.g., Everaert, et al., 2008b; Kont, 2011; Namazi, 2016) investigated the theoretical background of the TDABC model and found that the TDABC system is more sophisticated and easier to update than the conventional ABC system. They found that the TDABC system can be implemented in all organizations and service industries with less difficulty in products and services.

The researchers also mentioned that the TDABC system can be quickly adapted to fluctuating circumstances and provide more detailed resources for decision makers to get accurate managerial and financial results. In addition, the TDABC model can be considered as an instrument for developing and perform-

ing an effective management operation (Kaplan and Anderson, 2007a; Putteman, 2008).

Another group of researchers (e.g., Kaplan and Anderson, 2007b; Dalci, et al., 2010; Oker and Ozyapici, 2013) examined the implementation of the TDABC system in organizations in order to demonstrate the efficiency and effectiveness of the system. They mentioned that the TDABC system is a new costing system that is applied based on both capacity cost rates and the time needed by activities to increase managerial and financial performance in organizations. In addition, they emphasized that this model requires less time and costs for collecting and analyzing resources. They also found that the TDABC system was developed to solve or eliminate the problems that occurred with the conventional ABC system. They noticed that the TDABC system increases the performance of organizations.

It is also important to emphasize that technological innovation has led companies to invest in advanced technologies. Accordingly, the overhead rate has risen (Tanis, 2005). In addition, increases in transactions result in variation in overhead costs (Banker, et al., 1995). Therefore, it is expected that costing systems using volume-based cost drivers will produce different results than the ones using the number of transactions as an allocation base. That is, increasing the magnitude of overhead costs may result in difficulties in managing and allocating overhead costs.

Costing systems may also produce different results from each other when a company's overhead costs are high, because overhead costs include both variable and fixed components. In this regard, the magnitude of overhead costs may have an effect on the results of costing systems.

However, to the best of our knowledge, even though many studies related to TDABC have been conducted by researchers, no studies have investigated the impact of the magnitude of overhead costs on the results of the ABC and TDABC systems. Accordingly, this study is unique in the sense that it investigates whether the magnitude of overhead costs has an impact on the differences between the results of ABC and TDABC systems.

2 Theoretical background

TCS, in general, uses direct labor hours to trace overhead costs to products (Gunasekaran and Sarhadi, 1998). In spite of TCS being more than 70 years old, many organizations still use it for their financial goals (Manalo, 2004; Abbeele, et al., 2014). However, using a single application rate, which is mainly volume based, causes inappropriate results, especially in complex organizations producing various types of products (Rasiah, 2011; Tanis and Ozyapici, 2012). In addition, since it uses single or volume-based cost drivers, it causes cost distortions in companies with a wide range of products (Krishnan, 2006; Oker and Ozyapici, 2013). TCS may also not provide appropriate non-financial resources for enterprises, especially small- and medium-sized ones (SMEs) (Rasiah, 2011; Ghanbari, et al., 2016). Accordingly, today's highly competitive environment has forced organizations to implement advanced costing systems (Ghanbari, et al., 2016).

ABC was developed by Robert S. Kaplan in the beginning of the 1980s as an alternative to TCS because of the problems, such as unproductiveness and cost estimations that were not accurate, encountered by cost accountants and managers (Oker and Adiguzel, 2016). ABC is a costing system that uses activities to assign the cost of resources to products or services (Oker and Ozyapici, 2013).

The ABC system covers two stages (Everaert, et al., 2008b). In the first stage, indirect costs are assigned to the activities by using resource drivers. In the second stage, the costs of the activities are allocated to the cost objects by using activity drivers (Everaert, et al., 2008b).

ABC ensures more accurate resources for companies, which had mostly moved from the old generation that used TCS to the well-designed modern generation (Cooper and Kaplan, 1992). Although the ABC system has some benefits, such as providing more accurate results than TCS or disclosing details regarding activities, it is not convenient for the demands of modern business environments (Oker and Adiguzel, 2016).

Indeed, many organizations, especially medium- and large-sized ones, abandoned the ABC system because it is costly to implement, maintain, and update (Kaplan and Anderson, 2004). Therefore, Kaplan and Anderson developed the TDABC system to minimize and eliminate the problems of the conventional ABC system (Abbeele, et al., 2014; Campanale, et al., 2014; Namazi, 2016).

The TDABC system is easier to use, more effective, and less costly than the ABC system (Kaplan and Anderson, 2007b; Hajiha and Alishah, 2011). It is a modernized costing system solving the complexities and impediments of the conventional ABC system (Abbeele, et al., 2014).

The TDABC system uses a new cost structure based on time duration and capacity cost rate in order to improve cost management performance. The new system also allows managers to obtain accurate cost resources for establishing organizational long-term strategies (Oker and Ozyapici, 2013; Namazi, 2016). In addition, updating process is very quick in this system because the TDABC uses time equations for each activity (Demeere, et al., 2009; Oker and Ozyapici, 2013).

The TDABC offers convenient and detailed preferences for defining capacity, costs, operations, and customers (Abad, 2016). TDABC is an excessively efficacious accounting method that allows enterprises to recognize unused capacity and gather cost information in a detailed way (Manner, 2015).

The TDABC system eliminates the problems and obstacles that occur with the conventional ABC system (Oker and Ozyapici, 2013). This system helps managers to develop and modernize the various organizational processes through the objectives of the financial department (Demeere, et al., 2009).

The TDABC system also provides significant predictions regarding the costs of resource consumption and capacity utilization (Cengiz, 2011). Demeere, et al. (2009) emphasized that the TDABC system discloses activities, resources, and costs that were excluded from the previous accounting attempts.

The TDABC system can be upgraded and improved more easily and is less costly than the conventional ABC system (Kaplan and Anderson, 2007a; Demeere, et al., 2009).

Many studies (Dalci, et al., 2010; Oker and Ozyapici, 2013) have been carried out to compare the differences between the ABC and TDABC systems. They concluded that (see e.g., Banker, et al., 1995; Tanış (2005, pp.32-34). ABC and TDABC systems have different results from each other. Indeed, it is expected that costing systems using volume-based cost drivers will produce different results than the ones using duration as an allocation base. It is also expected that increases of the overhead costs may boost differences between the results of ABC and TDABC systems.

3 Research Methodology

The purpose of this study was to analyze the relationship between the total amount of overhead costs and the differences in the results of ABC and TDABC systems. Accordingly, published articles and research studies were analyzed. The population of this study is all the published scientific research studies comparing ABC and TDABC systems. Even though a total of 170 scientific articles were investigated related to ABC and TDABC systems, only 39 articles including the comparisons of the systems were analyzed. Nevertheless, 37 articles were considered because 2 articles were removed due to the outliers. Table 1 presents a list of the articles used in this study.

The research period began in January 2016 and was completed in May 2017. The research data was analyzed with SPSS version 20. After completing 37 research articles out of 170, the results reported in the articles were entered into SPSS.

The study measured the differences in the results of ABC and TDABC systems as a dependent variable and the total amount of overhead cost as an independent variable. In this study, Pearson's correlation analysis and regression analysis were used to interpret the results.

Table 1. Complete list of articles used in the research study
(Source: Authors' own research)

	Authors	Year	Overhead Costs	Differences	Title
1	Mitchell Max	2007	774 900.00	43 945.00	Leveraging Process Documentation for Time-Driven Activity-Based Costing
2	Levent Koşan	2008	2 719 776.00	291 036.00	Faaliyet Tabanlı Müşteri Karlılık Analizi: Bir Konaklama İşletmesinde Uygulama
3	Levent Koşan	2007	250 000.00	33 000.00	Sürece Dayalı Faaliyet Tabanlı Maliyet Sisteminin Müşteri Karlılık Analizinde Kullanılması: Bir Konaklama İşletmesinde Uygulama (using time driven activity based costing system for customer profitability analysis: a case study in an accommodation company)
4	Patricia Everaert, Werner Brugeman, Gertjan De Creus	2008a	362 880.00	142 272.00	Sanac Inc.: From ABC to Time-Driven ABC (TDABC) – An Instructional Case
5	Levent Polat	2008	1 287 560.00	7 862.00	Zaman Sürücülü Faaliyet Tabanlı Maliyetleme ve Bir Sanayi İşletmesinde Uygulaması
6	Figen Oker, Hasan Ozyapici	2013	14 184.00	280.01	A new Costing Model in Hospital Management: Time-Driven Activity-Based Costing System
7	Michel Gervais, Yves Levant, Charles Ducrocq	2010a	49 920.00	3 900.00	Time-Driven Activity-Based Costing (TDABC): un premier bilan à travers une étude de cas longitudinale
8	İnci Demir	2009	2 507 520.00	1 141 387.40	Sürece Dayalı Faaliyet Tabanlı Müşteri Karlılık Analizi: Bir Eğitim Kurumunda Uygulama (Customer profitability analysis with time driven activity based costing: a case study in an educational institution)
9	Ilhan Dalci, Veyis Tanış, Levent Kosan	2010	2 092 135.00	19 941.00	Customer Profitability Analysis with Time-Driven Activity-Based Costing: A case Study in a Hotel
10	Metin Saban, Gülay Güğərçin İrak	2009	567 000.00	46 260.00	Çağdaş Maliyet Yönetimi Sistemlerinden Sürece Dayalı Faaliyet Tabanlı Maliyetleme (Modern cost management system: time driven activity based costing)
11	Michel Gervais Yves Levant Charles Ducrocq	2010b	51 170.00	2 754.00	Time-Driven Activity-Based Costing (TDABC): An Initial Appraisal Through a Longitudinal Case Study
12	Figen Oker, Humeyra Adiguzel	2016	9 998 303.00	6 638 972.00	Time-Driven Activity-Based Costing: An Implementation in a Manufacturing Company
13	Mark Thomas Stelling, Rajkumar Roy, Ashutosh Tiwari, Basim Majeed	2010	56 250.00	21 154.00	Evaluation of Business Processes Using Time-Driven Activity-Based Costing
14	David E. Stout, Joseph M. Propri	2011	6 624.00	2 751.68	Implementing Time-Driven Activity-Based Costing at a Medium-Sized Electronics Company

Table 1. Complete list of articles used in the research study (cont.)
(Source: Authors' own research)

	Authors	Year	Overhead Costs	Differences	Title
15	Emre Cengiz	2011	19 547.00	4 325.71	Faaliyet Tabanlı Maliyetleme ve Sürece Dayalı Faaliyet Tabanlı Maliyetleme Arasındaki Farklar-Bir Mobilya Üreticisi Firmada Vaka Çalışması (The Differences Between Activity Based Costing And Time-Driven Activity Based Costing – A Case Study In A Furniture Manufacturer Company)
16	Ayşe Aydın	2011	47 131.14	11 036.75	Zamana Dayalı Faaliyet Tabanlı Maliyet Sistemi ile Hizmet Karlılık Analizi: Dış Hekimliği Fakültesinde Uygulama
17	Onur Tamur	2012	4 667 414.00	1 139 909.00	Creating a Product Portfolio Strategy Via Activity-Based Costing Application in Food Production
18	Selçuk Capuk	2012	56 730.00	9 315.00	Bir Havayolu Şirketinde Zaman Etkenli Faaliyet Tabanlı Maliyet Uygulaması (Application of time driven activity based costing for an airline company)
19	Azende Terungwa	2013	1 938 000.00	496 192.00	Time-Driven Activity-Based Costing and Effective Business Management: Evidence from Benue State, Nigeria
20	Çağrı Koroglu	2012	795 721.54	23 673.88	Stratejik Maliyet Yönetimi Kapsamında Sürece Dayalı Faaliyet Tabanlı Maliyetleme Yönteminin Analizi ve Bir Otel İşletmesinde Uygulama
21	Zohreh Hajiha, Samad Safari Alishah	2011	5 670 000.00	377 471.34	The implementation of Time Driven ABC System
22	Fatemeh Kowsari	2013	3 862.00	654.00	Changing Costing Models from Traditional to Performance Focused Activity-Based Costing (PFABC)
23	Morteza Bagherpour, Afshin Kamyab Nia, Mehdi Sharifian, Mohammad Mahdavi Mazdeh	2012	346 000.00	85 814.23	Time-Driven Activity-Based Costing in a Production Planning Environment
24	Kristof Stouthysen, Michael Swiggers, Anne-Mie Reheul, Filip Roodhooft	2010	10 756.00	2 067.00	Time-Driven Activity-Based Costing for a Library Acquisition Process: A Case Study in a Belgian University
25	Paul Grant	2015	1 941 000.00	267 200.00	How Much Does a Diabetes Out-Patient Appointment Actually Cost? An Argument for PLICS
26	Jaroslav Mielcarek	2014	560 000.00	89 040.00	Falsification of Time-Driven Activity-Based Costing (TDABC) and Instead What?
27	Hilmi Kirlioglu, Bedia Atalay	2014	2 866.27	308.00	Hastane İşletmelerinde Sürece Dayalı Faaliyet Tabanlı Maliyetleme Modellemesi
28	Zheng-Yun Zhuang, Shu-Chin Chang	2017	350 000.00	104 155.00	Deciding Product Mix Based on Time-Driven Activity-Based Costing by Mixed Integer Programming
29	Bas Basuki, Mertzha Dwiputri Riediansyaf	2014	14 432 932.53	289 897.36	The Application of Time-Driven Activity-Based Costing In the Hospitality Industry: An Exploratory Case Study

Table 1. Complete list of articles used in the research study (cont.)
(Source: Authors' own research)

	Authors	Year	Overhead Costs	Differences	Title
30	Murat Küçüktüfekçi	2014	500 000.00	5 027.00	Zamana Dayalı Faaliyet Tabanlı Maliyetleme Sistemi ve Faaliyet Tabanlı Maliyetleme Sisteminin Karşılaştırılması: Bir Üretim İşletmesinde Uygulama (Compression of time-driven activity based costing system and activity based costing system: application of a manufacturing enterprise)
31	Sina Akhavan, Lorrayne Ward, Kevin J. Bozic	2016	14 349.00	6 559.80	Time-Driven Activity-Based Costing More Accurately Reflects Costs in Arthroplasty Surgery
32	Muhsin Celik	2016	560 000.00	12 648.00	Bulanık Sürece Dayalı Faaliyet Tabanlı Maliyetleme Sistemi (Fuzzy Time-Driven Activity-Based Costing)
33	Seyed Taha Hossein Mortaji, Morteza Bagherpour, Mohamed Mahdavi Mazdeh	2013	1 872 000.00	97 120.00	Fuzzy Time-Driven Activity-Based Costing
34	Robert S. Kaplan, Steven R. Anderson	2007	567 000.00	32 760.00	The Innovation of Time-Driven Activity-Based Costing
35	Doğan Özata	2016	37 190.00	2 976.48	Çağdaş Bir Maliyetleme Yöntemi Olarak Zaman Etkenli Faaliyet Tabanlı Maliyetleme ve Otomotiv 37.Sektöründe Faa38.liyet Gösteren Bir Firma Örneği (Time driven activity based costing as a modern costing methodology and a sample on a firm operating in the automotive sector)
36	Mehrdad Ghanbari, Hamid Khorasani, Mohammad Zabih Manesh, Bahamin Khoshnava	2016	59 167.00	8 053.00	Reasons of Limited Development of Activity-Based Costing Compared to Traditional Costing
37	Yangyang R. Yu, Paulette I. Abbas, Carolyn M. Smith, Kathleen E. Carberry, Hui Ren, Binita Patel, Jed G. Nuchtern, Monica E. Lopez	2016	4 335.00	1 582.00	Time-Driven Activity-Based Costing to Identify Opportunities for Cost Reduction in Pediatric Appendectomy

4 Results and Discussions

In this study, the impact of overhead costs on the differences in the results of ABC and TDABC systems has been analyzed. Accordingly, both correlation analysis and regression analysis were performed.

4.1 Correlation Analysis

Table 2 demonstrates the correlation between the total amount of overhead costs and the differences in the results of ABC and TDABC systems. According to Table 2, the correlation is 0.878, with $P < 0.05$ ($P = 0.000$), indicating a significant and strong relationship. This means that the differences in the results of ABC and TDABC systems become larger

when a company's overhead cost is high. In other words, when overhead cost is high or when the proportion of overhead cost to the total cost is high,

the TDABC system produces more accurate results when compared to the ABC system.

Table 2. Correlation analysis (*Source: Authors' own research*)

Correlations			
		Overhead cost	ABC-TDABC differences
Overhead cost	Pearson Correlation	1	0.878**
	Sig. (2-tailed)		0.000
	N	37	37
ABC-TDABC differences	Pearson Correlation	0.878**	1
	Sig. (2-tailed)	0.000	
	N	37	37

**Correlation is significant at the 0.01 level (2-tailed).

4.2 Regression Analysis

A regression analysis model indicates the relationships between the variables in the research data. Table 3 shows both R square and adjusted R square values.

The R square value indicates the variation of the differences in the results of ABC and TDABC systems that can be determined by the overhead costs. The R square value is 77%, which is very strong.

R square values less than 0.2 are determined as weak, R square values between 0.2 and 0.4 are determined as moderate, and R square values higher than 0.4 are determined as strong (Pallant, 2013). The adjusted R square for this model is 0.764, which means that the difference in the results of the ABC and TDABC systems can be explained by 76.4% of the total overhead cost.

Table 3. Model Summary (*Source: Authors' own research*)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.878 ^a	0.770	0.764	0.52878

^a Predictors: (Constant), Overhead cost

Table 4 presents the regression output, which is 0.912. This means that if the amount of total overhead cost increases by 1%, the value of the difference in the results of ABC and TDABC will increase by 91.2%. In this case, the intercept value is -0.475. The t-statistics and P-value is used to determine whether a coefficient result is significantly different from zero.

By using 95% confidence levels, the regression for the total overhead cost (0.912) is significantly different from zero because its P-value is equal to 0.000, which is less than 0.05. Based on this result, it is concluded that the magnitude of overhead cost has a statistically significant effect on the difference between ABC and TDABC.

Table 4. Regression Analysis (*Source: Authors' own research*)

Regression Analysis						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.475	0.456		-1.042	0.304
	Overhead cost	0.912	0.083	0.878	10.989	0.000

According to the findings and results of the study, when the overhead costs are increased, the TDABC system produces more different results than ABC. This finding is very important for organizations and industries, especially those operating with a high amount of overhead cost such as heavy industries, automobile sectors, telecommunications, and energy sectors. This result provides a better reason for managers to use a suitable costing system in order to calculate the cost of resources more efficiently and effectively.

The TDABC system offers a comprehensive solution for eliminating complexity and obstacles during operations by using time equations. Our findings indicate that the results of the TDABC system may provide more appropriate outcomes for organizations, particularly those operating with high amounts of cost. Consequently, our research study shows that the magnitude of overhead cost or an increase in the proportion of overhead cost will affect the difference in the results of ABC and TDABC systems.

5 Conclusion

5.1 Concluding comments

In the global business environment, organizations are facing many obstacles, problems, and strong competition. Organizations seek new opportunities to increase their productivity and services. Managers need effective and accurate product costs to minimize financial and managerial risks when they deal with problems in their organizations.

Advanced costing systems play a crucial role in assisting organizations to reach accurate cost results. TCS was developed to analyze the costs of products and services. In the last few decades, organizations have had limited products and passive competition,

so TCS could solve certain problems simply. However, nowadays, organizations deal with many difficulties and obstacles that affect the productivity and performance of the organization.

The ABC system, developed in the mid-1980s, produced more accurate cost information than TCS. However, ABC systems are not appropriate for some organizations because the implementation of the ABC model is expensive and takes time to maintain and update (Kaplan and Anderson, 2007b). Therefore, a new costing system, TDABC, was developed to meet the needs of organizations.

In this research, we conducted a literature review and collected scientific research articles from different fields related to both ABC and TDABC systems. We used the methods of correlation analysis and regression analysis to clarify our objective. The objective of this study was to clarify the relationship between total overhead cost and the difference in the results of ABC and TDABC systems.

The correlation analysis demonstrated that there is a significant relationship between overhead costs and the differences in the results of ABC and TDABC systems. In addition, the regression results confirmed that every amount of cost increase in the total overhead cost will affect the difference in the results of ABC and TDABC systems. To sum up, this study concludes that the magnitude of overhead cost has an effect on the results of ABC and TDABC. In this regard, increases in overhead costs will result in increases in the difference of ABC and TDABC. Consequently, this study indicated two implications.

First, companies especially those using ABC can use TDABC to have alternative pricing strategies because when the overhead costs are increased in total cost the TDABC system produces more different results than ABC.

Second, the TDABC system estimates time duration and use to drive costs directly from the cost resources to the cost objects, eliminating the tedious and error-prone stage of assigning resource costs to activities (Kaplan and Anderson, 2007b).

Accordingly, by considering the philosophies of TDABC system, managers can solve the existing system's restrictions and consolidate their strategies to improve the performance of their organizations in addition to having different results, which are more accurate. Based on the findings, the magnitude of overhead costs will positively affect the differences in the results of ABC and TDABC systems, especially when the amount of total overhead costs is high, such as in large manufacturing firms.

5.2 Limitations of the Study

This study provides clear evidence of and outcomes about the effects of the magnitude of overhead cost on the difference in the results of ABC and TDABC systems based on data analysis and findings. However, two limitations have resulted in some gaps in the study.

The data collection process and evaluation procedure is quite long. It was difficult and time consuming to find the resources and data needed. Accordingly, the research study was done over a period of one year, from January 2016 to May 2017. The second limitation is that only a small number of articles about the research topic were available; therefore, only 37 articles were analyzed. The outcomes of this study would have been more comprehensive and meaningful if a wider range of articles and research journals had been available.

5.3 Recommendations for Future Research

Research studies may specify critical research recommendations for future studies to improve the knowledge and the literature in the field. Accordingly, this research study analyzed the impact of the total amount of overhead cost on the difference in the results of ABC and TDABC systems. As a result, three recommendations can be suggested for future research:

- First, researchers can divide data into low level and high level, and then investigate whether there

are any statistically significant differences between the means of two groups.

- Second, researchers may try to investigate the relationship between the differences in the results of ABC and TDABC systems and total overhead costs in a specific industry, such as healthcare, hospitality, or banking.
- Third, it would be valuable to investigate the impact of overhead costs on the difference between the results of TDABC and Resource Consumption Accounting (RCA) system.

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