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Teaching and educational note

Sanac Inc.: From ABC to time-driven ABC (TDABC) – An instructional case

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Abstract

This case deals with the decision of Sanac Inc., a Belgian wholesale company, on whether to proceed with the implementation of an activity-based costing (ABC) system or switch to time-driven activity-based costing (TDABC). As a business consultant, you are hired to decide about the appropriate costing method. Your task is to decide which system the company should implement, given the desire of the president of the company to calculate profitability at the order and the customer level.

Keywords: Activity-based costing (ABC); Time-driven activity-based costing (TDABC); Teaching case; Logistics; Customer-profitability analysis

1. Case materials

1.1. Introduction

> "We are competing in an environment with a wide variety of customers, many different products and complex services provided to the customers. Our sales are grow-

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ing, as is operational and administrative complexity, but profitability is suffering. We urgently need detailed insight into customer profitability. Although ABC seems like the perfect textbook tool to understand costs and profits, in this situation given the increased complexity of the business and our seasonal demand, it turns out to provide inaccurate information at best. How can that be and what can be done about it?" Gertjan De Creus, CEO of Sanac.

In 2000, Gertjan De Creus was appointed as the new CEO of Sanac Company, located in Wervik, Belgium. His mission was to change the company culture from revenue to profit maximization. To retain customers and to defend market position in a fiercely competitive market, sales reps at Sanac were promising more services to customers. As a result, the company was growing, but profits were falling. De Creus wanted to have detailed monthly reports on customer profitability. In June 2005, the company started an ABC project. After reviewing the initial results, De Creus doubted whether ABC could ever be successfully implemented in his company.

1.2. Company background

Sanac is a family-owned distributor of plant-care products in Belgium; the company posts total sales of €62 million, a transportation fleet of 25 trucks, and a warehouse of 22,500 pallets of products. Sanac neither produces nor sells any of its products under its own name. It only retails well-known brand products to three different customer groups: farmers, growers, and retail outlets (large and small department stores, do-it-yourself shops, and garden centers), as shown in Table 1. Sanac has about 7000 customers, 7000 products, and receives approximately 298,000 order-lines[3] per year. The company employs 129 people, 40 of whom are sales reps and 57 work in the warehouse. The company has been in continuous expansion; in the last 10 years its sales have increased by 10% annually.

Sanac's competitive strategy is predicated on three core elements. The first is *product know-how*. Sanac not only sells items related to planting and growing (especially the plant-care products) but also distributes its product knowledge to the customer. Sanac compares itself to a pharmacist: its mission is to help farmers and growers find an appropriate phyto[4] and fertilizer. Based on this product know-how, Sanac builds long-term relationships with farmers and growers. For the retail outlets, Sanac compares itself more to a consultant, by providing displays to the outlet stores. The purpose of a display is to provide information to the final consumer so that (s)he immediately finds the right product for typical garden problems (e.g., insects on roses). Often, employees of retail outlets do not have the appropriate skills to guide the final consumer. Sanac, in fact, operates a sales area within the retail outlet, ensuring its profitability per square meter, without any, or very little, investment or training required on the part of the outlet store.

[3] An order-line consists of one line in a sales-order. It indicates the product and the related quantity of a given product that the customer intends to buy from Sanac. For example, four different products ordered by the customer at a given time results in four order-lines on the sales-order.

[4] Phyto is a general term for all kind of pesticides. It basically is a chemical substance used to kill harmful insects, small animals, wild plants and other unwanted organisms on crops and plants.

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Table 1
Lines of business (LOB) – characteristics

	Agriculture	Horticulture	Home and garden
Activities	Purchasing Technical support Marketing Sales	Purchasing Technical support Marketing Sales	Purchasing Product management Marketing Sales
Customers	Farmers: small to large	Growers: small to large	Garden centers: small to large DIY stores: small to large Department stores (e.g., Hubo, Makro, Gamma, Leroy Merlin, Carrefour)
Products	Professional products Phyto (crop protection) Fertilizer Seeds Other	Professional products Phyto Horticultural supplies (e.g., small pots)	Products for individual consumers Phyto in small packs Fertilizer in small packs Garden furniture Cutting tools Pottery and deco Garden consumables e.g., swimming pools
Sales[a]	Strong seasonal trend	Strong seasonal trend	Strong seasonal trend
Market stage	Declining market	Stagnating market	Growing market
Competitors	Many	Many	Strong position of Sanac

[a] In reality there is a fourth business segment, which was deleted in the case. This fourth business offered professional products to landscapers and public greenery companies and accounted for approximately 4% of total sales.

The second key component in Sanac's strategy is *market know-how*. Sanac's markets are seasonally sensitive and subject to trends. Therefore, feedback from sales technicians[5] and sales representatives[6] is essential as this feedback constitutes an important source of information on what is happening in the market. Also, information from truck drivers is important because these individuals know the customer very well. Trend analysis, visits to fairs, and trend-watching are important to detect trends for the next season. If pottery needs to be procured in China, Sanac must know what kind of color customers will prefer in the coming year. This market knowledge is important to avoid unsold items.

Third, providing *services* to the customer is important. Sanac is a logistics company; fast and on-time delivery are important since the company deals either with professionals within supermarkets and hypermarkets (for whom any delay means a loss of sales) or with farmers and growers (for whom speed-of-delivery may adversely affect their production).

[5] Sales technicians are highly skilled bio-engineers employed by Sanac. They have knowledge on how to treat for crop protection or how to fertilize to make the plants grow well. They mainly visit farmers and growers to provide advice on crops (farmers) and plants (growers).

[6] Sales reps are also employed by Sanac, but are more marketing-oriented than the sales technicians. Sales reps visit retailers (instead of the farmers and growers). They discuss new products (and related displays) with the retailer. Sales reps also register sales-orders during their visit and transfer them by phone to the sales-order-processing employees at the premises of Sanac, who in turn enter the sales-orders into the company's computer system.

1.3. Profitability paradox

In the 1990s, Sanac was primarily sales driven. There was a total lack of insight into the relative profitability of customer segments. In the 2000s, competition increased, profit margins came under pressure, and customers asked for more services. Furthermore, the company faced a fast-changing market, strong seasonality, growing complexity, and diversity of its products and customers. These changes forced Sanac to switch from a growth strategy to a "*profitability-enhancing*" strategy.

Marketing strategy was focused on the retail outlets (the so-called home & garden business), which was a new segment since the early 2000s. However, Sanac did not understand the true cost of this new activity or the resources invested in it (e.g., the logistics, administration, and financing cost—due to long payment terms). Despite a significant increase in annual company sales (from €37 to €62 million in 4 years) and stable gross margins, a decrease in operating profit was noticed. To address this paradox at Sanac, Gertjan De Creus wanted more insight into the cost data. The existing cost accounting system only allowed for the calculation of a contribution margin (i.e., sales minus cost of purchases) for major product lines (see Table 2).

There remained, however, unallocated overhead (approximately €2.5 million in 2000) and these costs, considered fixed in principle, were actually increasing each year. Based on the annual increase in overhead costs, and the fact that customers did not have to pay for the increased services (e.g., delivery terms), De Creus believed that the home and garden business was generating significant losses, that agriculture was profitable, and that horticulture was slightly loss-making. In fact, the line of business with the highest growth potential was probably also the least profitable line. Sanac was changing its business but the financial complexities associated with the new business were not well understood.

1.4. Activity-based costing (ABC)

The reduced profitability (20% decrease in the annual profit to sales ratio over the period 2000–2004; almost 100% increase in sales from 2000 to 2004) meant that a more accurate cost system was needed. Sanac changed its focus from "growth" to "profitability." The growth focus forced the company to have a wide range of products, to maintain large stocks, and to deliver any order to any customer in the shortest possible time in whatever quantity was requested. Further, customers did not pay a specified premium for the costs associated with the service level provided. Gertjan De Creus commented:

> "We apparently have 'good' and 'bad' customers. Our good customers generate margins and profit, but we do not know who they are. If we do nothing, we will end up with only bad customers. I need cost information per business, per customer, per order, per delivery, per order-line, per product, and per supplier. All of this is needed

Table 2
Contribution margin in 2005

Line of business (LOB)	Contribution margin (%)	Increase in sales (%)
Agriculture	17	+3
Horticulture	20	+10
Home and garden	24	+20

to provide profitability insight. Afterwards, we can start talking about whether to discard certain clients, products, suppliers or even businesses. But for this to occur, or for any change in strategy, we first need a reliable system for measuring costs and profit."

In June 2005, Gertjan De Creus directed his controller, Mike Johnson, to implement an ABC system. Johnson hired a leading consultancy company to help him design the ABC model. To start the process, consultant Chris Miller interviewed the heads of the functional departments about the activities they performed and the percentage of time they spent on the various activities. Next, Miller designed an activity database and identified appropriate activity-cost drivers. However, it soon dawned on him that a traditional ABC system would represent a huge challenge for Sanac. Chris Miller had a discussion with Gertjan De Creus about the requirements of the ABC model.

Gertjan De Creus:

> "I absolutely need monthly profitability reports at the level of business, customers, orders, products and suppliers."

Chris Miller replied:

> "Can you imagine how much the ABC system will cost you to provide monthly profitability reports based on actual sales and services provided? I guess Sanac will need to hire 10 controllers to update the model monthly."

But Gertjan De Creus progressed:

> "The model should be updated monthly with up-to-the-minute data. The rapidly growing market of retail outlets requires me to act immediately on a customer request. Outlet stores are very demanding when it comes to price and services. Sanac has to be an agile company, able to quickly change processes. In such a dynamic environment the adjustments of the ABC model to changing service requests of customers is very important."

Miller looked at the data and explained:

> "The great complexity and diversity of customers and products means that there are just too many activities to keep track of. Sanac has 7000 clients, a portfolio of 7000 products in stock and 20,000 in catalogue. It receives approximately 298,000 orderlines a year and issues 69,000 invoices. But more importantly, clients have varied demands in terms of services. This wide diversity in the consumption of resources makes it difficult to trace and analyze costs. There is a wide discrepancy in resource consumption according to products (e.g., type of product, type of packaging) and customer behavior (e.g., order frequency, delivery terms, visits of sales technicians or sales rep, payment terms). Of course, a small farmer does not generate the same profit margin or the same costs as the outlet store of a large chain, but how can I accurately include in the ABC model their relative service demands?"

Chris Miller looked further into the activity-cost driver selection. The strong seasonal trend in sales made it difficult to define a "normal capacity" for each of the activity-cost drivers. About 80% of the sales were realized in four (summer) months; there was signif-

Table 3
Average monthly cost data for sales-order processing and picking a delivery*

Activity	Number of FTEs	Total cost	Activity-cost driver	Driver volume	Activity-cost driver rate
Panel A: January–June 2005					
Picking a delivery	7.5	€177,840	Number of deliveries	30,000	€5.93 per delivery
Sales-order processing	5	€106,704	Number of orders	25,000	€4.27 per order
Panel B: July–December 2005					
Picking a delivery	7.5	€177,840	Number of deliveries	12,000	€14.82 per delivery
Sales-order processing	5	€106,704	Number of orders	10,000	€10.67 per order

**Notes:*
FTE = full-time employee.
Total cost = actual costs, over the six month period.
Driver volume = actual volume, over the six month period.
Activity-cost driver rate = actual rate over the 6-month period, calculated by dividing "total cost" by "driver volume".
"Picking a delivery" activity = preparation of the sales-orders to be delivered. It basically involves warehouse employees taking, for a given customer order, the appropriate goods from the storage racks and deliver these goods to the quay. From here, orders are combined and picked up by a truck for delivery to customers.
Sales-order processing activity = registration of the sales-orders received by phone, either from the customers directly or from Sanac's sales reps.

icant idle capacity in the winter months. It was clear that Gertjan De Creus wanted to know each month which departments were faced with overcapacity and which were running under capacity. Based on the data of the first 6 months of 2005, Chris Miller assigned the costs to the individual activities. For the activities "sales-order processing"[7] and "picking a delivery"[8] the following information was collected (see Table 3). Based on this information the activity-cost driver rates were calculated, as shown in Panel A.

In December 2005, Mike Johnson recalculated the activity-cost driver rates. He entered into the ABC system the total costs and total driver volumes over the last 6 months, as shown in Panel B of Table 3. De Creus observed a significant change in the activity-cost driver rates and asked Mike Johnson to check whether the cost assignments were made correctly. Mike explained that the higher activity-cost driver rates were due to the low season. But De Creus could not understand the logic. He could not understand why customers were apparently using more resources in the off-peak season than in the high season.

[7] The "sales-order processing" activity consists of employees answering the phone and then entering customer orders (requested products and quantities) into the computer system. Phone calls are made by customers or by Sanac's sales reps.

[8] Products are delivered from Sanac's warehouse to customers with Sanac-trucks. A given sales-order from a customer can be delivered in one or more deliveries (depending on the availability of the products and the service requests of the customers). The preparation of the goods to be delivered is called "picking a delivery." It basically involves warehouse employees taking the appropriate goods from the storage racks and then delivering them to the quay for loading. *The activity of loading the truck and driving to the customer is not considered part of "picking" since this activity is performed by other employees.*

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Mike Johnson explained that he had used the actual number of orders and the actual number of deliveries to calculate the activity-cost driver rates:

> "I could also use 'practical capacity' for the orders and deliveries, i.e., the largest number of orders (or deliveries) that could be handled without creating unusual delays or forcing overtime work. Using such capacity levels will result in activity-cost driver rates that stay the same during high and low season. During the low season, we could then calculate the unused capacity. But our people keep saying that it is almost impossible to estimate what is called the 'practical volume of orders' or 'practical volume of deliveries that they can handle without forcing overtime work,' because the practical volume really depends on the characteristics of the orders and deliveries to handle. That is why I used the actual volume of the activity-cost drivers."

1.5. *Activity complexity*

When conducting the activity analysis, the controller (Mike Johnson) and his team indeed noticed that many activities were complex. Cost rates, such as the picking cost per delivery and the drop-off cost per delivery, were in fact too aggregate and did not mean anything to De Creus and his sales reps. The sales reps explained that the *cost per sales-order processed* and the *picking cost per delivery* were different for each customer because these costs depend on the specific characteristics of the sales-order and on the specific characteristics of the delivery[9]. The following examples describe how these two typical activities were carried out in practice.

1.5.1. *Picking a delivery*

Sanac's own transportation fleet carries out order delivery. Here we consider the delivery-preparation process, otherwise referred to as "picking," i.e., the preparation in the warehouse of products to be delivered to the customer. The total cost (salaries, depreciation, etc.) of the warehouse department in the first half of 2005 was €177,840. The department employed 7.5 full-time employees (FTE) in the warehouse (each of whom worked 38 h per week, 52 weeks per year), costing a total of €355,680 per year. The employees work at a practical capacity of 80%. The warehouse employees were 100% dedicated to the "picking-a delivery" activity.

In the ABC model, the activity-cost driver identified with "picking a delivery" was the "number of deliveries". However, Mike Johnson was not sure whether this single cost driver adequately reflected resource demands associated with the picking activity. His interview data revealed the following complexity of the picking activity:[10]

[9] A single sales-order can be delivered in one or more deliveries, depending on the service requests of the customer. For instance, one sales-order might be delivered in parts, to one or many different locations, as requested by the customer. The customer would do this to minimize his/her inventory holding costs.

[10] The picking activity is performed for each delivery to the customer. One truck load can contain deliveries to different customers, but the operation of picking is performed separately for each delivery to a given customer. For didactical purposes, the operation of loading the truck, the operation of driving the truck to the customer's place and the operation of dropping off the goods are not included in this case.

> "The warehouse employee first prints the picking-list. This task is done for each delivery to the customer (1 minute). Then, the employee drives a fork lift truck to the appropriate storage rack to pick the first sales-order-line, as described on the picking-list (18 seconds). Driving to the rack is in fact repeated for each sales-order-line. For boxes and containers, an empty pallet is picked and the boxes/containers are manually loaded on the pallet of the fork lift truck. Full pallets are immediately picked with the fork lift truck. Loading units (boxes or containers) on the fork lift truck requires 6 seconds per unit. Loading a full pallet with the fork lift truck takes 1.5 minutes per pallet. When all products (boxes, containers) are loaded, the warehouse employee drives the fork lift truck to the quay (2 minutes per round trip). Of course, for full pallets the trip to the quay is needed for each pallet. For boxes or containers, the number of trips to the quay depends on the volume of the boxes. When the pallet (full pallet or pallet with boxes/containers) needs to be wrapped-up in plastic film, the warehouse employee needs to stop at the wrap-around packaging machine (3 minutes per pallet to wrap around a pallet). When all goods are ready on the quay, the employee makes a final check and signs off the picking-list (2 minutes)."

In other words, the interview results show that picking a delivery was driven not only by the number of deliveries, but also by the number of order-lines, the number of boxes/containers/ pallets to load, and whether the pallet needs to be wrapped around or not.

1.5.2. Sales-order processing

The sales-order processing department, which employs five FTEs (each of whom works 38 h per week, 52 weeks per year), carries out the processing of sales-orders. These employees also work at a practical capacity of 80%. The amount of work to handle a sales-order depends on the situation. One of the interviewees described the activity as follows:

> "We are taking orders by phone, either from customers or from our sales reps. Taking an order from a customer is more time consuming than taking an order from a sales rep, because our sales reps are trained to talk in an efficient type of 'code' language and we don't need to do the commercial talk. In general, you can say that the welcome talk to a sales rep is very short (1 minute), and to a Dutch-speaking customer it is somewhat longer (3 minutes). But for a French-speaking customer the welcome talk is much longer (10 minutes), because these customers tend to be garrulous. Next, we need to open the customer file in the software program. For a well-known customer (i.e., one who places at least 12 orders per month), we know the customer number by heart. Finding the customer file then only takes 12 seconds; for a non-regular customer finding the customer file takes about 30 seconds, because we need to look up the customer ID-number. If customer data (e.g., delivery address, invoice address, phone, fax, language code) have changed, these fields need to be updated (36 seconds per field). Then, the sales-order is entered order-line by order-line. When the sales rep calls, we can enter 5 order-lines in 1 minute. However, when a customer is on the phone, we can enter only 2 order-lines per minute. Sometimes, we need to make an additional

calculation with a calculator and this activity depends on the number of order-lines (6 seconds per order-line). For rush orders, we need to call the planning department to see whether the products can be delivered within 24 hours (this phone call takes approximately 10 minutes). Finally, some large customers request a confirmation letter. Preparing such a letter and faxing it to the customer takes 15 minutes per sales-order."

The interview results show that the number of sales-orders does not drive the activity alone. The time for processing a sales-order depends on the type of phone call received (from a sales rep, a Dutch-speaking customer, or a French-speaking customer), the type of customer (regular or non-regular), the number of customer fields to change (if any), the number of order-lines ordered by the sales rep, the number of order-lines ordered by a customer, the need to make a manual calculation (yes/no and, if yes, the number of order-lines), and the need to write a confirmation letter (yes or no). Johnson felt that it would be virtually impossible to include all these activity-cost drivers into the ABC model. However, without such detail the resulting ABC model would not be able to estimate the differential resource demands associated with the processing of different sales-orders.

1.6. Time-driven ABC (TDABC)

De Creus asked the consultant to look for an alternative to a traditional ABC system. They discovered the time-driven approach, as described by Kaplan and Anderson in the November 2004 issue of the *Harvard Business Review*. De Creus had doubts about the next course of action. Should Sanac proceed with a traditional ABC system (and what kind of ABC system?) or should it implement a time-driven ABC system, which was totally new to him (as well as to the controller, Mike Johnson, and the consultant, Chris Miller)?

2. Case requirements

Assume the role of a business consultant. The case that you have just read summarizes the experience of your client trying to grapple with the issue of cost-system design. Your task is to decide which system the company should implement, given the desire of the president of the company to calculate profitability at the order and the customer level: (1) a simple ABC model, (2) a detailed (refined) ABC model that attempts to capture the complexity of the activities, or (3) a time-driven ABC model, as described in Kaplan and Anderson (2004). You are required to create a slide presentation in which you address the following:

1. Analyze Sanac's business environment (e.g., in terms of markets, products and customers, profitability, and strategy).
2. What difficulties would Sanac experience in attempting to implement a traditional ABC system?
3. Which activity-cost drivers should be selected for the "picking a delivery" activity?
4. Which activity-cost drivers should be selected for "sales-order processing"?
5. Should Gertjan De Creus abandon ABC? Why or why not?

6. Build a time equation[11] for each of the following two activities: *picking a delivery* and *processing a sales-order*. For the former, the time equation should estimate the picking time per delivery, while for the latter the time equation should model the processing time per sales-order. You can find information on the time-drivers (and their time estimates) in the interview data in the case.
7. After your slide presentation, the client asks you to use a TDABC model to estimate the picking cost for each of the following delivery situations:
   a. Delivery A (related to sales-order 1): five order-lines of one box for each order-line, one trip to the quay, no wrap-up.
   b. Delivery B (related to sales-order 2): one order-line of one full pallet, one trip to the quay, no wrap-up.
   c. Delivery C (related to sales-order 3): one order-line of one full pallet, one trip to the quay, one wrap-up.
   d. Delivery D (related to sales-order 4): five order-lines, three boxes, two full pallets, three trips to the quay, customer asks wrap-up of the two full pallets and of the third pallet, containing all boxes.
   e. Delivery E (related to sales-order 2): five order-lines, five full pallets, five trips to the quay, no wrap-up.

8. After your slide presentation, the client asks you to use your TDABC model to estimate the *sales-order processing cost* for each of the following orders:
   a. Sales-order 5: an order from a sales representative, regular customer, five order-lines, no fields to update, no calculations, normal delivery, no confirmation letter.
   b. Sales-order 6: an order from a Dutch-speaking customer, regular customer, five order-lines, no fields to update, no calculations, normal delivery, no confirmation letter.
   c. Sales-order 7: an order from a Dutch-speaking customer, regular customer, one order-lines, no fields to update, no calculations, rush order, no confirmation letter.
   d. Sales-order 8: an order from a French-speaking customer, non-regular customer, five order-lines, 10 fields to update, no calculations, normal delivery, no confirmation letter.
   e. Sales-order 9: an order from a French-speaking customer, regular customer, five order-lines, no fields to update, additional calculations needed, rush order, confirmation letter is required.

[11] A time equation is a formula for modeling the time spent on each activity based on the characteristics of the activity. The characteristics are called *time-drivers*, because they drive the time required to perform the activity. If you are unfamiliar with time-drivers, the following short example, taken from an education context, might give a start. Assume that we want to estimate the time spent by the teacher for finishing a course. First, the teacher needs to prepare the written exam (which takes 240 min per course) and needs to develop a solution key (which takes 60 min per course). Then, he/she needs to grade the exams, which is a function of the number of students in the course (assume 15 min per student). For some courses, the teacher needs to make a summary report with statistics on the grades, which takes another 30 min per course. The time equation for finishing a course can be modeled as follows: time for finishing a course = 240 min + 60 min + (15 min × number of students in course) + 30 min (if summary report is required). Based on this time equation, the teacher can estimate the time he/she will spend on finishing each of the courses at the end of the semester. For example, for a class with 100 students, where a summary report of the grades is required, the teacher will spend 240 min + 60 min + 15 min × 100 + 30 min = 1830 min = 30.5 h for finishing a course. A colleague with 20 students in class and no grade summary will spend 240 min + 60 min + 15 min × 20 = 600 min = 10 h for finishing the course.

9. Follow-up questions (to use during in-class discussion of the case):
   a. What new difficulties could arise when attempting to implement a TDABC system?
   b. Is TDABC appropriate for a dynamic environment?

3. Case teaching notes

3.1. Overview and learning objectives

The Sanac case provides an introduction to time-driven activity-based costing (TDABC). The case is based on the experiences of a real company that struggled with the implementation of an ABC system and soon discovered that TDABC was more appropriate. The quotations included in the case were based on interviews conducted with employees of the company and/or the consultant. However, for confidentiality purposes, the cost and profitability data have been disguised.

The requirements of the case are designed to accomplish four learning objectives. The first objective is to help students understand *when* a time-driven ABC system is *appropriate*. The wide diversity in the use of resources by the various customers made it difficult for this company to trace and analyze costs in a traditional ABC system. And in this complex and dynamic environment, highly accurate and up-to-the-minute cost information was considered essential. Second, this case was setup to help students understand the *differences* between traditional *ABC and TDABC*. The description of two activities (picking a delivery, and sales-order processing) allows for showing the differences in techniques between traditional ABC and TDABC. By providing tasks and subtasks of these two activities, in fact, students can build three models: a simple (i.e., "aggregated") ABC model, a complex (i.e., "detailed" or "refined") ABC model, and a TDABC model. Students quickly find that the simple ABC model does not provide the information required by the CEO, while the complex ABC model would be very challenging to implement. The third learning objective is to *illustrate the concept of time-drivers and time equations,* two unique elements of TDABC. The case's realistic nature, by including detailed description of two activities (picking-a-delivery and sales-order-processing), allows students to understand how time equations can capture the complexity of operations. Finally, this case was designed to allow students *to build a TDABC model*. Without asking for too much arithmetic, this last objective can be realized either by a discussion of the case (as in assignment questions 5 and 6) or by asking for more calculations (as in assignment questions 7 and 8).

3.2. Implementation guidance

This case can be used in a junior- or senior-year cost accounting course at the undergraduate level and in either an introductory or advanced management accounting course at the graduate level, both for students and executives. For executives we mainly use the case as an illustration, while our experience with the case is that undergraduates prefer to show their understanding of the problem with short calculations, as in questions 7 and 8.

For the case to be taught effectively, students need to be familiar with ABC. Terms such as activities, activity-cost drivers, and activity-cost driver rates are used in the case. Also, the case briefly addresses the problem of deciding on the practical capacity volume to calculate activity-cost driver rates. If students have not been exposed to the mechanism of

ABC, this case could be difficult to comprehend. We usually consider four cases in our advanced management accounting classes, in the following sequence: The Classic Pen Company Case (Kaplan, 1998), John Deere Components Works (A) (March & Kaplan, 1987), Kanthal (A) (Kaplan (1989)), and Sanac. For the introductory management accounting class, we focus on the first and last case.

Teachers can exercise discretion when deciding how much additional background to give students before analyzing the case. For example, teachers can provide supplementary readings to introduce students to TDABC before teaching this case (e.g., Everaert & Bruggeman, 2007; Kaplan & Anderson, 2004). With this approach, students could *test* their understanding of ABC and TDABC. Alternatively, teachers can use the Sanac case as a *starting point* in the discussion on TDABC. Then the case is used as a vehicle to discover the environment for which ABC might no longer be appropriate and where the use of time-drivers might be a good alternative. In the last approach, the authors use assignment questions 7 and 8 as homework or exam questions.

3.3. Teaching approaches

The case can be taught in a 90-minute class or as a take-home exam at the end of the semester. For class teaching, it is necessary that students prepare the assignment beforehand. For example, we usually ask each of three teams to make an oral presentation of questions 1–6, while asking other teams to hand-in a one page memo with their suggested solutions. We typically assign two questions to each team (of four students) and keep the last two assignment questions to discuss in class (or as homework for the next class). By asking the non-presenting teams to hand-in a one page solution, we experience a much richer in-class discussion after each presentation. The case takes about 4 h for both reading and preparing answers, as reported by our students.

When we teach this case, we follow the sequence of the assignment questions. Inspiration for exam questions on new activities of similar services can be found in Everaert, Bruggeman, De Creus, and Moreels (2007). For inspiration on activities in the manufacturing industry, we refer to Walker and Wu (2000).

3.4. Student assessment

Both academic authors used this case at the undergraduate and graduate level. This section summarizes survey data from 26 students who completed the case during the Spring 2006 semester in an advanced management accounting class. The class was taken by MBA students in Advanced Accounting who had completed an introductory Management Accounting class during their senior year. The case was used as an out-of-class assignment. Teams of four students were formed at random. The teams were required to formulate answers to two of the six assignment questions and either present their solutions to the class by PowerPoint slides, or prepare a management memo to be handed-in before class. Each presentation was followed by a plenary discussion. Assignment questions 7 and 8 were distributed at the end of the class as a self-study task.

Table 4 summarizes the survey results for the 26 students enrolled in the class. About half of the students were international students. None of them had English as a native language and the case was taught in English as usual. A five-point Likert-type scale (1 = “totally disagree”,…, 5 = “totally agree”) was used to assess their answers to eight

Table 4
Classroom assessment data ($n = 26$)

Measurement scale:

1 Totally disagree · *2 Disagree* · *3 Neutral* · *4 Agree* · *5 Totally agree*

	Survey questions	Response frequencies 1	2	3	4	5	Mean	Std dev.
Indicate the extent to which you agree or disagree with the following statements. There are no right or wrong answers								
1	The Sanac case provided a realistic business situation	0	0	4	13	9	4.19	0.69
2	The case encouraged me to think critically about the appropriateness of a traditional ABC system	0	0	4	15	7	4.12	0.65
3	The Sanac case was helpful in understanding the difference between "rate-based" ABC and "Time-driven" ABC	0	0	3	17	6	4.12	0.59
4	The Sanac case enhanced my understanding of the concept of "time-drivers," as used in time-driven ABC	0	0	2	18	6	4.15	0.54
5	Completing the case assisted me in understanding how a time-driven ABC model can be setup	0	0	5	14	7	4.08	0.69
6	Overall, the Sanac case was a beneficial learning experience	0	0	2	18	6	4.14	0.54
7	The Sanac case was a challenging case	0	2	13	9	2	3.42	0.76
8	The Sanac case was more difficult, compared to the other cases we had in management accounting	1	13	8	3	1	2.62	0.90

questions in a specially designed questionnaire administered to students at the conclusion of the case coverage. Table 4 shows the survey questions, response frequencies, and the mean and standard deviation for each item. The results demonstrate that students thought the case provided a realistic business environment (mean = 4.19). Students also thought the case encouraged them to think critically about the appropriateness of a traditional ABC system (mean = 4.12), and that the case was helpful in understanding the difference between traditional ABC and TDABC systems. In addition, students believed that the case enhanced their understanding of the concept of time-drivers (mean = 4.15) and how a TDABC model could be setup (mean = 4.08). Overall, students believed the case was a beneficial learning experience (mean = 4.15). In terms of difficulty of the case, the students did not find the case too challenging (mean = 3.42). Compared to other cases they had in their advanced management accounting class (Classic Pen, John Deere, Kanthal (A)), the Sanac case was considered less difficult (mean = 2.62). We included an open-ended question at the end of the questionnaire. Here are some examples of the comments we received:

> "The case is well-developed with a very clear logic."
> "Very useful to illustrate time-driven ABC."
> "The case was very clear, easy to understand, and it was a good illustration of the appropriateness of time-driven ABC."

3.5. Suggested solutions

3.5.1. Analyze sanac's business environment (Q1)

a. The market environment in which Sanac operates is considered difficult. Sanac is principally positioned in:

1. Two *declining markets* where there is intense competition and where margins are low or falling. Sanac is mainly a distributor (wholesaler) of garden products. The company does not manufacture products, but buys products from large suppliers and then distributes these products to customers. The company does not mark the products with its own brand, but sells products with the original brand name. The two declining businesses mentioned in the case are: (1) agriculture: selling phyto-chemical products (i.e., plant-care products to protect crops against insects) and fertilizers (products to make plants grow faster) to large and small farmers, and (2) Horticulture: selling phyto-chemical products and fertilizers to small and large growers. Product know-how is important. Sanac likes to compare itself to a pharmacy. Sales reps visit customers and provide support to farmers and growers. In both professional markets, one finds many competitors.
2. One *rapidly growing* market (home and garden) where clients are very demanding in terms of price and service. The customers in this segment are large department stores (viz., Aldi, Makro, Delhaize, Carrefour, Hubo, Gamma, Leroy-Merlin), as well as small garden centers and Do-It-Yourself (DIY) stores that are commonly found in every town. So, in this market there are very big and very small customers. Sanac offers a full service to the large department stores. Examples are small storage units (displays to put in the store), where gardeners are able to immediately find appropriate garden products thanks to the information provided on the display. The business is different from that of the professional market, because merchandising is important here, as well as a store's profitability per square meter. However, Sanac faces more hard-selling in this segment than in the agriculture and horticulture segments.
3. Unstable and frequently *changing markets* with *periods of inactivity*. Business is very seasonal: 80% of sales are made over a 4-month (summer) period with idle capacity[12] in winter months. Market know-how and trend-watching is very important for the home and garden segment. For instance, market fashion in pottery changes every year and Sanac needs to follow these trends very carefully ("market awareness") in order to minimize the number of unsold units.

b. Sanac offers *different types of products*. Products for the agriculture and horticulture business are professional products, while products for the outlet stores are products (in smaller packs) for individual consumers. The variety of products is high and changes each year, because of new products or fashion. Sanac has a portfolio of 7000 products in stock and 20,000 in catalogue. It receives approximately 298,000 orders a year and issues 69,000 invoices.

c. Sanac has *numerous customers*: there are both *small* and *large* customers in each of the three businesses (*farmers, horticulture, and retail outlets*). Customers have considerable and varied service demands. A small farmer does not require the same services as a big retail outlet.

[12] Idle capacity in this company means idle capacity of the employees. Employees of the picking and sales-order processing departments, for instance, all have a fixed employment contract, and work 38 h per week, for a monthly fixed wage. Employees are not laid off during the winter months because these same employees are needed in the spring, and there is no time for recruiting or training new employees. As a consequence, during winter, the employees have less work to handle and represent unused capacity, while during the summer overtime is needed.

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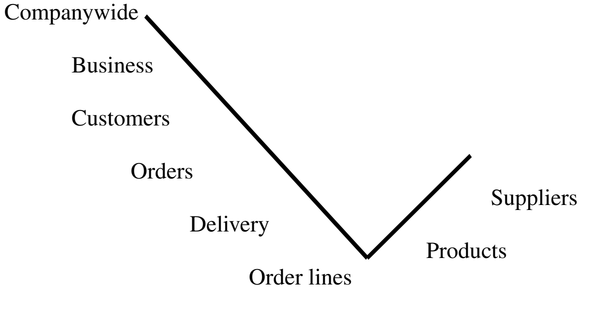
d. Sanac's business environment is characterized by *declining profitability*. Sales are growing at Sanac and line-of-business (LOB) contribution margins are increasing, but overhead costs are growing faster than sales, hence bottom-line *profitability is declining*. In the case this is referred to as the "profitability paradox."
e. Sanac changed its *strategy* from revenue-driven to profit-driven. Before 2000, the strategy was *revenue-driven*. Sales level and contribution margin (sales minus purchase price) per major product line had been the only performance measures used by the company before Gertjan De Creus took over as CEO. You can give the following examples to explain to students that this medium-sized company was not very profit-oriented: Before 2000 Sanac was running sales without a budget and there was no communication between the accounting and marketing departments. Next to the contribution reports per product line, a balance sheet was drawn up twice a year but always appeared very late. In fact, before 2000 *the company was driven by revenue*. After 2000, the strategy was *profit-driven*. After De Creus took over as CEO (2000), Sanac's aim was to regain profitability by shifting the focus of the company from *growth* (which forced the company to have a wide range of products, maintain large stocks, and to deliver *at a single price* any order to any client in the shortest possible time in whatever quantity requested by the customer) to *profitability*. Sanac wanted to know what its costs were per business, per customer, per order, per delivery, per order-line, per product, and per supplier. The company represented this by the "fork figure" (see Table TN-1). Each business has customers, each customer is placing orders, each order is delivered in one or more deliveries, and each delivery contains order-lines. On the other hand, each supplier has products and these products are consumed by order-lines. This fork figure explains that cost roll-up can be done in two directions: from order-lines, to deliveries, to orders, to customers, to businesses, or from order-lines, to products, to suppliers. For each level, there are costs and revenues. This detailed cost roll-up was meant to lead to an improvement in services, and to favor customers (suppliers) who generate value, that is, margins and profit for Sanac, even if this means discarding certain customers and/or products or even markets. For this to occur there had to be a reliable system for measuring costs and performance before there

Table TN-1
Where does Sanac make money?



could be any changes in strategy. In fact, the challenge for this company was to discover profit priorities with an ABC model (see Cooper & Kaplan, 1991 for an additional reading on this topic).

3.6. Which difficulties would Sanac experience when attempting to implement an ABC system (Q2)?

1. The CEO wants *monthly profitability reports*: ABC is appropriate as a kind of stand-alone system, but would not be appropriate for monthly reporting, based on the actual sales and the actual characteristics of the orders and deliveries. The data collection would be very time-consuming. Here you can discuss the four stages of accounting system design (Kaplan, 1990).
2. *Maintainability*: the model needs to be up-to-date. Sanac faced fast-changing markets, with changing products and services to customers. For instance Hubo (a large DIY chain) tried to skip Sanac as a distributor and started negotiations with Sanac's main supplier. By doing so, Hubo could get a good price from the supplier; however, the supplier was not prepared to provide the delivery services requested by Hubo. Hence, Hubo asked Sanac whether Sanac could distribute the products from the supplier's warehouse to the various stores of Hubo. For Sanac, the delivery costs had to be allocated appropriately to ascertain the profitability of the services rendered. This suggests that on temporary basis employees of the support departments need to be re-interviewed and that the ABC model would need to be updated on a regular basis.
3. *Too many activities*: If one wants to capture the customized services provided to the different customer groups, all activities (e.g., receipt of incoming goods, taking an order on the phone, delivery of ordered products to the customer, planning a routing for the driver) need to be split into sub-activities to include all possible variants of the activity. For instance, for order-entry processing: some customers order by phone, others order through a sales rep, and for some of them a confirmation letter is needed. These three subtasks consume support costs in different proportions and are, in fact, driven by other activity-cost drivers. As a consequence, the controller faced the task of accounting for a proliferation of activities. Here you can also refer to the article by Kaplan and Anderson (2004) in the *Harvard Business Review*, which discusses problems encountered during the implementation of traditional ABC systems.
4. *Unstable activity-cost driver rates due to seasonality*: The controller suggested working with the *actual* volumes of the activity-cost drivers to calculate activity-cost driver rates. This resulted in higher rates for the second half of the year, because of the lower actual volumes of sales-orders and deliveries in this period. For instance, the activity-cost driver rate for the sales-order processing was calculated as €4.27 for the first half of the year, versus €10.67 for the second half. However, the CEO made the right point, saying that the activity-cost driver rates should be based on the *practical* capacity. The unused capacity during winter time should not be allocated to the customers buying at that time. Customers buying during the winter period do not consume more resources than customer buying during the summer months. However, somebody is responsible for the unused capacity. Who? In Sanac, the unused capacity is not acquired to meet the demands of a specific customer or a specific market segment. The unused capacity in winter is needed to meet demands from all kinds of customers during the summer. So, the cost of unused capacity

is best treated at the company level (so-called "facility sustaining" cost). As explained by Cooper and Kaplan (1992), the cost of unused capacity should not be allocated to individual products or customers. Because such an allocation could cause some products to "appear" unprofitable during the low season, making managers to increase the price of these products during the low season, which will result in lower sales levels in the next period and hence even more unused capacity during the low season. De Creus understood this "death spiral" argument and therefore questioned the use of the actual volumes in ABC. Furthermore, De Creus was also interested in capacity utilization reports of the departments. He wanted to know each month which departments had unused capacity and which departments were running short of capacity, to stimulate the discussions about desired staffing levels. However, there was a specific reason why the controller used the *actual* volumes (instead of the *practical* capacity) for the activity-cost driver rates: it was difficult to find agreement on the practical capacity in terms of number of sales-orders and the number of deliveries. In particular, employees stressed that it was impossible to estimate the number of sales-orders (or deliveries) that they can handle in a normal week, because the number of sales-orders (or deliveries) they can handle really depends on the characteristics of the sales-orders (deliveries). As we will see in the practical examples at the end of this case, the time to handle a complex sales-order is almost 20 times more than the time to process a simple sales-order.
5. *Activity complexity*: for many activities it was difficult to select the appropriate activity-cost driver because the activities depended on many drivers. For instance, the picking of products to be delivered to customers depends not only on the number of deliveries, but also on the number of order-lines, the number of pallets to move to the quay, the number of boxes/containers to pick, whether the pallet needs to be wrapped-up, etc. (We will come back to this in the next question.) This pitfall of "activity complexity" is related to the third difficulty discussed above. Either the ABC system is keeping track of all possible differences in resource consumption by splitting the activities into many small activities (leading to an excessively complex ABC model), or the differences in resource consumption are ignored (leading to an inaccurate but simple ABC model). Neither of the two possibilities appealed to the CEO of Sanac.

Conclusion: different environments require different kinds of cost systems. The basic question of this case is: what is the most appropriate cost system for complex, dynamic, low-margin, and highly competitive environments?

When teaching the case to experienced participants, you might ask participants whether they have experienced similar problems. Usually managers from companies with a sizeable logistics operation (warehousing, transportation) recognize the problem. Hospital managers, for instance, will often say that, in their experience, ABC is unable to model the full complexity of hospital operations and frequently complain about the high maintenance costs of their ABC systems.

3.7. Which activity-cost drivers should be selected for the activity "picking a delivery" (Q3)?

We used the following progression in the discussion:

1. Break down the first activity into its subtasks.
2. Show that the activity is not homogeneous.

3. Show that the activity has multiple drivers.
4. Would selecting one activity-cost driver make sense (aggregated ABC model)?
5. Could activity-splitting be a solution (detailed ABC model)?

3.7.1. What are the subtasks of the "picking a delivery" activity?
In the interview data, we can discern the following subtasks:

- Print-out of picking-list.
- Driving to storage rack.
- Loading boxes/containers on fork lift.
- Loading full pallet on fork lift.
- Driving to quay.
- Wrap-up of pallet.
- Final-check on the quay.

Many companies make process descriptions (sometimes called process-value maps) because such "maps" are needed for ISO-certification purposes. See Table TN-2 for the process description of the "picking-a-delivery" activity at Sanac. In fact, this chart was made by one of our students, when answering this assignment question.

3.7.2. Is the "picking a delivery" activity homogeneous?
Is the picking activity relatively constant across deliveries? The answer is no. If we look at the various subtasks, students may notice that the "number of deliveries" is driving some subtasks, e.g., printing the picking-list, final-check on the quay. Other subtasks are driven by the "number of order-lines," e.g., driving to the storage rack. Still other subtasks are driven by the "number of full pallets to load," the "number of boxes/containers to load," or the "number of trips from warehouse to quay." Finally, the "number of pallets to wrap-up" is driving the subtask of wrapping-up containers.

3.7.3. What could be appropriate activity-cost drivers for each of the subtasks within the "picking-delivery" activity?

- Printing delivery-list: number of deliveries.
- Driving to storage rack: number of order-lines per delivery.
- Loading containers/boxes on fork lift truck: number of boxes/containers per delivery.
- Loading full pallets on fork lift truck: number of full pallets per delivery.
- Driving fork lift to quay: number of trips (depending on number of pallets and number of boxes/containers) per delivery.
- Wrapping-up pallet: number of pallets to wrap-up per delivery.
- Final check: number of deliveries.

See Table TN-3.

3.7.4. Would selecting one activity-cost driver make sense (aggregated ABC model)?
The aggregated ABC model for the picking-a-delivery activity with a single activity-cost driver (here, "number of deliveries") is shown in Table TN-4. When only one driver is selected, the ABC system will lose accuracy, because it is not differentiating between a

Table TN-2
Process mapping –"picking-a-delivery" activity

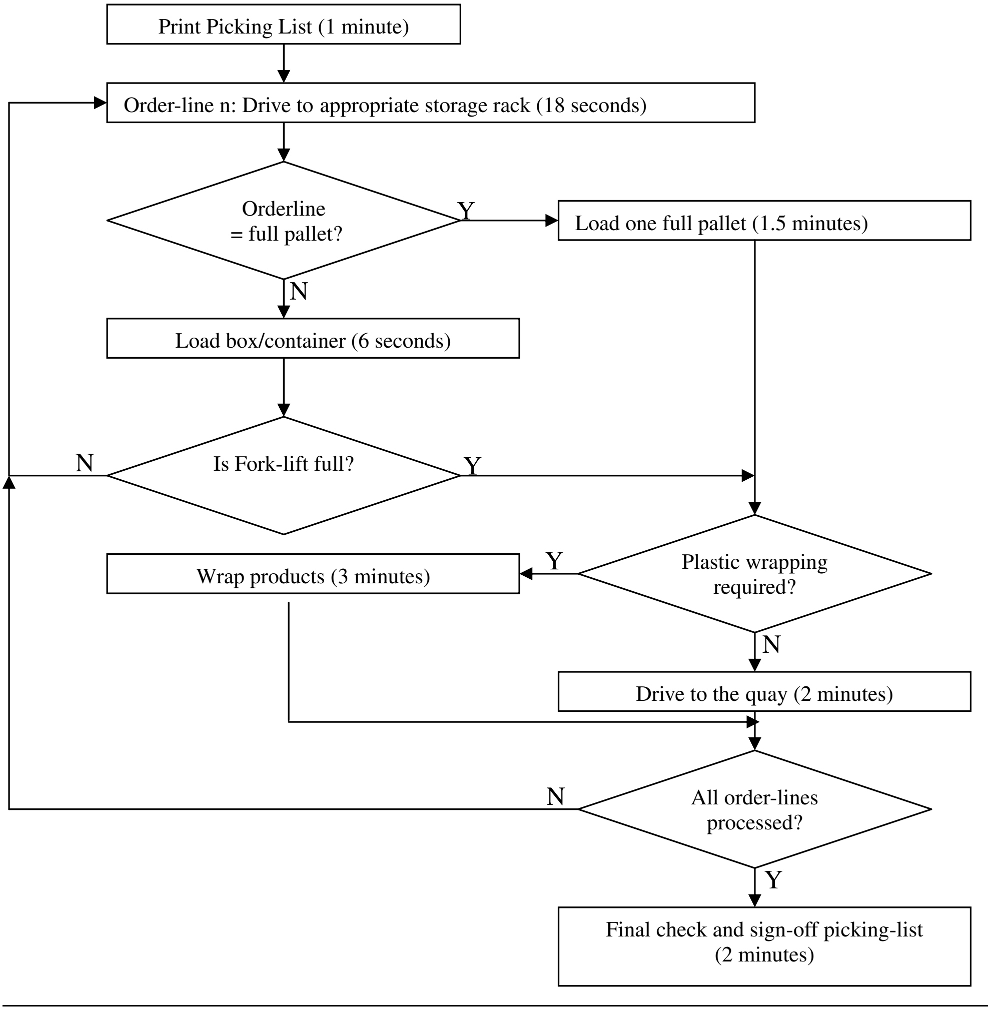
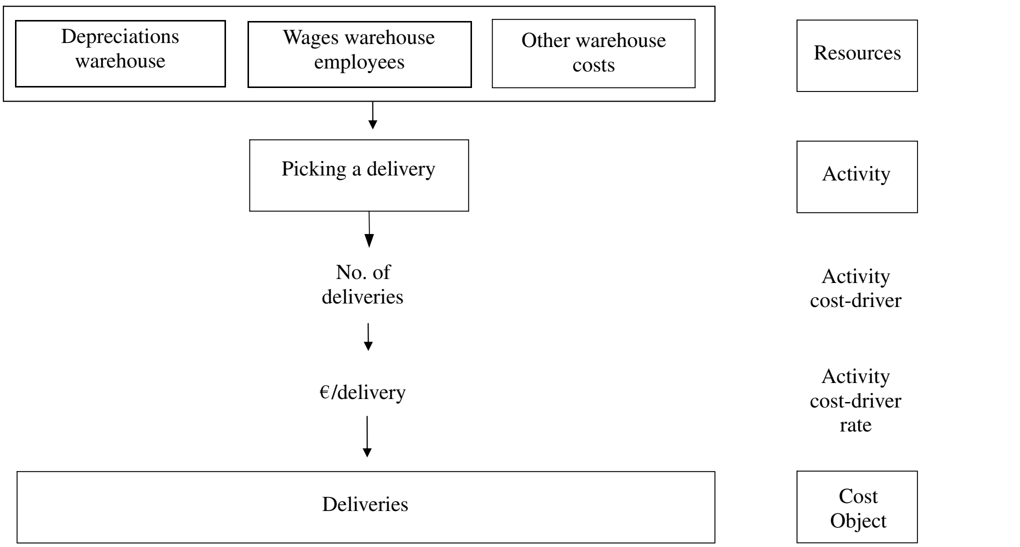


Table TN-3
Activity-cost drivers for "picking-a-delivery" activity

Subtask	Activity-cost driver
Print-out of picking-list	Number of deliveries
Driving to storage rack	Number of order-lines per delivery
Loading boxes or containers	Number of units (boxes/containers) per delivery
Loading full pallets	Number of pallets per delivery
Driving to quay	Number of trips to quay per delivery
Wrap-up of pallet	Number of pallets to be wrapped-up per delivery
Final-check on the quay	Number of deliveries

Table TN-4
Aggregated ABC model for "picking-a-delivery" activity



simple picking activity and a complex picking activity, resulting in distorted cost information. From the answers on the previous question, it is clear that the CEO wants highly accurate cost information (subject, of course, to cost-benefit trade-offs).

3.7.5. Could activity splitting be a possible solution for the "picking a delivery" activity?

Yes, splitting up the "picking" activity into sub-activities would likely yield a more accurate ABC model than the previous aggregated ABC model. See Table TN-5. But what about finding the practical volume for each of the activity-cost drivers? Let the students think about how difficult it would be for the picking manager to estimate for each month the total number of deliveries, the total number of order-lines, the total number of units, the total number of pallets, the total number of trips to the quay, and the total number of pallets to wrap-up. S/he would probably say that this is impossible to estimate. But if you asked the manager to estimate the *time* spent on final checking of one delivery or loading one pallet, s/he would probably know the answer, e.g., a final check takes 2 min, loading one pallet requires two minutes. Moreover, the manager would be in a position to estimate the time spent for each picking of a delivery if s/he knew the characteristics of that delivery.

3.8. Which activity-cost drivers should be selected for the "sales-order processing" activity (Q4)?

We used the following progression in the discussion:

1. Break down the first activity into its subtasks.
2. Show that the activity is not homogeneous.

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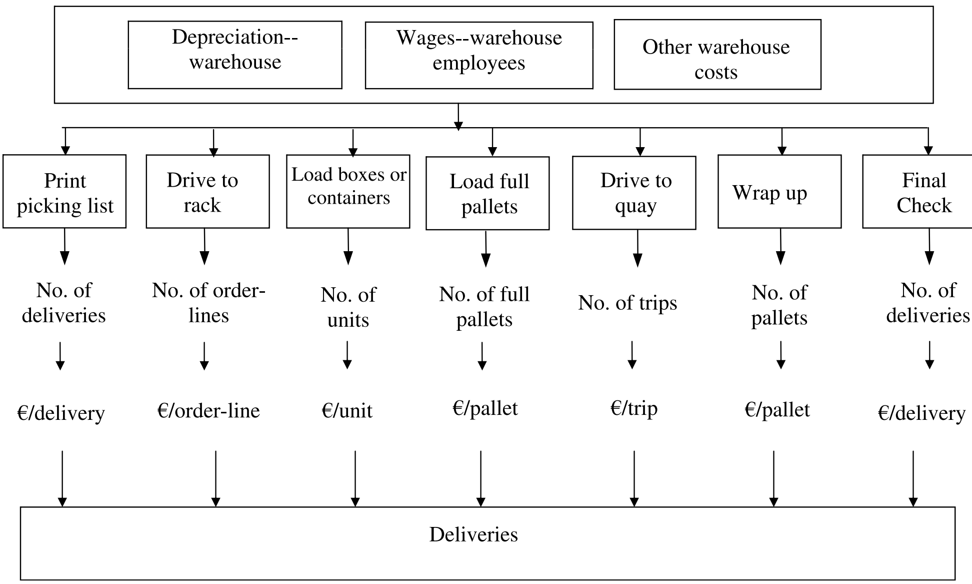
Table TN-5
Detailed ABC model for "picking-a-delivery" activity



3. Show that the activity has multiple drivers.
4. Would selecting one activity-cost driver make sense (aggregated ABC model)?
5. Could activity-splitting be a solution (detailed ABC model)?

3.8.1. What are the subtasks of the "sales-order processing" activity?

In the interview data, we can read the following subtasks:

- Welcome talk when answering the phone.
- Opening customer file.
- Changing customer data.
- Call planning when it is a rush order.
- Entry of order-lines.
- Calculation by calculator.
- Writing confirmation letter.

See Table TN-6 for the process description of the sales-order processing activity at Sanac. This chart was made by one of our engineering students, when answering this assignment question.

3.8.2. Is this activity homogeneous?

Is the activity capable of being represented by a single activity-cost driver? The answer is no! If we look at the various subtasks (Table TN-7), we notice that the "number of sales-orders" is driving some subtasks, e.g., welcome talk. Other subtasks are driven by the "number of order-lines," e.g., entry of order-lines. Still other subtasks are driven by the "number of rush orders" or the "number of order-lines for which there is a calculation needed" or the "number of confirmation letters."

3.8.3. Which activity-cost drivers should be selected for the "sales-order processing" activity?

This second activity is more complex than the first one. The interview data in the case show that the processing time for a sales-order depends on:

- who is placing the order (sales representative, Dutch-speaking customer, French-speaking customer);
- the type of customer (regular versus non-regular);
- the number of codes that need to be changed, if any;
- the necessity to call planning ("yes" for rush order or "no" for normal order);
- the number of order-lines;
- the need to perform a manual calculations (yes or no);
- the need to write a confirmation letter (yes or no);

These activity-cost drivers are presented in Table TN-7.

Table TN-6
Process mapping – sales-order processing activity

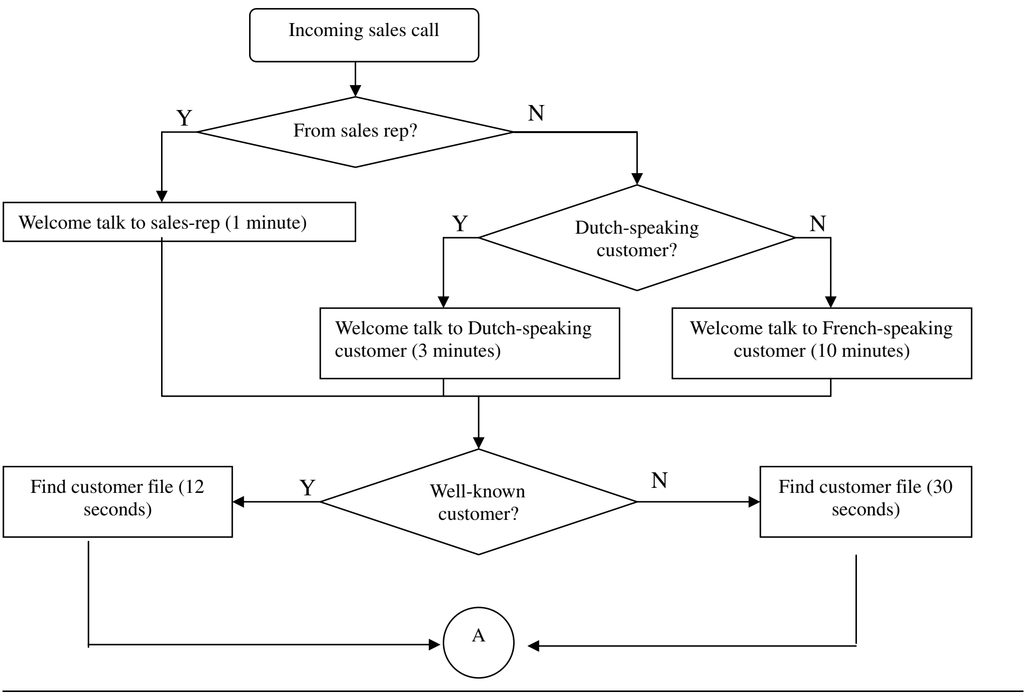
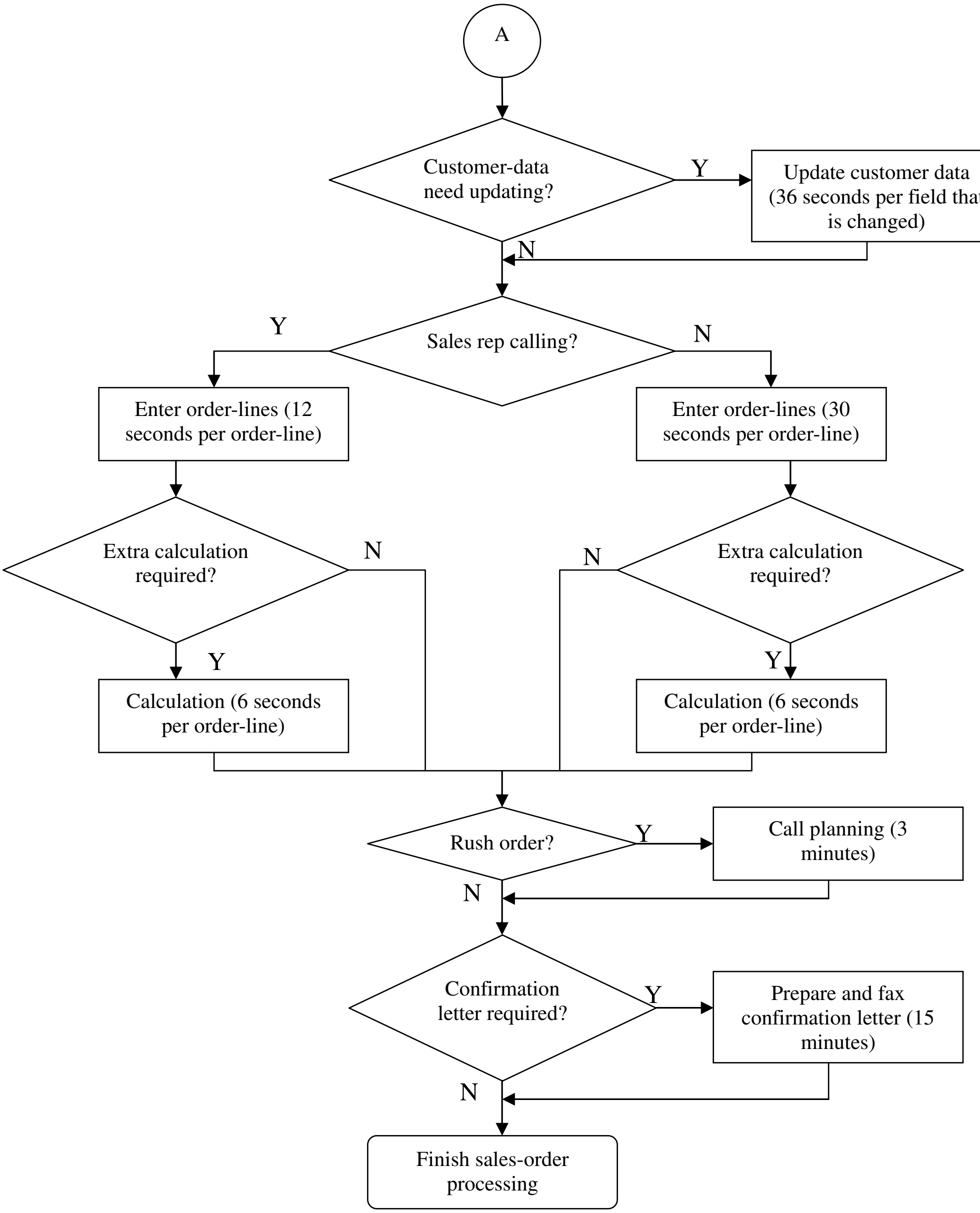


Table TN-6 (*continued*)



3.8.4. Would selecting one activity-cost driver make sense (aggregated ABC model)?

Selecting one activity-cost driver would not make sense because the sales-order processing activity is driven by several different drivers. Building an ABC model with the number

Table TN-7
Activity-cost drivers for sales-order processing activity

Subtask	Time driver
Welcome talk when answering the phone	Number of orders from: • Sales representative • Dutch-speaking customer • French speaking customer
Opening customer file	Number of orders from: • Regular customers • Non-regular customers
Changing customer data	Number of fields to update
Call planning when it is a rush order	Rush order or not
Entry of order-lines	Number of order-lines: • Order received from sales representative • Order received from customer
Calculation by calculator	Manual calculation needed or not: Number of order-lines
Writing confirmation letter	Confirmation letter needed or not

of sales-orders as the sole activity-cost driver for the sales-order processing activity (e.g., Table TN-8) would likely lead to an inaccurate ABC model.

3.8.5. Could activity splitting be a solution to solve that problem (detailed ABC model)?

Yes, splitting up the general activity into sub-activities would provide a more accurate ABC model than using only the number of sales-orders as the activity-cost driver. See Table TN-9 for the detailed ABC model for the sales-order processing task, which involves 11 different sub-activities. Again, this model is very complicated. It would be almost

Table TN-8
Aggregated ABC model for sales-order processing activity

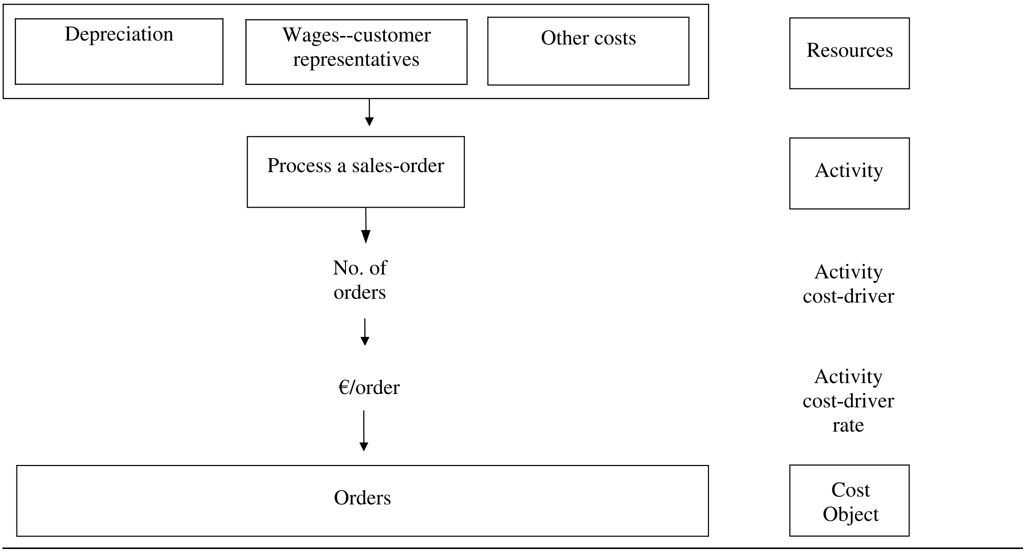
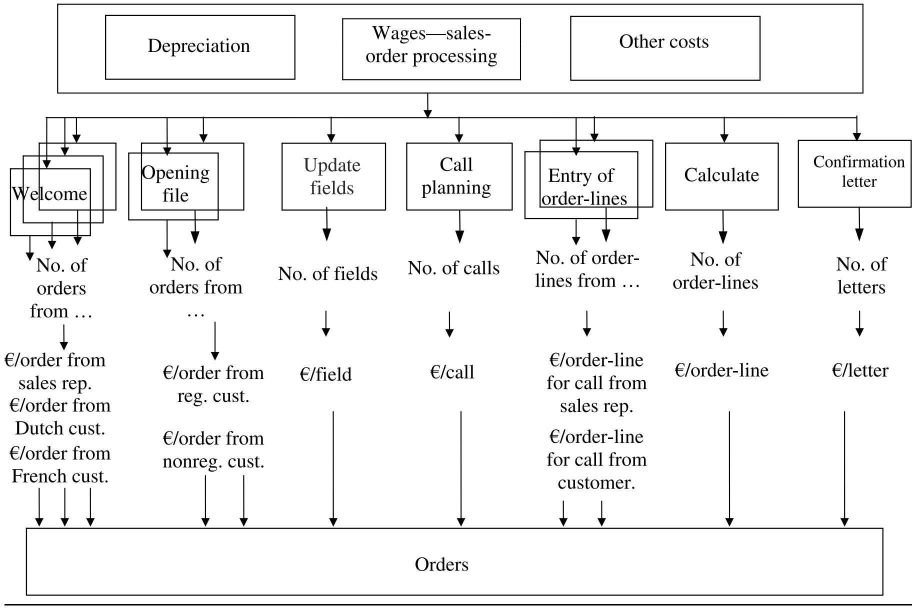


Table TN-9
Detailed ABC model for sales-order processing activity



impossible to estimate the practical capacity level for each of the different activity-cost drivers. Let the students think about how difficult it would be for the sales-order processing staff to estimate the total number of calls from sales representatives, Dutch-speaking customers, and French-speaking customers they can handle without overtime, or to estimate the total number of order-lines they can enter on a normal working day, or the total number of calls they can make to the planning department if the customer wants a rush delivery, etc. Most managers would probably say that this is impossible to estimate. But if you asked the manager to estimate the time spent on the processing of, say, a sales-order for a Dutch customer that orders five different product codes, s/he would probably be able to give an accurate estimate. That is, the manager would be in a position to estimate the time spent for processing each sales-order if s/he knew the characteristics of that sales-order.

3.9. Should De Creus abandon ABC? Why or why not (Q5)

In fact, students can come up with one of the following solutions: Go for ABC and opt for (1) an aggregated ABC model, or (2) a detailed ABC model. Abandon ABC and opt for (3) a volume-based cost system, or (4) a TDABC model.

In general, when making cost-system design choices, the goal should be to design an optimal cost system for the company, that is, one that balances the cost of errors made from inaccurate estimates with the cost of developing (and maintaining) the cost model itself, balancing the so-called error cost with measurement cost (Kaplan & Atkinson, 1998). For instance, on the one extreme, a model can be very inexpensive to operate, but will lead to large distortions in cost reporting for the cost objects, possibly resulting in dysfunctional decisions. At the other extreme, attempting to build a very detailed cost system, might lead to a very expensive cost model. The cost of operating such a detailed system could greatly exceed the benefits of improved decisions made with the more accurate information.

At Sanac, the high error cost (because of the intense competition and the high complexity of the nature of the activities) called for a more detailed cost model. The expectations of the CEO both in terms of accuracy and level of detail are clear on that issue. The case is also clear on the high measurement cost of a detailed ABC system. Let us consider now the error and measurement costs for each of the four cost models to decide about the optimal cost system for Sanac.

3.9.1. Opt for an aggregated ABC model

If Sanac had to cope with *only* two very complex activities and if all other activities were driven by mainly one activity-cost driver, then it may be justified to stay with ABC and use the aggregated ABC solution for the two activities. In this situation, the error cost of the less accurate cost system is rather low, so that the benefits of developing a new cost system would not justify the cost of developing a new model. However, Sanac, as a distributor company, faces numerous complex activities that are driven by more than one activity-cost driver, suggesting that this solution may not be the best choice for the company.

3.9.2. Opt for a detailed ABC model

In general, if the percentage of activity costs related to multiple drivers to total costs is high, ABC will need a large number of activities but will still *not be satisfactory* in terms of accuracy. Activities will become very small and resource allocation to activities becomes very difficult (see Tables TN-5 and TN-9), leading to a cost model with both high measurement cost and high error cost. When teaching this case to Ph.D. students we refer to the Datar and Gupta paper in *The Accounting Review* (1994), which deals with the issue of measurement errors in product costing.

3.9.3. Abandon ABC and go back to volume-based overhead allocations

In this case, this alternative is probably not desirable because:

1. Volume-based overhead allocations ignore batch-level activities (e.g., picking a delivery, processing a sales-order).
2. The company competes in a low-margin industry. Accurate cost information is crucial to the company's survival.
3. It is important to have accurate information on the cost-to-serve for individual customers because Sanac is confronted with high-volume versus low-volume customers as well as with low-cost-to-serve versus high-cost-to-serve customers.

To conclude, the cost of making wrong decisions is probably too high in the present context to justify the use of a volume-based cost system.

3.9.4. Opt for a time-driven ABC (TDABC) model

This last option might be the best solution because TDABC can capture the full complexity of the two activities on which the Sanac case focuses. How can TDABC include

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multiple drivers for a single activity? The answer lies in the concept of *time equations*. Based on the characteristics of a specific delivery to pick, the warehouse manager might estimate the time consumed with that delivery. S/he could setup a time equation (general formula) showing how the time spent for each specific delivery is influenced by the number of order-lines, the number of pallets, the number of units, the number of trips, and the number of pallets to be wrapped. To conclude: in TDABC, *multiple* drivers can be taken into consideration to define the cost of a customer-specific activity. In traditional ABC, only one activity-cost driver can be considered for each activity. If many activity-cost drivers are necessary for accurate costing, different activities are needed in traditional ABC. In TDABC, many separate activity-cost drivers can be considered for a single activity, by distinguishing different subtasks in the time equation. This makes it possible to capture the full complexity of activities performed at Sanac.

3.10. Build a time equation for each of the two activities (Q6)

In building the TDABC model, TDABC requires the estimation of two parameters (Kaplan & Anderson, 2004):

1. the *cost per time unit* of the supplied resource capacity, and
2. the *unit time* required to perform an activity by the supplied resource capacity.

For both activities (viz., picking a delivery, and sales-order processing), we now estimate the unit time required in a time equation. For the cost per minute, we refer to the next question.

3.10.1. Time equation for "picking a delivery" activity

In TDABC the picking time is calculated for each delivery. Indeed the picking time depends on the specific characteristics of the delivery to pick, and the TDABC model includes the time for each specific characteristic of the delivery. Based on the characteristics of a specific delivery (viz., number of order-lines, the number of units, number of pallets, number of trips to the quay, number of pallets to wrap-up), the picking time is estimated for each delivery as follows (see Table TN-10):

$$\begin{aligned}\text{Picking time per delivery} = {} & 1 + 2 + (0.3 \times X_1) + (0.10 \times X_2) + (1.5 \times X_3) \\ & + (2 \times X_4) + (3 \times X_5)\end{aligned}$$

where X_1 is the number of order-lines, X_2 is the number of units (boxes or containers), X_3 is the number of full pallets, X_4 is the number of trips to the quay, and X_5 is the number of pallets to wrap-up.

3.10.2. Time equation for sales-order processing activity

The following time-drivers affect the processing time of a sales-order: type of phone call (from a customer or from a sales rep), language of the customer (Dutch-speaking or French-speaking), customer type (regular or non-regular customer), number of fields to update (if any), the number of order-lines, whether the order is a rush order, the number of manual calculations, and whether a confirmation letter is needed. The time equation for the sales-order processing activity can be setup using the information in Table TN-11.

Table TN-10
Time equation for "picking a delivery" activity

Panel A: Information needed to build the time equation

Subtask (TN-3)	Time driver (TN-3)	Duration of the time driver (case facts)
Print-out of picking-list	Number of deliveries	1 min per delivery
Driving to storage rack	Number of order-lines per delivery	18 s per order-line
Loading boxes or containers	Number of units per delivery	6 s per unit
Loading full pallets	Number of full pallets per delivery	1.5 min per pallet
Driving to quay	Number of trips to quay per delivery	2 min per round trip
Wrap-up of pallet	Number of pallets to be wrapped-up per delivery	3 min per pallet to wrap-up
Final-check on the quay	Number of deliveries	2 min per delivery

Panel B: time equation

Picking time per delivery = 1 + (0.3 × # order-lines) + (0.1 × # units) + (1.5 × # full pallets) + (2 × # trips to quay) + (3 × # pallets to wrap-up) + 2

Table TN-11
Time equation for sales-order-processing activity

Panel A: Information needed to build the time equation

Subtask (TN-7)	Time driver (TN-7)	Duration of the time driver (case facts)
Welcome talk when answering the phone	Number of orders from: • Sales representative • Dutch-speaking customer • French speaking customer	• 1 min per order • 3 min per order • 10 min per order
Opening customer file	Number of orders from: • Regular customers • Non-regular customers	• 12 s per order • 30 s per order
Changing customer data	Number of fields to update	• 36 s per updated field
Call logistics when it is a rush order	Rush order or not	• 3 min per order if rush order
Entry of order-lines	Number of order-lines: • Order received from sales rep • Order received from customer	• 12 s per order-line • 30 s per order-line
Calculation by calculator	Manual calculation needed or not: • Number of order-lines	• 6 s per order-line if calculation
Writing confirmation letter	Confirmation letter needed or not	• 15 min if confirmation letter

Panel B: time equation

Processing time per sales-order = $1_{\text{[if sales rep]}} + 3_{\text{[if Dutch-speaking customer]}} + 10_{\text{[if French-speaking customer]}} + 0.2_{\text{[if regular customer]}} + 0.5_{\text{[if non-regular customer]}} + 0.6 \times \#\text{ updated fields} + (0.2 \times \#\text{ order-lines})_{\text{[if sales rep]}} + (0.5 \times \#\text{ order-lines})_{\text{[if customer]}} + (0.10 \times \#\text{ order-lines})_{\text{[if manual calculations]}} + 10_{\text{[if rush order]}} + 15_{\text{[if confirmation letter needed]}}$

If we use the regression type of representation (as explained in Everaert & Bruggeman, 2007), we have now *main effects* on the processing time (e.g., confirmation letter, rush order, codes to change, type of person who is placing the order, regular/non-regular customer) as well as *interaction effects*. The latter are needed to capture the situation where the time effect of a given driver depends on the value of one or more other drivers. For example: the time of order-entry is not always 0.20 min per order-line – this is the case only when the order is placed by a sales rep. When it involves a call from a customer, 0.50 min is required per order-line. So, the subtask "entry of order-lines" can be modeled via a two-way interaction between "type of person who is placing the order" (X_1) and "number of order-lines" (X_6). In the time equation, you find the interaction effect in the terms "$0.2\ X_1\ X_6 + 0.5\ X_2\ X_6 + 0.5\ X_3\ X_6$." The number of order-lines (X_6) is either multiplied by 0.2 when the sales reps is ordering, either multiplied with 0.5 when a customer is ordering. For the Dutch-speaking customers and the French-speaking customers, the number of order-lines is multiplied by the number of orders. The time equation of the sales-order processing activity can be modeled as follows: Processing time per sales-order

$$
\begin{aligned}
&= 0.2 + X_1(1 + (0.2 \times X_6)) + X_2(3 + (0.5 \times X_6)) + X_3(10 + (0.5 \times X_6)) + 0.3X_4 \\
&\quad + 0.6X_5 + ((0.10 \times X_6)X_7) + (10 \times X_8) + (15 \times X_9)
\end{aligned}
$$

where X_1 is the sales rep on the phone: yes (1) versus no (0), X_2 is the Dutch-speaking customer on the phone: yes (1) versus no (0), X_3 is the French-speaking customer on the phone: yes (1) versus no (0), X_4 is the non-regular customer: yes (1) versus no (0), X_5 is the number of fields that are updated, X_6 is the number of order-lines, X_7 is the calculation by calculator needed: yes (1) versus no (0), X_8 is the rush order: yes (1) versus no (0), and X_9 is the confirmation letter needed: yes (1) versus no (0).

3.11. Use the TDABC model to estimate costs for picking a delivery under various contexts (Q7)

3.11.1. Data (see Table TN-12)

(a) Delivery A (sales-order 1): five order-lines of one box for each order-line, one trip to the quay, no wrap-up required.
(b) Delivery B (sales-order 2): one order-line of one full pallet, one trip to the quay, no wrap-up.
(c) Delivery C (sales-order 3): one order-line of one full pallet, one trip to the quay, one wrap-up.
(d) Delivery D (sales-order 4): five order-lines, three boxes, two full pallets, three trips to the quay, customer asks wrap-up of the two full pallets and of the third pallet, containing all boxes.
(e) Delivery E (sales-order 5): five order-lines, five full pallets, five trips to the quay, no wrap-up.

Table TN-12
Picking a delivery activity: data for numerical examples

Picking ID	Order-lines	Units	Full pallets	Pallets	Pallets to wrap-up
A	5	5	0	1	0
B	1	0	1	1	0
C	1	0	1	1	1
D	5	3	2	3	3
E	5	0	5	5	0

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Table TN-13
TDABC – cost per minute for picking-a-delivery activity

1. Available capacity – picking a delivery		
Per week	38 h × 7.5 FTEs =	285 h
Per year	285 h × 52 weeks =	14,820 h
2. Practical capacity		
Per year	80% × 14,820 h =	11,856 h
3. Total cost		
Per 6 months		€177,840
Per year	2 × €177,840 =	€355,680
4. Cost of capacity per time unit		
Cost per year		€355,680
Cost per hour	€355,680/11,856 =	€30.00
Cost per minute	€30/60 =	€0.50

3.11.2. Cost per minute for picking a delivery

The cost per time unit for picking a delivery is calculated in Table TN-13. The available capacity per year (in hours) is based on a 38-hour work week per person, and 7.5 FTEs. However, we need to consider that none of the employees can work at this theoretical capacity. Sanac estimates a 20% difference between available (theoretical) and practical capacity to allow for breaks, holidays, training and communication. The total cost for picking a delivery is equal to €355,680 per year, the practical capacity is equal to 11,856 h per year. Hence, the cost per hour is €30.00 and the cost per minute is €0.50.

3.11.3. Time estimate for picking a delivery

$$\begin{aligned}
&\text{Picking time per delivery} \\
&\quad = 1 + 2 + (0.3 \times \text{number of order-lines}) \\
&\qquad + (0.10 \times \text{number of boxes or containers}) \\
&\qquad + (1.5 \times \text{number of full pallets}) \\
&\qquad + (2 \times \text{number of trips to quay}) \\
&\qquad + (3 \times \text{number of pallets to wrap-up})
\end{aligned}$$

The estimated time per event can be calculated using the preceding time equation and the data from Table TN-12, as follows:

(a) Delivery A: $3 + (0.3 \times 5) + (0.1 \times 5) + (1.5 \times 0) + (2 \times 1) + (3 \times 0) = 7.0$ min.
(b) Delivery B: $3 + (0.3 \times 1) + (0.1 \times 1) + (1.5 \times 0) + (2 \times 1) + (3 \times 0) = 6.8$ min.
(c) Delivery C: $3 + (0.3 \times 1) + (0.1 \times 0) + (1.5 \times 1) + (2 \times 1) + (3 \times 1) = 9.8$ min.
(d) Delivery D: $3 + (0.3 \times 5) + (0.1 \times 3) + (1.5 \times 2) + (2 \times 3) + (3 \times 3) = 22.8$ min.
(e) Delivery E: $3 + (0.3 \times 5) + (0.1 \times 0) + (1.5 \times 5) + (2 \times 5) + (3 \times 0) = 22.0$ min.

3.11.4. Solution

See Table TN-14 for a global overview.

Table TN-14
Estimated costs for picking a delivery based on TDABC

Picking ID	Time estimate (min)	Cost per minute[a]	Estimated picking cost
A	7.0	€0.50	€3.50
B	6.8	€0.50	€3.40
C	9.8	€0.50	€4.90
D	22.8	€0.50	€11.40
E	22.0	€0.50	€11.00

[a] From Table TN-13.

3.12. Use the TDABC model to estimate costs for sales-order processing under various contexts (Q8)

3.12.1. Data (see Table TN-15)

(a) A sales-order from a sales representative, regular customer, five order-lines, no fields to update, no calculations, normal delivery, no confirmation letter required.
(b) An sales-order from a Dutch-speaking customer, regular customer, five order-lines, no fields to update, no calculations, normal delivery, no confirmation letter required.
(c) An sales-order from a Dutch-speaking customer, regular customer, one order-line, no fields to update, no calculations, rush order, no confirmation letter required.
(d) An sales-order from a French-speaking customer, non-regular customer, five order-lines, 10 fields to update, no calculations, normal delivery, no confirmation letter required.
(e) A sales-order from a French-speaking customer, regular customer, five order-lines, no fields to update, additional calculations needed, rush order, confirmation letter is required (see Table TN-15).

3.12.2. Cost per time unit for sales-order processing

The available capacity per year (in hours) for sales-order processing is 38 h per week for each of the five employees. The practical capacity is estimated at 80% (a total of 7904 h per year). The total cost for sales-order processing is €213,408 per year. Therefore, the cost for sales-order processing is €27.00 per h or €0.45 per min (see Table TN-16).

Table TN-15
Sales-order processing activity: data for numerical examples

Order ID	Order source	L	Regular client	Order-lines	# Fields updated	Rush	Confirmation letter
005	SR	D	Y	5	0	N	N
006	Client	D	Y	5	0	N	N
007	Client	D	Y	1	0	Y	N
008	Client	F	N	5	10	N	N
009	Client	F	Y	5	0	Y	Y

Abbreviation:
SR, sales rep; L, language; D, Dutch; F, French.
Regular client: N = No, Y = Yes.
Rush: N = No, Y = Yes.

Table TN-16
TDABC – cost per minute for sales-order processing activity

1. Available capacity – sales-order processing		
Per week	38 h × 5 FTEs=	190 h
Per year	190 h × 52 weeks=	9880 h
2. Practical capacity		
Per year	80% × 9,880 h=	7904 h
3. Total cost		
Per 6 months		€106,704
Per year	2 × €106,704=	€213,408
4. Cost of capacity per time unit		
Cost per year		€213,408
Cost per hour	€213,408/7904=	€27
Cost per minute	€27/60=	€0.45

3.12.3. Time estimate for sales-order processing

$$\begin{aligned}
&\text{Processing time per sales-order}\\
&\quad = 1_{[\text{if call from sales representative}]} + 3_{[\text{if call from Dutch-speaking customer}]}\\
&\qquad + 10_{[\text{if call from French-speaking customer}]} + 0.2_{[\text{if regular customer}]}\\
&\qquad + 0.5_{[\text{if non-regular customer}]} + (0.6 \times \#\text{of fields to update})\\
&\qquad + (0.2 \times \#\text{order-lines})_{[\text{if sales representative on phone}]}\\
&\qquad + (0.5 \times \#\text{order-lines})_{[\text{if customer on phone}]}\\
&\qquad + (0.10 \times \text{number of order-lines})_{[\text{if manual calculations are needed}]}\\
&\qquad + 10_{[\text{if rush order}]} + 15_{[\text{if confirmation letter is needed}]}
\end{aligned}$$

The estimated time per sales-order can be calculated using the preceding time equation and the data from Table TN-15, as follows:

(a) Sales-order 6: $1 + 0.2 + (0.6 \times 0) + (0.2 \times 5) + (0.1 \times 0) + 0 + 0 = 2.2$ min.
(b) Sales-order 7: $3 + 0.2 + (0.6 \times 0) + (0.5 \times 5) + (0.1 \times 0) + 0 + 0 = 5.7$ min.
(c) Sales-order 8: $3 + 0.2 + (0.6 \times 0) + (0.5 \times 1) + (0.1 \times 0) + 10 + 0 = 13.7$ min.
(d) Sales-order 9: $10 + 0.5 + (0.6 \times 10) + (0.5 \times 5) + (0.1 \times 0) + 0 + 0 = 19.0$ min.
(e) Sales-order 10: $10 + 0.3 + (0.6 \times 0) + (0.5 \times 5) + (0.1 \times 5) + 10 + 15 = 38.2$ min.

Table TN-17
Estimated sales-order processing costs based on TDABC

Sales-order ID	Time estimate (min)	Cost per minute[a]	Estimated order-processing cost
005	2.2	€0.45	€0.99
006	5.7	€0.45	€2.57
007	13.7	€0.45	€6.17
008	19.0	€0.45	€8.55
009	38.2	€0.45	€17.19

[a] From Table TN-16.

3.12.4. Solution

These data show that the activity time per sales-order processing significantly differs depending on the characteristics of the order (see Table TN-17).

3.13. What new difficulties could arise when attempting to implement a TDABC system? (Q9a)

When looking at the time equations, participants usually question *how one can come up with accurate time estimates for the time equations*. Some individuals question the time needed to record the time spent on small tasks.

Arguments in favor of the time-equation technique are:

1. People know very well how much time it takes to perform repetitive tasks.
2. TDABC is not a system of time registration, but a cost-modeling technique.

It is interesting in this discussion to ask what could be more accurate in a dynamic environment:

(a) Asking operational people the percentage of their time (on average) they spend on performing a certain activity (e.g., writing a confirmation letter). This question is typical for ABC, or.
(b) Asking operational people how long it takes to execute an activity (e.g., writing a confirmation letter). This question is typical for TDABC.

Students will recognize that when asking the first question, people (interviewees) will make sure that the percentages of all activities performed will add upto 100%. Due to this, traditional ABC may not properly capture the cost of unused capacity. When using TDABC the accuracy of the time estimates in the time equations can be tested by a capacity utilization report. For instance, at Sanac, entering the mix of transactions of a certain month into the model, the resulting capacity report showed that the department needed a capacity utilization of 180%. In reality no significant overtime had to be spent in that department. This indicates that the estimates in the time equation had to be revised.

3.14. Is TDABC appropriate for a dynamic environment? (Q9b)

One can ask: Is TDABC a key tool for agility? TDABC is more appropriate than traditional ABC for an environment where the operations and processes are fast changing. As mentioned above, in TDABC only two parameters need to be estimated: the cost per time unit of the department, and the time required to perform an activity by the department. Both parameters are easy to update, which we illustrate with the following two examples. The first example deals with changing the tasks of the sales-order department. The second example deals with changing the resources of the sales-order department.

First example: Assume that Sanac faces payment problems of the do-it-yourself (DIY) customers and wants to introduce an additional credit check when receiving sales-orders by these customers, by checking trading information with Graydon – a company providing information on trade partners. In fact, the sales-order processing department now performs a new task, i.e., consulting the Graydon website to check the solvency of the customer "do-it-yourself shop." Assume that this website-information-check takes 5 min per sales-order.

In TDABC, the sales-order department can accommodate this new task by adding the following term: "$+5_{[\text{if sales-order received from do-it-yourself customer}]}$". The new time equation can be modeled as follows: Processing time per sales-order

$$= 0.2 + X_1(1 + (0.2 \times X_6)) + X_2(3 + (0.5 \times X_6)) + X_3(10 + (0.5 \times X_6)) + 0.3X_4 + 0.6X_5 + ((0.10 \times X_6)X_7) + (10 \times X_8) + (15 \times X_9) + 5X_{10}$$

where X_1 is the sales rep on the phone: yes (1) versus no (0), X_2 is the Dutch-speaking customer on the phone: yes (1) versus no (0), X_3 is the French-speaking customer on the phone: yes (1) versus no (0), X_4 is the non-regular customer: yes (1) versus no (0), X_5 is the number of fields that are updated, X_6 is the number of order-lines, X_7 is the calculation by calculator needed: yes (1) versus no (0), X_8 is the rush order: yes (1) versus no (0), X_9 is the confirmation letter needed: yes (1) versus no (0), and X_{10} is the do-it-yourself customer: yes (1) versus no (0).

In traditional ABC, adding a new task to the sales-order processing is treated as adding a new activity to the detailed model, as previously developed in Table TN-9. In theory, we only need to estimate the total cost of this new activity and then divide this cost by the practical capacity of the activity-cost driver, resulting in a new activity-cost driver rate. In ABC, however, we would need to tackle two difficult implementation issues: (1) "What percentage of their time are the sales-order processing employees busy with checking the Graydon website?"[13] As mentioned above in Section 3.13 this question is much more difficult to answer than estimating how long it takes to do one credit check at the Graydon website. (2) "How many checks can the sales-order-processing employees perform in a normal work week?" This second question is about estimating the practical capacity of the activity-cost driver. Again, this is very difficult to estimate at Sanac, since the sales-order processing employees are involved with many different subtasks. As shown in Table TN-9, estimating the practical volume for each of the activity-cost drivers for the detailed ABC model requires estimates for twelve (previously, eleven) activity-cost drivers.[14]

Second example: Assume that Sanac invests in a new computer system to handle the sales-order processing. Assume that the monthly depreciation will increase by €600, resulting in a cost increase of €7200 per year for the department. The TDABC model will now calculate a higher cost per time unit of the resources supplied. In particular, the total cost of the sales-order processing department will increase by €7200 per year, from €355,680 to €362,880. The capacity supplied by the sales-order processing department remains unchanged at 11,856 h per year (7.5 full time employees, working 38 h per week at a practical capacity of 80%). Hence, the cost per minute increases from €0.50 per min to €0.51 per min. In fact, in TDABC, only one parameter needs to be updated, whereas in the detailed ABC model, as shown in Table TN-9, all of the eleven activity-cost driver rates will change.

[13] In ABC, the total cost consumed by an activity is calculated by multiplying the percentage of the time spent of the employees on this activity by the total resources of the department.

[14] To avoid this difficult estimation process, the controller at Sanac suggested using the actual volumes for the activity-cost driver rates, as mentioned before in the answers to Q1.

To conclude: in TDABC the activities can be considered as very broad and still capture the operations in full detail because of the time equations. In the case, the TDABC model could be built on a limited number of very broad activities in the value chain, such as sales-order processing and delivery picking. Properly formulated time equations ensure that these generic activities can be modeled in full detail. And more important here, the time equations allow the cost system designers to update the TDABC model by simply adding/changing the terms (representing subtasks) in the time equation, when the operations change.[15] However, in traditional ABC the model requires many detailed activities, requiring many updates when the operations change. Furthermore, in TDABC, the cost per time unit is calculated for the whole department, while in a detailed ABC model, the activity-cost driver rates need to be calculated for each subtask. In fact, costs under TDABC are no longer assigned to activities, but are calculated for a pool of resources (department in this case).

4. Epilogue

What happened in reality? In collaboration with the consultant, the company decided to implement a TDABC model. In the time-driven approach, 50 activities were defined. The cost of installation was 11 man-days, 60 per cent of which were outside the firm. Less than one year later, the company was successfully using the monthly TDABC reports. The results were considered very successful. The customer profitability reports provided by the TDABC system showed that most of the largest retail customers (home & garden), indeed, had the lowest profitability. These customers had used their negotiation power in the past to get lower prices, but also to receive extremely high services. The largest customer showed a net profit of −14%. Via drill-down to profitability per order and profitability per delivery, De Creus learned about the sources of this low customer profitability. This customer had 3–4 deliveries per week on more than one delivery site. De Creus communicated this new insight (from the TDABC model) to the account manager and told him to renegotiate the terms of trade. De Creus explained again to the account manager that the objective was not to maximize sales revenue, but to maximize net profits. The account manager was very astonished by the figures. Prior to this he was considered one of the best account managers. That is why he received the job of managing the relationship with the largest customers! At first the account manager refused to "believe the numbers." However, by looking at the time equations he learned about the time for this customer spent during the picking a delivery and drop-off process. De Creus and the manager ultimately met with the customer to discuss delivery practices. The customer concluded that the high number of deliveries per week and the high number of different drop-off sites could be reduced. De Creus used the TDABC model to simulate the effect of the new delivery conditions on customer profitability and found that the new delivery conditions would reduce the loss from this customer from 14% to a loss of 2%. In addition he found out that a large part of the products purchased by this customer came from a limited number of suppliers.

[15] Subtasks can be added to the time equation, as long as the employees performing the subtask belong to the same department. This means, for instance, that for the time equation for picking a delivery we cannot add subtasks performed by the sales-order processing department (e.g., printing the picking-list), since both departments face a different cost structure (see Table 3). The different cost structure will result in a different cost per minute, as shown in the calculations provided in Tables TN-13 and TN-16.

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De Creus was then able to renegotiate prices and delivery conditions with these suppliers. He reduced the cost of ownership of the delivered products and the net profits of this large customer became positive.

Although sales reps could now understand the profitability information, and saw how one could use this information to create win-win situations with customers and to increase the profitability of supply chains, De Creus found it difficult to change the culture of his sales team from a volume- and revenue-driven organization to a profit-focused organization. He wanted the sales managers to use the profitability information to continuously improve profitability.

However, the TDABC model had a positive impact on profitability and on the value of the company. In the industry Sanac built an image of a well-run company with increasing profitability in a market with high rivalry among competitors. Due to this, Sanac became an interesting acquisition candidate. In 2006, Sanac was acquired by AVEVE, the market leader in the industry. De Creus had never thought he would be able to create so much shareholder value with the TDABC project.

5. Conclusion

This case draws on one of the author's real-life experiences with ABC. As far as we know, it is one of the first teaching cases on TDABC. The case requires students to assume the role of a business consultant in deciding about the appropriate costing method. Students must first analyze the competitive environment and learn about the difficulties experienced in the ABC model. Then, students are asked to select the optimal costing model for this company.

After completing the case students will understand the differences between ABC and TDABC. The case also illustrates the concepts of time-drivers and time equations with real life examples of logistics operations.

This case has been used in a management accounting course offered to MBA students, as well as in a cost accounting course at the undergraduate level. Students having only basic knowledge of ABC should have the required insights to work on this case. The case can be used either as an individual assignment or as a group assignment, followed by a plenary discussion. Numerical calculations have been added for homework assignments afterwards. The case is short enough to use as an in-class assignment (with preparation in advance) or as a take-home exam. The case requires only a limited number of calculations, but enough to illustrate how the TDABC model can be build up and to elicit a rich understanding of the differences between traditional ABC and TDABC.

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