DRAVING UP A BUDGET USING THE ACTIVITY BASED BUDGETING METHODOLOGY THROUGH THE SIMULATION OF PROCESSES

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1 INTRODUCTION

In the past years, the area of budgeting has undergone significant changes in the same way as other managerial and economic tools. In today's business practice, budgeting is considered very important because of its ability to plan and control the development of economic indicators of companies and to perform responsibility controls of executives at all management levels (Popesko, 2009). Moreover both the theoretical and empirical results suggest that organizational budgetary processes do not provide similar understanding of budget targets for each person (Kihn, 2011). It is a pity that it has not been fully connected with the company's quality management – after all, these two areas should go hand in hand because the correctly implemented quality system guarantees that customers will get perfect and high-quality products with the required features while the company keeps their production costs to a minimum. The other side of the quality definition is often neglected in practice and the economics of quality are somewhat omitted. The purpose of this paper is, through a simple example, to show how production costs of individual products can be realistically specified using the simulation of processes, including poor quality costs, and how to draw up a budget of the whole process. ABC (Activity Based Costing) and ABB (Activity Based Budgeting) methods and MS Excel, where a simple simulation of processes will be made, will be used.

Traditional methods of drawing up budgets are often one of main reasons of ineffective company resource management. The main disadvantages of traditional budgets are as follows:

- The main problem is time perspective: nowadays, the budget lifecycle does not correspond to the turbulent environment of companies at all, and mostly, this data loses its topicality before it takes effect (drawing up budgets usually starts in September and they are approved in December). And changes of the budget are unacceptable after being approved.
- Mostly, budgets are not coherent – so various kinds of plans which do not form a consistent complex coexist in companies.

- Cause-and-effect relationships between the indicators measuring business objects and processes are not sufficiently used in planning models; moreover, there is no clear definition of ways to reach the objective.
- Budgets suppress opportunities to use synergetic effects between divisions because each division tends to protect its activities (and thereby finances) while they could come together and for example, use their facilities better, create new business opportunities etc.
- In most cases, nobody is concerned about the real core and usefulness of overhead expenses spent.
- It often happens that at the beginning of the year, executives save, and at the end of the year, they hastily spend budget means because they are rewarded according to budget fulfilment (i.e. sanctions for its exceeding on one hand and decreasing the budget for the next year when the finances are not withdrawn, especially in the area of overhead expenses, on the other hand).
- Division managers usually endeavour to justify the centre's current budget, and top managers usually give in to this pressure since they do not have any possibility to verify the eligibility of these requirements. Thus, budget chains of individual years that differ only in the amount of costs of partial items are drawn up, and in total, they have a permanent tendency to grow (Popesko, 2009).

These shortcomings had brought the necessity to search for more effective ways of budget planning; thereafter, some firms set out on a radical journey and entirely ceased to draw up traditional budgets, introducing more flexible and effective systems for planning and evaluating costs and revenues; the most popular are for example Beyond Budgeting, Zero-Based Budgeting – Popesko (2009) for example, presents more information about these methods – or Activity-Based Budgeting, hereinafter referred to as ABB.

2 METHODOLOGY

As its name suggests, this method is closely connected with the calculations according to ABC activities; as a matter of fact, it concerns the application of these principles to the area of budgeting. Activity-based costing (ABC) data have the potential to inform a widerange of management decisions (Partridge & Perren, 1998). Thus, plans and budgets are drawn up on the basis of the expected consumption of performance of individual activities and we are able to measure them by real performance units. The whole budget is then naturally more comprehensible at all the company's organisational structure levels. Basic phases of ABB drawing up will be clarified using an example from the area of aviation, specifically a catering firm, which delivers meals according to the requirements of individual customers on board airplanes. The objective is to determine a budget of delivery processes for a concrete customer Z, to specify the effectiveness of the processes and to quantify wasting.

First, data about the process must be available:

a) How the process works – a process scheme is made (MS Visio is used for drawing) on the basis of documents and observing the real process. The process scheme is mentioned in Figure 1 (see below).

b) A list of customers and their withdrawals – at the moment, we are interested only in customer Z.

Table 1 – Overview of customers and their withdrawals

Customer	Number of meals per month	Of which J (Business Class)	Of which Y (Economy Class)
XY	50,000	6,000	44,000
Z	12,000	1,500	10,500
AB	10,000	2,000	8,000
CD	200	x	200

It results from the table that the customer Z withdraws 16.6% of the total number of delivered products.

c) Traditional Calculation – used uniformly for all customers

Table 2 – Traditional calculation used

Menu description	Ingredients costs (variable) *[CZK]*	Direct, personnel and other fixed costs *[CZK]*	Gross margin within the volume of 60,000 meals (fixed) *[CZK]*	Price per menu in total *[CZK]*	Selling price per menu *[CZK]*
Hot meal J	86.12	4.78	19.32	110.22	150
Hot meal Y	31.94	3.06	19.32	54.32	65

Now, we start to analyse the costs for individual processes. We divide the costs into:

a) Direct costs, namely those which are connected as resources to individual processes and according to the period of process duration – namely times of using the concrete resource; their amount can be easily calculated.

b) Indirect or overhead costs that must be divided into individual processes for which we use the ABC method.

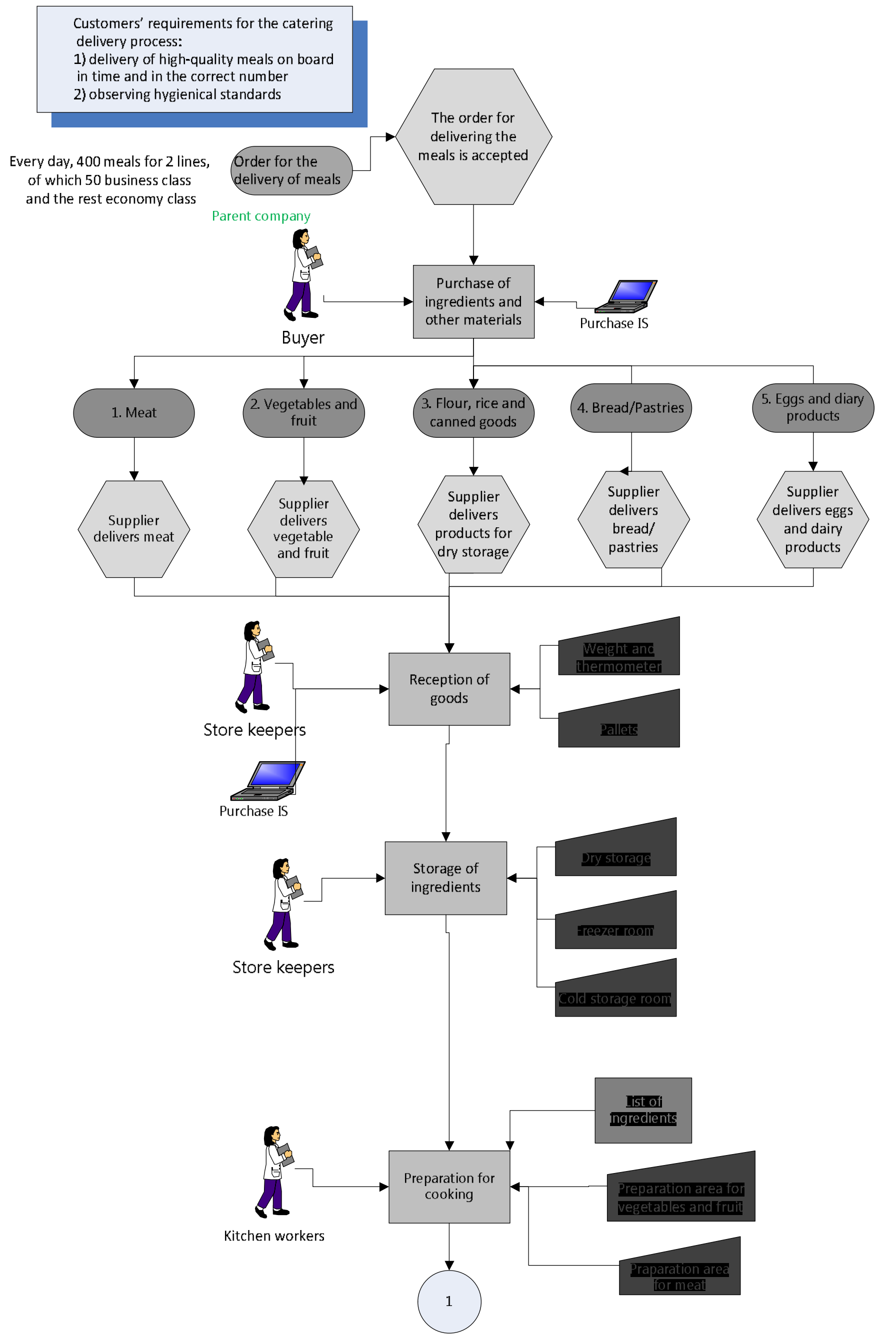

Figure – 1 Process model for catering deliveries to airplanes (part 1)

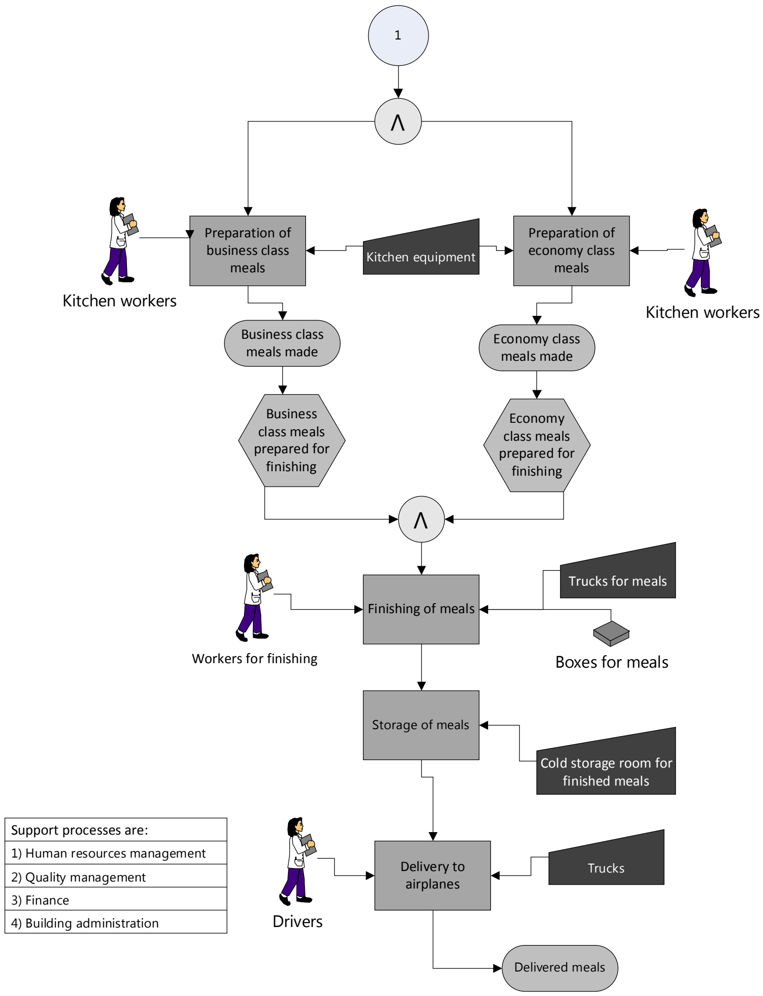

Figure – 1 Process model for catering deliveries to airplanes (part 2)

STEP 1: Direct costs determination

First, it is necessary to have general knowledge of the costs for individual resources as well as of the lead time of individual processes to be able to calculate direct costs of processes. This value is a random variable which will be subject to the later simulation of processes. The process lead time is calculated per one entity's (i.e. an order's) passage through the process for one resource, thus, for example the preparation of J meals takes 1 hour a day, however, 4 workers work on it.

The result of process lead time determination and possible variances is mentioned in the following table:

Table 3 – Process lead time and variances

Process	Process lead time *[hours]*	Distribution of the time of process duration	Distribution parameters	Added value	Variance	Average variance frequency	Costs for removing the variance
Purchase of ingredients	0.25	normal	X=0.25 S=0.0833	yes			
Reception of goods	13.3	normal	X=13.3 S=1	yes	Required goods are not delivered or they are not delivered in the satisfactory quality	6 x a week	1,000
Storage of ingredients	24.0	normal	X=24 S=5	no	Expired goods in stock	1 x a day	300
Preparation for cooking	3.0	normal	X=3 S=0.2	yes			
Preparation of J meals	4.0	normal	X=4 S=0.2	yes	Spoiled meals, waste	1 x day	2,000
Preparation of Y meals	3.0	normal	X=3 S=0.2	yes	Spoiled meals, waste	1 x day	500
Finishing of meals	2.0	normal	X=2 S=0.1	yes	Incorrect indication of meals – exchange of lines.	1 x month	5,000
Storage of meals	0.33	normal	X=0.33 S=0.0822	yes			
Delivery to airplanes	2.0	normal	X=2 S=0.2	yes	Late delivery of meals – contractual penalty	2 x month	30,000

**Here, the storage of meals has added value since for reasons of cooling, it is necessary to cool down the meals for required temperature (8°C according to the ITCA standard).*

Now, the quantification of personnel (see the Table 4) and other resources (see the Table 5) must be made:

Table 4 – Personnel quantification overview

Position	Wages & social and health insurance *(CZK per month)*	Rewards, employee benefits *(CZK per month)*	Costs for uniforms and work aids *(CZK per month)*	Training costs *(CZK per year)*
Buyer	33,000	3,000		1,000
Store keeper	18,000	3,000	100	300
Kitchen worker	18,000	2,000	100	500
Finishing worker	15,000	2,000	100	500
Driver	16,000	3,000	100	1,000

Table 5 – Resource quantification overview

Resource	Price for maintenance *(CZK per month)*	Depreciation costs *(CZK per month)*	Frequency of failure occurrence	Costs for removing the failure *(CZK)*
Cold storage room	500	300	0.2* month	500
Freezer	500	400	0.5* month	600
Dry storage	100			

Note to Table 3,4,5: In our example, we disregard resources such as pallets, thermometers and others, which are also used in the process, for reasons of clarity.

By simple multiplication of the lead time and resource costs in the given process, we determine direct costs and thus we can proceed to dividing the indirect costs using a matrix of costs.

STEP 2: Indirect costs determination

See the Matrix of Cost Classification in the Table 6.

STEP 3: Drawing up a simulation model

Now, the process simulation will be made on the basis of the process model and received data; naturally with regard to MS Excel restrictions.

The lead time of the process duration in individual days and the amount of classified costs (according to the matrix of costs – see Table 7), as well as the occurrence of eventual variances (see Table 3), are random variables. Each process can include 3 figures: direct costs determination, indirect costs determination and possible occurrence of variance:

1) The columns for determination of costs according to the process duration and indirect costs determination. Both are random variables generated as follows:

   ```
   ROUNDUP(NORMINV((RANDBETWEEN(1;99)/100); mean
   value; standard deviation);0).
   ```

2) The occurrence of variances is simulated according to the following condition:

   ```
   =IF(RANDBETWEEN(1; length of the variance
   occurrence interval) > length of the variance
   occurrence interval -1; display variance costs;0).
   ```

   Average process variance costs can be specified in a qualified way, or – if the variances did not generate only costs but also the time for their removal – we can add the given occurrence to the total process lead time.

In the first phase, we determine how many support processes we "use" for customer Z:

1) We start with support processes (Table 6) first, we divide them into logical groups to divide the costs more easily.
2) We classify the costs in individual groups recorded in the accounting.
3) If we have more customers/we produce more types of products then we choose a method of dividing individual costs into the given customer/product; in this case, it is pro rata according to the number of products withdrawn (Table 6).

In the second phase, we associate these costs of support processes according to a parameter related to individual processes in the model.

1) We continue with the processes in the model; in the same way as with the support processes, we classify remaining costs for the process from the accounting; we naturally leave out the direct costs that have already been classified.
2) Using related parameters, we classify a proportional part of costs from the support processes (Table7).

Now we can use data from matrix to make a simulation of the result amount (Table 8).

The final calculation is as follows:

Costs per 1 J meal are:	208 CZK	... their original calculation was 110 CZK
Costs per 1 Y meal are:	31 CZK	... their original calculation was 54 CZK

It follows that the costs for the preparation of J meals have been undervalued and on the contrary, the costs for the preparation of Y meals have been overvalued.

When drawing up a budget according to ABB, the process is as follows:

1) Strategy analysis – in this phase, we define critical success factors for each of the formulated strategies – for example, increasing the satisfaction of customers – and then, we determine measurable parameters for this factor. In our case, these are: timely deliveries and high-quality meals which customers consider delicious and that are suitable for consumption.

2) Value chain analysis – we explore what activities and processes correspond to defined strategies and which are not significant from this point of view; eventually they do not create value perceived by a customer. In our example, the processes are set in compliance with the strategy; with regard to renting trucks that deliver meals to airplanes, I recommend considering the possibility of the total outsourcing of this process. Try another simulation.

3) Working load forecast – we identify the load volume of employees performing individual activities on the basis of the specified number of products. According to the contract, customer Z will buy 12,000 meals a month next year, of which 1,500 will be J meals and 10,500 Y meals.

4) Planning instructions – factors specified by the management or another competent body regarding the supposed inflation, interest rates, growth dynamics, and eventually other external factors are included here.

5) Analysis of investments in activities – investments in activities specify their cost structure. It is important to consider this, especially in the area of depreciation costs and efficiency of processes. It will be necessary to reconstruct the cold kitchen which has a very high room temperature unsuitable for the hygienic requirement of 8°C (according to ITCA) next year. The costs will be CZK 450,000, calculated according to the number of meals bought: for customer Z, it is CZK 74,700.

6) Activity-level analysis – specifying the rate of activity performance to determine unit costs for each activity (in the case that we have an actual ABC model, this step is useless). See the table of cost classification.

7) Calculation of costs for processes and products – we specify the expected future consumption of activity units. Simply by multiplying the number of J and Y meals bought, it is: CZK 637,500 a month; for more detailed budgets for individual resources and processes, see the table of costs. Furthermore, the investment costs, i.e. CZK 74,700, and corrections according to point 4, must be added. In the end, it can be said that the rate of non-productive costs (i.e. variances and time not adding any value) is high (59%) and a strategy leading to the elimination of waste and significant decrease of variances must be prepared.

8) Budget specification – then, we have a sufficient amount of information to draw up a budget; it can be constructed in more variations, and it can offer modelling scenarios for future development.

Table 6 – Matrix of costs for supporting processes

Support processes	Cost groups	Energy *(Budget according to m^2 used)*	Services *(Invoices associated with the processes that caused their occurrence)*	Repairs	Personnel costs	Depreciation costs	Method of cost division for customer Z *(Z buys 16.6%)*	For the process in total
Human resources management	employees 2				65,000		pro rata according to meals bought	68,280
	translations		3, 000					
	IT and office	280						*0,166 = **11,334**
Building administration	employees 6				127,000		pro rata according to meals bought	297,350
	IT and office	350						*0.166 = **49,360**
	building maintenance		55,000	36,000		45,000		
Quality management	employees 3				90,000		pro rata according to meals bought	104,800
	IT and office	400						*0,166 = **17,396**
	equipment for operations			3,000				
	Analyses, tests		15,000					
Finance	employees 3				75,000		pro rata according to meals bought	75,230
	IT and office	230						*0,166 = **12,488**

Table 7 – Matrix of costs for main processes for Z customer

Matrix of Costs for Processes – for Z customer (monthly budget)									
Process/Type of costs	Parameter related to support processes	Energy *(CZK)*	Services	Repairs	Human resources management	Building administration	Quality management	Economics	Process in total
Purchase of ingredients	number of employees, m^2, qualified estimation	160*0.166			251	400	300	250	**1,228**
Reception of goods		250*0.166			504	600	2,359	550	**4,054**
Storage of ingredients		8,700*0.166			504	10,000	2,359	550	**14,353**
Preparation for cooking		4,200*0.166			1,763	3,360	2,359	1,943	**10,122**
Preparation of J meals		2,800*0.166			1,637	15,000	2,500	1,941	**21,542**
Preparation of Y meals		2,800*0.166			1,637	15,000	2,500	1,941	**21,542**
Finishing of meals		3,900*0.166		6,500	3,526	3,000	2,359	3,885	**19,917**
Storage of meals		5,300*0.166			189	2,000	2,359	208	**5,636**
Delivery to airplanes		50000*0.166			1,259		300	1,386	**11,245**

Table 8 – Simulation table

Costs for individual orders in CZK

The quality of goods is not satisfactory at the reception of goods. New goods must be ordered. Process delay

Expired goods in stock

Spoiled meals, meals for microbiological tests, waste...

Spoiled meals, meals for microbiological tests, waste...

Incorrect meal indication (it does not correspond to the report for the given line)

The delivery to the airplane will be delayed; contractual penalty from the carrier of 100,000

Entity	Purchase of ingredients		Reception of goods			Matrix – storage of ingredients			Preparation for cooking		Preparation of J meals			Preparation of Y meals			Finishing of meals			Storage of meals		Delivery to aircrafts			
1 order	direct	matrix	direct	matrix	noncon	direct	matrix	nonconf	direct	matrix	direct	matrix	nonconf	direct	matrix	nonconf	direct	matrix	nonconf	direct	matrix	direct	matrix	noncon	In Total
1	72	46	783	127	0	239	455	300	200	361	7536	706	0	3577	654	500	622	626	0	85	173	241	379	0	17 682
2	81	42	752	137	5000	243	510	0	211	291	7449	757	0	3578	691	500	639	685	0	93	165	246	437	0	22 507
3	81	44	844	124	0	248	584	0	216	392	7629	673	2000	3575	773	0	662	625	0	108	156	239	385	0	19 358
4	80	45	853	147	0	249	460	0	197	270	7488	695	2000	3581	725	500	631	747	0	89	195	265	408	0	19 625
5	72	37	824	147	0	244	471	300	228	366	7534	761	0	3557	749	0	656	571	50000	90	194	267	388	0	67 456
6	60	39	729	115	0	246	465	300	227	436	7541	749	0	3540	673	500	603	648	0	74	203	252	432	0	17 832
7	53	34	894	104	5000	237	465	300	237	239	7481	657	0	3569	730	500	651	724	0	93	182	240	369	0	22 759
8	58	45	836	118	5000	247	355	0	234	357	7518	704	2000	3522	715	500	629	644	0	82	172	247	314	0	24 297
9	81	45	824	123	0	244	428	0	217	397	7428	620	0	3553	796	500	594	660	50000	75	197	244	369	0	67 395
10	70	35	836	119	0	243	515	300	240	364	7575	706	2000	3612	701	0	628	638	0	78	182	269	389	0	19 500
11	62	38	752	116	0	243	503	300	218	408	7544	751	2000	3552	703	500	627	642	0	72	226	264	380	0	19 901
12	55	45	857	98	0	244	480	300	196	334	7446	788	0	3614	768	500	655	684	0	95	176	244	349	0	17 928
13	56	41	752	116	0	248	414	300	221	321	7590	652	2000	3530	743	500	635	711	0	76	147	255	392	0	19 700
14	71	38	861	160	0	238	430	0	209	359	7577	808	2000	3611	718	500	643	615	0	94	157	243	382	0	19 714
15	56	39	729	119	0	243	485	0	187	331	7474	640	0	3433	725	0	620	673	0	61	192	246	331	0	16 584
16	60	41	844	161	0	245	555	300	224	362	7537	733	2000	3599	691	500	603	645	0	70	153	247	425	0	19 995
17	43	50	815	141	0	247	559	0	246	253	7555	688	2000	3570	689	0	631	727	0	83	209	251	369	0	19 126
18	78	48	853	127	0	245	462	0	187	405	7528	692	2000	3509	711	500	641	716	0	70	214	250	376	0	19 612
19	52	44	794	132	0	248	523	300	245	402	7463	646	2000	3572	708	500	617	636	0	83	164	256	428	0	19 813
20	73	33	798	143	0	246	483	0	216	359	7479	817	0	3493	648	500	633	628	0	73	186	245	314	0	17 367
21	62	41	816	115	0	248	430	300	232	351	7594	669	2000	3486	636	500	606	629	0	77	179	231	352	0	19 554
22	55	47	803	114	0	245	525	0	208	414	7485	834	0	3518	645	500	652	634	0	84	169	233	351	0	17 516
23	63	42	758	116	0	247	426	0	212	408	7499	785	2000	3522	708	0	633	680	0	98	184	246	432	0	19 059
24	73	37	799	156	0	246	426	0	167	431	7583	697	0	3537	624	0	606	676	0	77	208	240	365	0	16 948
25	67	32	845	152	0	246	408	0	211	382	7546	676	2000	3502	746	0	659	704	0	84	183	242	408	0	19 093
26	49	42	808	155	0	247	438	300	201	376	7470	620	0	3581	752	500	634	669	0	101	193	236	375	0	17 747
27	79	49	815	146	0	247	492	0	242	431	7620	850	0	3594	727	500	619	688	0	70	206	266	432	0	18 073
28	71	40	858	136	0	244	355	0	213	291	7572	654	2000	3510	755	0	625	703	0	83	162	254	384	0	18 910
29	43	44	797	155	0	248	521	300	200	232	7426	640	0	3568	664	0	643	676	0	81	173	261	411	0	17 083
30	72	42	808	136	0	243	505	300	202	366	7538	720	2000	3518	707	0	616	589	0	80	156	257	368	0	19 223
						no value added process																		Average	22 379

3 CONCLUSION

In this example, especially the interconnection of typically financial processes, such as calculations of product costs or building up a budget, with the system of quality management in the area of the analysis of processes and observing costs for poor quality is interesting. It is apparent that even the calculations used over a long period of time were absolutely different after the accurate calculation of the real consumption of product costs compared to their long-time use, and business class meals were entirely unprofitable. Interconnecting the analysis of processes with the budget drawing up is also interesting – i.e. during the very budgeting process, we specify if the process continues like this or we determine optimisation measures. Costs for variances and non-productive time such as waiting or product storage are hardly ever considered in the calculation of process/product costs and in budgets. By simulating the process, we will get a far more realistic view of the process and products, and moreover, we can directly define weak points and possibilities for change in processes, and determine on which variances we should focus improvement projects when working out a budget.

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