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IMPLEMENTATION OF TIME-DRIVEN ACTIVITY-BASED COSTING IN WEAVING SERVICE COMPANY

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Abstract

The feasibility of the application of the Time-Driven Activity-Based Costing (TDABC) method have been investigated in practice for a while now. However, there has been no research conducted in companies providing weaving services. The object of the research is the implementation of TDABC system. The aim of the research is to assess the process of implementation of TDABC in weaving service company. The paper uses cases analysis as a research method. The implementation of TDABC required different measures, while different interviews were carried out and historical data was used. The project team for TDABC implementation was created and the plan of TDABC implementation was prepared. In order to have smooth implementation of TDABC it was revealed that it is critical to evaluate challenges encountered by enterprises starting to apply the TDABC system. The main challenges which are encountered by the enterprise in the course of installing the TDABC system appeared to be: major resistance from the staff was encountered when recording the duration of each particular function. The core advantages provided by the TDABC system appeared: the analysis helped the enterprise identify the processes which should be improved by decreasing the factual time of the service for the cost drivers. The profitable products were disclosed. Herewith, the additional unused capacity was revealed.

Keywords: cost management, activity-based costing, time-driven activity-based costing, weaving services.
JEL codes: M41.

Introduction

Zinkevičienė and Stravinskaitė (2013) claim that in order to increase competitiveness in the regularly changing business environment, it is of fundamental importance to select such a system of cost accounting which would provide information beneficial for governance and would help to answer such questions as: "What price should we foresee for the product we are currently manufacturing?", "Does it make sense to go on producing some specific product?", or "How should the costs of the enterprise be managed efficiently?". To answer above listed questions a properly developed costing system should be adopted, because if companies want to influence their costs, they must understand the relationship between the volume and mix of the products they produce and the expenses they incur.

A number of authors have investigated the feasibility of the application of the TDABC method and have applied this method in practice in the fields of logistics (Gervais et al., 2010; Afonso and Santana, 2016), marketing (Yonpae et al., 2019), hotel management (Hajiha and Alishah, 2011), manufacturing (Florosi and Adiguzel, 2018), medicine (Demeere et al., 2009; Keel et al., 2017; Martin et al., 2018), electronics (Stout and Propri, 2011), science (Ozyürek and Ulutürk, 2016; Pernot et al., 2007) and services (Szychta, 2010). When employing the TDABC system, a cost-accounting model may be developed more rapidly and easily. Kaplan and Anderson (2007) claim that TDABC may be easily integrated with the data which is accessible from management systems; as a result, the system is becoming more dynamic. The system assigns costs on the basis of properties of specific orders, processes, suppliers and clients. This may be repeated monthly in order to register the efficiency of the latest operations. TDABC forecasts the need for resources, allows drafting budgets and forecasting the number of orders and the difficulty levels of their fulfillment. The TDABC system is easily adaptable for business models of various sizes. The system is rapidly and inexpensively maintained; it delivers extensive information which helps to identify the main causes of the issues faced by the enterprise. According to Kaplan and Anderson (2007), the developers of the TDABC system, TDABC may be used in any industry or at any enterprise involving complex clients, products, channels, etc. The information provided by the TDABC model improves the understanding of various organizational processes by the management and the entire staff thus facilitating strategic decisions. The TDABC method develops healthy competition and open cooperation among different departments regarding potential improvements of the activity (Demeere et al., 2009). Therefore, by employing this method of accounting for costs, enterprises may implement systemic strategic developments thus boosting the current and future value of the enterprise and its efficiency.

The implementation of the TDABC system is similar to the implementation of the ABC system, however, the cost drivers and the level of the efficiency of the system are different. The TDABC system is more advanced because it requires only two parameters: the factual consumption of a unit of cost, and the amount of time required to conduct a specific activity. Whereas, the ABC system uses cost drivers, e.g., the assembly of equipment or implementation of a client's order, and treats them as being equal in terms of time, whereas the TDABC system employs a time unit for each particular activity because the duration of various processes is not equal. The TDABC system does not require conducting interviews with the staff in order to find out the percentage of time assigned to conducting each particular activity. TDABC also allows easily updating the cost system when products or services are modified, or when processes of manufacturing or service provision are altered (Somapa et al., 2012). When the activity driver (e.g., the number of orders) is not used anymore and when the time is considered which is required for the implementation of some kind of activity (e.g., for processing orders), the costs per item (order) may be entirely dependent on various situations modifying the time factor; thus, no additional activities need to be created in this particular situation.

The object of the research is the implementation of TDABC system. *The aim of the research* is to assess the process of implementation of TDABC in weaving service company.

Research Methods

The paper uses case analysis as a research method. The majority of the case analysis studies and research papers available to the authors of the present research acknowledge the efficiency of the system use case analysis as research method. Even though only scant empirical data is available, it may still be concluded that the TDABC system is beneficial for the enterprise activity. The steps of case analysis method were as follows: 1) to apply the stages of the TDABC system at an enterprise providing weaving services; 2) to investigate whether additional fine-tuning of data after the installation of the system is important for the further application of the TDABC system; 3) to identify the main challenges which are encountered by the enterprise in the course during installing the TDABC system; 4) to outline the core advantages provided by the TDABC system after implementation. The fulfillment of the aim and the objectives is highlighted in the discussion and the conclusions.

Researches focusing on the efficiency of TDABC and the benefits it provides are conducted at specific enterprises by employing the interventionist and interpretive approach. This interpretive research focuses on analytically disclosing these meaning-making practices, while showing how these practices configure to generate observable outcomes. This method of research is applicable so that to obtain profound understanding on the matters. One of the key research limitations of this research is that the model was applied for the company-customized products (Stončiuvienė et al., 2020). The implementation of TDABC required different measures (distances, times, speeds), while different interviews were conducted, and historical data was used at the engineering department.

Yet, in the course of this case analysis, all the drawbacks of the TDABC method: 1) inaccuracies stemming from the inherent errors of the time formulas; 2) difficulties of application when no management system is available; 3) indefiniteness of the guidelines of model application; 4) subjectivity of the time equations; 5) regular renewal due to altering processes of production (Gervais et al., 2010; Kuang, 2013; Szychta, 2010; Namazi, 2016) as well as the strengths: 1) the model is less complex than ABC and is easily applicable to business models of various sizes; 2) the model is well-integrated with the data which is available from the management systems; 3) the model defines time-wasting and limiting factors; 4) the model encourages cooperation among departments; 5) time equations provide more precise calculations of the process time and reduce the number of activities (Bruggeman et al., 2005; Demeere et al., 2009; Kaplan and Anderson, 2007; Martin et al., 2018) were singled out in the course of our case analysis.

Namazi (2016) highlights the following challenges encountered by enterprises starting to apply the TDABC system: 1) imprecise initial data or its absence; 2) failure to establish the various activities at the first stage of implementation due to similarity of processes at the enterprise; 3) the system is efficient only at these enterprises where time can be identified as the main cost driver; 4) departments of the enterprise are conducting various activities which are not homogeneous; therefore, the sheer amount of calculations increases. The challenges identified by Namazi (2016) were used as the assessment criteria for successful implementation of TDABC in weaving service company.

During the preparatory stage of the research, the project team was made up, and the plan of TDABC implementation was prepared. When assembling the project team, the qualification of the staff and their practical experience related with the manufacturing processes was considered. The project team consisted of the following members: the highest-ranking manager of the weaving production, the production accountant, a planning-logistics specialist, and the accountant. TDABC was implemented in the manufacturing department.

At the enterprise, the costs of the weaving service are calculated by applying the process (phase)-based method of costs calculation. This method is being employed as the technological process at the enterprise is divided into independent stages of production. A phase in this context is the entirety of the technological operations of one type, after which, the product becomes essentially different in terms of its qualities of use and application. This method is also referred to as non-semimanufacture method. The enterprise weaves by using the raw materials delivered by the customer (the yarn, the weft, and the throwing thread). In the course of weaving, fabrics can be divided into three categories in terms of their material: 1) wool, nylon, rayon; 2) polyester and viscose/rayon; 3) polyester. All the woven production is passed over to the supervising institution.

According to Kaplan and Anderson (2007), the authors of the TDABC system, the development (implementation) of TDABC involves six stages:

1) identification of costs and groups of costs;
2) distribution of costs in terms of their groups;
3) identification of the capacity in practice;
4) calculation of the costs of groups in minutes;
5) derivation of time equations;
6) calculation of the costs of a product or a service.

On the grounds of the recommended stages of TDABC installation, the multi-disciplinary team created a plan of adopting TDABC. Action had to be taken by adhering to the following sequence:

1) identification of all the costs of weaving production and service processes;
2) analysis of the direct and indirect costs of the enterprise;

3) calculation of the theoretical capacity of the staff involved in the weaving production process;
4) identification of all the phases and activities of the weaving process and the functions required for their implementation;
5) survey of the staff for the sake of estimating the distribution of their working time regarding work activities;
6) survey and observation of the staff with the objective to determine the time required for performing the identified activities and their functions;
7) gathering and systemizing production data required for the performance of their activities;
8) calculation of the factual working time of the staff involved in the weaving production process;
9) derivation of time equations;
10) testing of the TDABC system;
11) assessment of the results.

According to the established activity plan, first of all we identify all the costs pertaining to the production and service processes of weaving, during the researched quarter, the total costs of weaving production and services were nearly 558,000 Eur. The lion's share of the costs was made up of salaries and transportation, specifically, 50.77% and 25.36%, Table 1 lists all the indirect manufacturing costs of weaving incurred during the researched quarter. The process of transferring the financial data from the source of information to the cost-accounting model is smooth; *Microsoft Excel* software is employed.

Table 1. Structure of Indirect Costs Per Quarter

Indirect costs, Eur		Distribution, percent
Environment protection	778.82	0.60
Use of vehicles	3,697.58	2.85
Office	3,894.29	3.01
Salaries/remuneration	25,440.09	19.63
Insurance	2,457.86	1.90
Long-term asset wear depreciation	12,368.11	9.54
Use of equipment	43,626.46	33.67
Rent of equipment	669.03	0.52
Other general costs	4,041.17	3.12
Communal services	17,500.04	13.50
Training	504.24	0.39
Supplementary materials	4,212.56	3.25
Services	4,690.17	3.62
Building maintenance	5,703.71	4.40
Total:	*129,584.14*	*100.00*

(Source: compiled by authors)

According to the established plan of method installation, the next step is the calculation of the theoretical capacity of the weaving production staff. The theoretical capacity of the staff is the entire time which is planned for work without eliminating all the failures to show up to work, training periods, work breaks, and work at other departments. During the researched quarter, the theoretical capacity of the enterprise was 4,159,680 minutes.

According to the assigned schedule, the staff works five days per week eight hours per day in three shifts. When calculating the theoretical capacity, the fact that there were staff members who started work later than at the beginning of the month was also taken into consideration (Table 2).

Table 2. Theoretical Capacity of Weaving Staff

Indicator	July	August	September	Total
Working week		5-day working week		-
Days of work	22	21	22	65
Number of staff	129	132	134	395
Members of staff starting work later than the beginning of the month	2	3	5	10
Theoretical capacity, hrs	22,968	22,432	23,928	69,328
Theoretical capacity, min	1,378,080	1,345,920	1,435,680	4,159,680

(Source: compiled by authors)

As the next step, in the process of weaving production, 10 phases, 27 activities (Table 3) and 205 functions required for performing the activities were singled out. The phases of the process were not difficult to establish as the enterprise has adopted ISO 9001:2008 Quality Management Standard.

Table 3. Phases and Activities of Weaving Production Process

Phases of the process	Activities
1. Weaving of a new design	1.1. Reception of a new design 1.2. Weaving by employing the new design 1.3. Approval of the new design
2. Reception of raw materials	2.1. Delivery of raw materials 2.2. Checking the raw materials 2.3. Unloading of raw materials
3. Renewal/ update of the order plan	3.1. Presentation of the work plan 3.2. Information on the altered work 3.3. Planning of the bobbin wheel loading work
4. Bobbin-making and bobbin wheel loading	4.1. Thread preparation for bobbin wheel loading 4.2. Threads are bound on bobbins 4.3. Threads are loaded
5. Maintenance of equipment	5.1. Preparation and implementation of the equipment maintenance plan 5.2. Ordering of parts/ spares, calibration and testing
6. Weaving	6.1. Preparation for weaving 6.2. Weaving of the first fabric; testing 6.3. Weaving
7. Quality control and darning	7.1. Quality control 7.2. Darning 7.3. Final sorting
8. Preparation for dispatching	8.1. Fabric roll registration 8.2. Distribution of fabric rolls 8.3. Preparation of threads for dispatching
9. Dispatching	9.1. Loading
10. Waste management	10.1. Emergence of the waste 10.2. Waste storage 10.3. Waste dispatching

(Source: compiled by authors on the basis of ISO 9001:2008 Quality Management Standard Weaving production delivery process)

The next position in the method installation plan involves the assessment of the distribution of the working time of the staff in terms of activities. This assessment is performed by conducting a survey of the employees. Before surveying the staff, the exact number of employees was established, and their duties were outlined (Table 4).

Table 4. Positions of the Staff of Weaving Production

Position	July	August	September
Equipment manager	1	1	1
Master’s assistant-binder	9	11	10
Shift master	4	4	4
Weaver	23	23	23
Weaving production manager	2	2	2
Planner-warehouse supervisor	1	1	1
Bobbin-maker	8	9	8
Bobbin wheel loader	40	42	45
Weaver assistant	5	5	5
Transporter*	4	2	3
Transporter **	1	1	1
Electrician – specialist of automation	1	1	1
Sorter***	3	4	6
Sorter*****	1	1	1
Manufacturing accountant	1	1	1
Specialist of planning and logistics	1	1	1
Electrician-technician	1	1	1
Sorter-darner	24	24	24
Warehouse master-driver	1	1	1
Total:	*131*	*135*	*139*

* Transporter of non-daytime shift(s), ** Transporter of the day shift, *** Sorter before darning, **** Sorter after darning

(Source: compiled by authors)

When conducting the staff survey regarding the distribution of their working time by activity, it is of fundamental importance to identify these members of the staff who work at across two or more departments. The fraction of work at another department needs to be eliminated from the factual capacity of the member of staff. Having completed the survey, it was determined that there were five individuals who spent a certain share of their working time at other departments. The share of their work at the weaving production department is shown in Table 5. Later on, when the factual capacity of the weaving production department is calculated in minutes, the share of their working time attributed to other departments shall be eliminated.

Table 5. Staff of Weaving Production also Working at (An)Other Department(s)

Position	Number of staff	% for weaving production
Equipment manager	1	70
Transporter *	1	90
Electrician – specialist of automation	1	90
Electrician-technician	1	80
Warehouse master-driver	1	80

* Transporter of the day shift

(Source: compiled by authors)

Further on, during the stage of the analysis of the method adoption process, it is essential to consider the time which is required to perform activities and their functions. In order to conduct this assessment, the staff is surveyed regarding the duration of the functions or observation they perform.

When adopting the TDABC system, a survey of the staff was performed along with observation of all the identified activities and their functions in terms of the required time. Table 6 lists the functions involved in raw materials reception with the corresponding timeframe.

The time evaluation of the functions involved in this activity was performed by surveying the staff. The identification of the functions activities and the duration measurement were easy to determine due to the top training levels of the staff at the enterprise; besides, the TDABC system introduction team was composed of representatives of various professions. However, major resistance from the staff was encountered when recording the duration of each particular function. When the staff members were asked to record the time required to perform a certain function, a fraction of the staff members significantly increased the duration of the function. Therefore, the duration of functions was registered with one of the members of the TDABC system introduction team being physically present in the measurement.

Table 6. Function of Raw Materials Reception Activity and Its Duration

Function	Time, minutes/pc.
Delivery of shipment documentation to the office	2
Unloading of pallets from vehicle to ramp	2
Unloading of boxes from vehicle to ramp	4
Unloading of transportation platforms	6
Unloading of spindles from vehicle to ramp	2

(Source: compiled by authors)

As shown in Table 6, five functions were identified in the raw materials reception activity. Table 7 contains the list of functions involved in yarn winding on bobbins along with time value estimates. By employing the direct observation method, the time of operation of each machine winding yarn on cones per cycle was determined. The direct observation method requires more time resource for the research, but it is more reliable for obtaining more precise time values.

We should note that activity function assessment by employing the direct observation method is only beneficial with these activities which involve repeating functions in the course of production, and the time value is stable. As a result, the working time of the project team increased due to the need to identify activity functions, conduct observation, and survey the staff.

Table 7. Functions of Bobbin Winding Yarn Activity and Their Duration

Function	Time, minutes/ pc.
Setting of bobbin winding machines	2
Filling in the account for yarn wound on bobbins	15
Yarn transportation to the warehouse	10
Yarn winding on cones (machine No. 1)	13
Yarn winding on cones (machine No. 2)	6
Yarn winding on cones (machine No. 3)	6
Yarn winding on cones (machine No. 4)	4
Yarn winding on cones (machine No. 5)	11
Yarn winding on cones (machine No. 6)	8
Yarn transportation to the bobbin wheels	8
Yarn transportation from the warehouse to the bobbin wheels	12

(Source: compiled by authors)

During the next step of the method implementation, we calculate the factual working time of the staff. This step of TDABC adoption requires selecting the strategy of the calculation of the factual working time of the staff.

The time may be determined by employing two methods, either by eliminating the factual failure to show up at work (holidays, health issues), trainings, breaks and work at other departments, or otherwise taking 10 to 20 percent of the theoretical capacity.

The factual time of work was identified by subtracting the factual failure to show up, trainings, breaks and work at other departments from the total time. The factual time of the staff of the enterprise was measured at 2,864,190 minutes (Table 8). This time constitutes nearly 69 percent of the theoretical capacity of the staff.

Should the enterprise determine the factual working time of its staff by eliminating 20 percent off the theoretical capacity, the obtained value would equal 3,309,528 minutes, and the error margin would be significant.

Table 8. Factual Working Time of the Staff

Quarter	Total
Number of working days	65
Number of staff members*	135
Minutes of work	4,159,680
Holidays in minutes	707,040
Disease, healthcare, etc., in minutes	436,320
Professional training, min	3,840
Breaks in work, min	125,520
Working time at (an)other department(s), min	22,770
Factual working time, min	2,864,190

* Average number of staff members

(Source: compiled by authors)

In the course of the weaving process, 31 time calculation equations were composed to define the activity of the enterprise. The formula (equation) of the weaving process is presented in Table 9. As shown in Table 13, the shift master notifies a weaver that a fabric is authorized to be woven (1 minute). During the second stage, the weaver eliminates all the defects which occurred in the course of weaving: breaking of the fluff or weft thread requires 2 minutes; if the thread needs to be drawn onto the loom, 10 minutes are required; also, the breaking of the arcade thread requires 10 additional minutes as well. In the next stage, the weaving process takes place. If the *Metex* loom is used, a single employee overlooks three looms, and one meter is woven in 17.1 minutes. Meanwhile, if the *Van de Wiele* loom is used, the process of weaving involves two employees overlooking four looms, and one meter is woven in 7.2 minutes. The required information is marked on the completed roll, which takes four minutes. After the completion of the fabric, each roll is registered in the work sheet, which takes one minute. During the weaving process, the shift master fills in the blank of the daily checks, where the information on a single loom is outlined in about three minutes. After the completion of an order, the work sheet is filled; it features information on the woven rolls, and it is rolled into the last woven roll. This sequence of operations takes four minutes.

Table 9. Equation of Weaving Duration

Duration of weaving
$= 1*a + 2*b + 2*c + 10*d + 10*e + (17.1*f/3) + (7.2*g/4*2) + 4*h + 1*i + 3*y + 4*j$

Mark	Meaning of the mark
a	Delivery of information to the weaver about launching the loom
b	Repair of defects – breaking of the fluff thread
c	Repair of defects – breaking of the weft thread
d	Repair of defects – drawing the thread onto the loom
e	Repair of defects – breaking of arcade thread
f	Measurement of fabric woven with *Metex* loom
g	Measurement of fabric woven with *Van de Wiele* loom
h	Notation on the roll of the fabric
i	Inscription of the recording of the woven roll of the fabric on the work sheet
y	Filling in the blank of the daily checks
j	Information on fulfilling the order

(Source: compiled by authors)

According to the darning time equation presented in Figure 1, it is evident that, at Stage A, a darner prepares a roll of fabric for inspection (3 minutes). During the next stage, the darner – as informed by the sorter – has to darn or review the fabric roll. If the roll is not darned, additional inspection is required, which takes roughly twelve minutes. If the roll has to be darned, the darning time depends on the length of the roll to be darned.

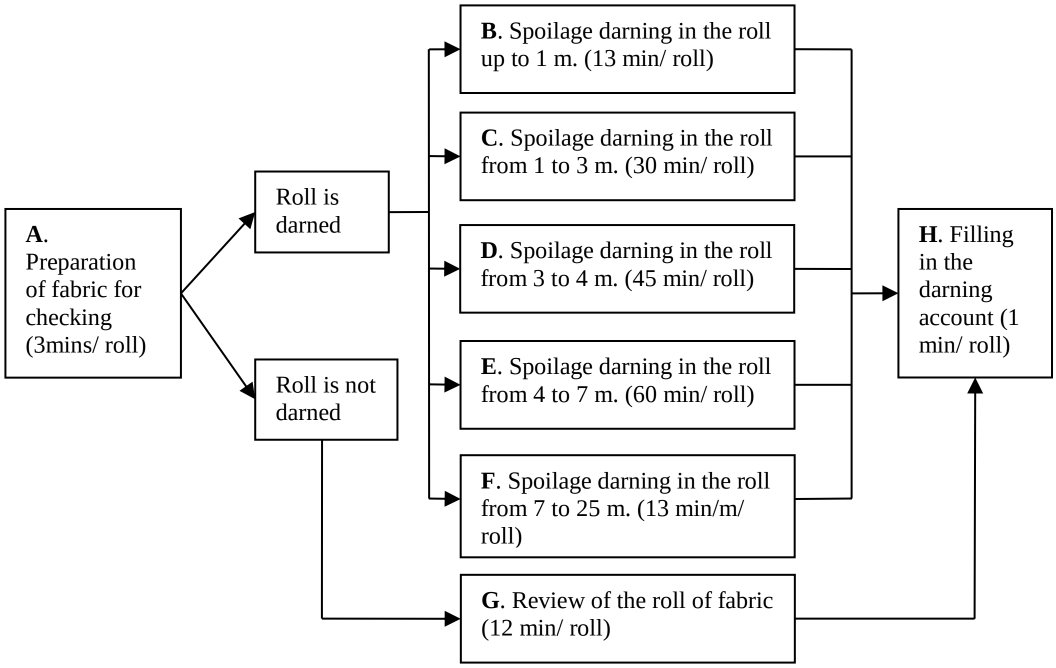

Figure 1. Scheme of Darning Time Equation

(Source: compiled by authors)

During the final stage of darning, the darner fills darning account containing information on each reviewed or darned roll. On the basis of the scheme presented in Figure 1, the darning time equation formula is derived: Darning time equation = 3*a + 13*b + 45*d + 60*e + 13*f + 12*g + 1*h.

Having inserted the values into time equations (formulas), the time is calculated which is required for performing all the activities involved in the weaving service.

Table 10. Time Consumed for Various Phases of the Weaving Service Process

Phases of the process	Duration of a process phase, min		
	Wool/ nylon/ rayon	Polyester/ viscose	Polyester
Weaving of a new design	5,609	1,028	0
Reception of raw materials	13,377	851	553
Renewal/ update of the order plan	18,158	2,175	577
Bobbin-making and bobbin wheel loading	513,558	62,442	4,504
Equipment maintenance	90,465	9,100	865
Weaving	955,286	105,312	17,247
Quality control and darning	454,085	78,958	8,786
Preparation for dispatching	12,424	1,252	294
Dispatching	3,070	421	132
Waste management	5,469	230	68
Total per service:	*2,071,501*	*261,769*	*33,026*
Total:		*2,366,296*	

(Source: compiled by authors)

Having inserted the values into the time equations, we calculate that, in a quarter, the provision of weaving services by the enterprise took 2,366,296 minutes of working time of the staff (Table 10). When the time spent on the phases and activities of the process is known, the factual working time of the staff is determined: indirect costs per unit = indirect costs/factual working time of staff = 129 584,14 Eur/ 2 864 190 min = 0,045243 Eur/min.

As the next step, indirect costs are redistributed for the activities of each production phase according to weaving services. Table 11 lists information on the distribution of the employed capacity and the indirect costs for each phase of the process.

Table 11. Analysis of TDABC Application

Process phase	Process phase cost drivers		Cost driver	Time per one phase	Time of process phase	Costs of process phase
	Title	Number				
Weaving of a new design	Number of instances of new design	39	7.70	170	6,638	300.31
Reception of raw materials	Number of shipments	44	15.20	336	14,781	668.71
Renewal/ update of the order plan	Number of work plans	65	14.55	322	20,910	946.03
Bobbin-making and bobbin wheel loading	Number of loaded bobbin wheel frames	1,317	19.94	441	580,505	26,263.78
Equipment maintenance	Number of instances of loom maintenance	3,733	1.22	27	100,430	4,543.75
Weaving	Number of meters of woven fabric	178,832	0.27	6	1,077,845	48,764.96
Quality control and darning	Number of sorted rolls	7,154	3.43	76	541,829	24,513.97
Preparation for dispatching	Number of rolls	6,975	0.09	2	13,969	632.01
Dispatching	Number of loadings of racks with rolls	634	0.26	6	3,623	163.89
Waste management	Number of pallets	130	2.01	44	5,767	260.92
Used capacity					2,366,296	107,058.33
Unused capacity					497,894	22,525.80
Total:					*2,864,190*	*129,584.14*

(Source: compiled by authors)

The unused capacity in the course of the weaving process constituted 497,894 minutes (17.38%), or 22,525.80 Eur of indirect costs. These costs of unused capacity are not assigned to products. Having completed the main stages of the introduction of the TDABC system, in order to analyze the obtained values, testing of the introduced system must be conducted.

Results

However, when researching the truthfulness of the adoption of the TDABC system, and while drawing specific conclusions or presenting suggestions, the most important aspect was to run thorough verification of the data once more, i.e., to verify whether the data is not distorted. Having checked the data of the adopted system, we performed several corrections during the data transfer stage (weaving of a new design; weaving) and in the evaluations of time equations for the phase of Bobbin-making and bobbin wheel loading.

Comparison between the process phase factual work time with the process phase capacity was conducted. The process phase factual work time was derived from time equation values, while the capacity was determined by interviewing the manager of the weaving production department along with three other production sector employees; information on the distribution of the employee work time among process phases and their constituent activities was sourced. As shown in Table 12, the lowest share of employed capacities was observed in the processes of dispatching and waste management, specifically, 32.48% and 27.07%. However, the conducted research demonstrated that the phases of weaving and preparation for dispatching used more factual capacity than should actually be possible. The analysis showed that when the staff was surveyed regarding the distribution of their work time, the staff presented data which was subjective and hard to assess. A renewed survey was thus required in order to obtain the distribution of the unused capacity in terms of process phases. Corrections were introduced in three phases in order to ensure correct data transfer from information sources and provide exact evaluation of the time equations. The initial model was easily updated by editing the values and assessments while employing the *Microsoft Excel* software. Repeated interviewing of the staff was still required in order to obtain more precise results of the analysis of the distribution of the employed capacity among the process phases. On the grounds of the test results, the cost accounting model was approved.

Table 12. Comparison of Factual Working Time of Process Phases with Process Capacity

Process phase	Process phase factual working time, min	Process phase capacity, min	Difference, min	Used capacity, percent
Weaving of a new design	6,638	18,325	-11,687	36.22
Reception of raw materials	14,781	25,215	-10,435	58.62
Renewal/ update of the order plan	20,910	59,984	-39,074	34.86
Bobbin-making and bobbin wheel loading	580,505	1,292,908	-712,403	44.90
Equipment maintenance	100,430	105,834	-5,404	94.89
Weaving	1,077,845	662,407	415,438	162.72
Quality control and darning	541,829	654,857	-113,028	82.74
Preparation for dispatching	13,969	12,199	1,771	114.52
Dispatching	3,623	11,154	-7,532	32.48
Waste management	5,767	21,308	-15,541	27.07
Total:	*2,366,296*	*2,864,190*	*-497,894*	-

(Source: compiled by authors)

After the enterprise adopted time-driven activity-based costing, analysis was conducted regarding the cost drivers of the process. As the information presented in Table 13 demonstrates, when weaving a wool, nylon or rayon fabric of a new design, on average, 175 minutes are required for one sample, whereas 147 minutes are required to obtain a sample fabric of polyester or viscose. In the process of the reception of raw materials, it is evident that a single load of fabrics of wool, nylon or rayon is quoted as 478 minutes, whereas polyester and viscose fabrics took 122 minutes, and polyester-only fabrics took 61 minutes. This difference of cargo reception was determined by the low amount of orders for synthetic fabrics. What concerns the phase of quality control and darning, it is evident that when rolls of fabrics of wool, nylon and rayon are sorted, the staff takes 72 minutes on average to complete the process of review and spoilage darning per one roll; meanwhile, polyester and viscose rolls take 106 minutes, and polyester-only rolls require 97 minutes. This difference of the fabric roll sorting stems from the more common spoilage when weaving fabrics from synthetic fibers in comparison to natural ones. This analysis may help the enterprise identify the processes which should be improved thus decreasing the duration of the factual time per cost driver.

Table 13. Process Phase Factual Working Time Per Cost Driver

Process phase	Process phase cost drivers	Factual working time per process phase, min/unit		
		Wool/ nylon/ rayon	Polyester/ viscose	Polyester
Weaving of a new design	Number of instances of new design	175	147	-
Reception of raw materials	Number of shipments	478	122	61
Renewal/ update of the order plan	Number of work plans	324	311	289
Bobbin-making and bobbin wheel loading	Number of loaded bobbin wheel frames	440	446	450
Equipment maintenance	Number of instances of loom maintenance	28	21	54
Weaving	Number of meters of woven fabric	6	6	8
Quality control and darning	Number of sorted rolls	72	106	97
Preparation for dispatching	Number of rolls	2	2	3
Dispatching	Number of loadings of racks with rolls	5	7	17
Waste management	Number of pallets	45	38	34

(Source: compiled by authors)

The time-driven activity-based cost accounting system at the enterprise allowed calculating the production costs of all the identified weaving services. By adopting the time management-based model of cost-accounting, it was determined that the production costs of the various provided weaving services per one meter of weaving largely differed from the traditional way of the distribution of indirect costs. The lowest manufacturing cost was observed for polyester and viscose fabrics, while the highest costs were observed for polyester fabrics. The significantly higher production costs for polyester were determined by the scarce orders for polyester fabrics.

The most significant sum of indirect costs was observed in articles of polyester and viscose. Meanwhile, wool, nylon and rayon articles had the smallest fraction of indirect costs. The differences of the costs were determined by more efficient employment of capacities when manufacturing wool, nylon and rayon articles. Having calculated the costs according to the TDABC method, the costs of two articles increased and for one article decreased in comparison to the values obtained by employing the traditional method of the distribution of indirect costs. An increase of costs for the fabrics woven from wool, nylon, rayon and polyester was determined, and, for the second type of the fabric, the increase was significant. This shift of costs was affected by the low number of orders, which results in a high number of activities to be implemented.

When dealing with the results of the time-driven activity-based costing model, it was determined that the full costs of fabrics woven from wool, nylon and rayon increased by 0.48 percent, for polyester and viscose fabrics, it decreased by 5.59 percent, and the costs of polyester-only fabrics increased by up to 31.91 percent.

On the grounds of the results of the model adoption, the management of the enterprise should quit weaving polyester fabrics as the service of their weaving is loss-making due to the insufficient volume of orders, the increased time of loom maintenance/service, the time required for roll sorting and darning, and the increased time of weaving per one meter of fabric. The dispatch of this type of fabric constituted as little as one percent of the totality of deliveries. It is suggested to increase wool, nylon and rayon production as it constitutes 89 percent of the total volume of deliveries. Considering the fact that the enterprise has 17.38 percent of unused capacity and the fact that the costs of the main type of production increased by merely 0.48 percent, it would be most efficient to increase the output of wool, nylon and rayon production by employing the unused capacity and the share of time required for the production of polyester. The enterprise should conduct internal analysis of unused capacities in order to determine the extent of unused capacities in each of the process phase and the exceed capacity volume.

Conclusions and Discussion

In order, to have smooth implementation of TDABC it is critical to evaluate challenges encountered by enterprises starting to apply the TDABC system. The challenges identified by Namazi (2016) were used as the assessment criteria for successful implementation of TDABC in weaving service company. It was confirmed that for adoption it is critical to obtain properly recorded initial data. The system appeared to be efficient, because time could be identified as the main cost driver. The sheer amount of calculations was not significantly huge, because enterprise are conducting various activities which are not homogeneous.

It can be concluded that additional fine-tuning of data after the installation of the system is important for the further application of the TDABC system. When researching the truthfulness of the adoption of the TDABC system, and while drawing specific conclusions, the most important aspect is to run thorough verification of the data once more. The initial model was easily updated by editing the values and assessments while employing the *Microsoft Excel* software. Repeated interviewing of the staff was still required in order to obtain more precise results of the analysis of the distribution of the employed capacity among the process phases. On the grounds of the test results, the cost accounting model was approved.

The main challenges which are encountered by the enterprise in the course of installing the TDABC system appeared to be: major resistance from the staff was encountered when recording the duration of each particular function and besides when the staff members were asked to record the time required to perform a certain function, a fraction of the staff members significantly increased the duration of the function. Therefore, the duration of functions have to be registered with one more employee from TDABC team being physically present in the measurement; the TDABC system introduction team has to be composed of representatives of various professions, because then the identification of the functions activities and the duration measurement easy to determine due to the top training levels of the staff at the enterprise; the direct observation method requires more time resource for the research, but it is more reliable for obtaining more precise time values. We should note that activity function assessment by employing the direct observation method is only beneficial with these activities which involve repeating functions in the course of production, and the time value is stable. As a result, the working time of the project team increased due to the need to identify activity functions, conduct observation, and survey the staff.

The core advantages provided by the TDABC system: the analysis helped the enterprise identify the processes which should be improved by decreasing the factual time of the service for the cost drivers. The profitable products were disclosed. Herewith, the additional unused capacity was revealed.

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