Using POC® decision support system in operations management teaching

Abraão Freires Saraiva Júnior (abraaofsjr@gmail.com), University of São Paulo

Reinaldo Pacheco da Costa, University of São Paulo

Helisson Akira Shimada Ferreira, PPE Associated Engineers

Abstract

The paper aims to discuss the use of decision support system POC® - Industrial Prices, Costs and Budgets - to assist operations management teaching in management accounting interface. To this end, we present a case study that illustrates the educational use of POC® in decision-making for manufacturing operations.

Keywords: Decision support system. Cost and prices. Operations management teaching.

Introduction

The teacher, in dealing with the teaching-learning process, faces constant challenge of choosing the most appropriate methods of imparting knowledge to students. In order to teach "costs" subject within the perspectives of managerial accounting and operations management, the teacher needs to provoke the student the using of cost information for decision making, such as pointed by Atkinson et al. (1997) and Garrison et al. (2006). Among the tools developed to address the theme "cost" within the perspectives of managerial accounting and operations management, is the system of decision support POC® (Industrial Prices, Costs and Budgets), developed by professionals and academics linked with the University of São Paulo, Brazil (Costa et al. 2010).

The POC® system was designed in partnership with more than a hundred small and medium companies in Brazil, in an integrated research initiative aiming to accomplish, accurately and quickly, several quantitative analyzes to support decision making, such as: (i) structuring and calculating unit costs of resources, sub-activities and products; (ii) determination of contribution margin per unit, per product type and total of the company; (iii) calculation of multiproduct breakeven point and simulation cost-volume-profit relationships; (iv) pricing varying sale payments conditions and desired margins; (v) economic analysis of product mixes; and (vi) economic analysis of outsourcing related to subassemblies, activities and products. Besides the analyzes specifically inherent management accounting, others related to the production planning and control®, in a secondary way, are also available to the decision maker by POC, such as: materials requirements planning (MRP I); manufacturing resources planning (MRP II - including manpower and equipment); capacity resources planning (CRP), the construction of ABC curves for materials costs and products revenues; and construction of the diagram "from-to" that can support decisions about the production plant layout (COSTA et al., 2010).

The POC® system is not restricted to the business environment, but also to the academic one, because this has been used as a teaching tool in university education in disciplines whose central theme is "cost" in management accounting perspective. Thereby, the POC® system permits the student to access the knowledge necessary to structure and analyze cost information in order to model economically operations for decision making, emphasizing manufacturing enterprises. In this context, this paper aims to present and discuss the use of POC® decision support system as a method of operations management teaching considering the management accounting interface. For this, a didactic case study concerning a company with manufacturing operations is used.

Besides the current introduction, the paper is structured from the theoretical foundations that address the main aspects inherent to the POC® decision support system. Then, the didactic case study is presented. Finally, the authors' conclusions, limitations and recommendations for future research are exposed.

The POC® Decision Support System

The POC® was designed as a decision support system based on concepts, methods and techniques of Cost Accounting, Management Accounting, Finance, Economics and Industrial Engineering, being developed by professionals and academics linked to the Department of Production Engineering of the University of São Paulo Polytechnic School, Brazil. The system is disclosed in detail in the book "Prices, Cost and Budgets - Essentials of Cost Management and Industrial Prices" (in Portuguese: “Preços, Orçamentos e Custos Industriais - Fundamentos da Gestão de Custos e de Preços Industriais”), published by Elsevier (Costa et al. 2010).

The research that led to the construction of the POC® system was held in partnership with Brazilian small and medium industries in the last 18 years, being supported by the Brazilian Service of Support for Micro and Small Enterprises (SEBRAE-SP) and funded by Foundation for Research Support of the State of São Paulo (FAPESP) through the program Project Innovation in Small Enterprises (PIPE), and by Foundation Carlos Alberto Vanzolini (FCAV).

Almost unanimously within the universe of companies studied, it was found that the incomplete knowledge of competitive products was verified as the main problem industries in the short term. Then, it was proposed the development and implementation of a tool that integrate operations management with management accounting. This was achieved from the integration between data related to demand and production system (i.e. bill of materials and production processes) culminating in the construction of production/assembly diagrams. In this diagram, are provided products names and codes, technical coefficients, subsets/sub-assemblies, and components outsourced. Internal operations are also presented and, with them, the consumption of manpower and machinery demanded for each product type (Costa et al. 2010).

The POC® aims to "automate" procedures and calculations which are repetitive in order to allow huge savings in time for users, whether they are students or managers, and accurate calculations and simulations of manufactured products costs and prices. The system was developed for the purpose of supporting the operations management in the economic perspective considering the following aspects (Costa et al. 2010):

- Quantifying the costs of products, sub-assemblies and activities;
- Calculation of contribution margin per unit, per product type and total of the company;
- Determination of the multiproduct breakeven point;
- Simulation of the cost-volume-profit relationship;

• Pricing;
• Preparing budgets for new orders;
• Economic analysis of product mixes;
• Economic analysis of productive resources replacement and modification;
• Economic analysis of outsourcing.

Costa et al. (2010) point out that the system also generates information to support the production management, such as the requirements for materials planning, manufacturing resources and capacity (MRP I, MRP II and CRP), the bill of materials, the ABC curves of materials costs, and products production/assembly diagrams. In this way, the POC® is fundamentally a system of costs, prices, margins and profits modeling, analysis and management which also supports production planning and control. Firstly, because the structure of analysis for planning optimal combination of prices and product mix is based on information from industrial engineering (product structure and process flow) and, secondly, because the input data for models of production planning are primarily the resources requirements and availability, in addition to selling prices and costs of resources, activities and products provided by POC®. Figure 1 shows a representation of how the POC® system structures the integration of basic company areas information (Costa et al. 2010):

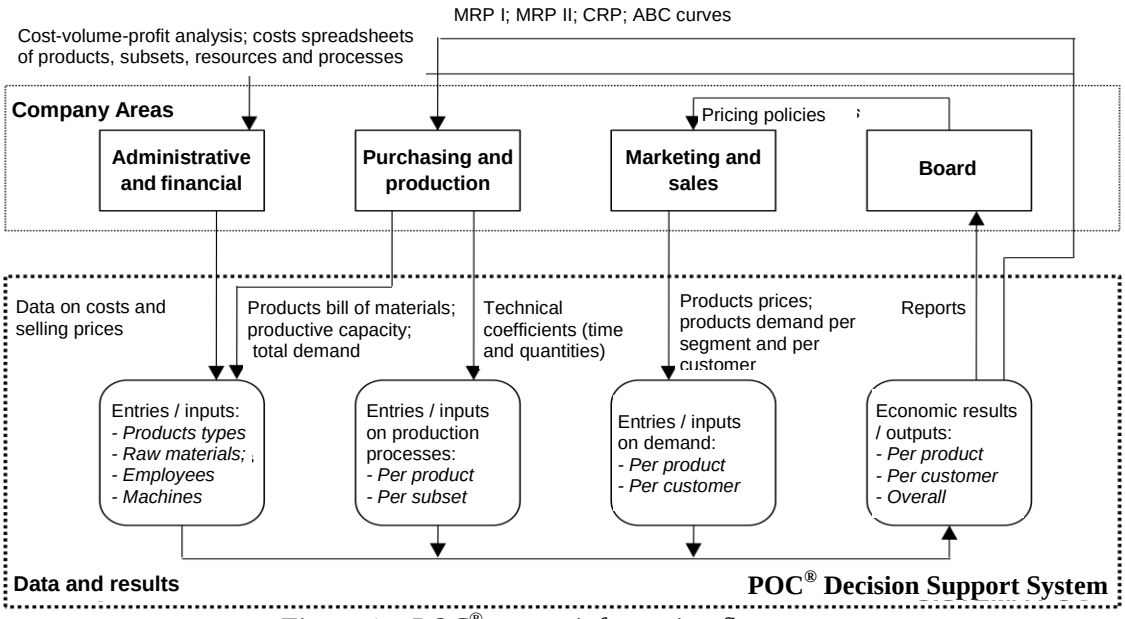


Figure 1 – POC® system information flow

The items in the expenditures structure raised by POC® system are:

• Direct costs: raw materials, direct labor and utilities (e.g. electricity). It considers the technical coefficients of resources consumption (time and quantity);
• Variable sales expenses: taxes, freight expenses and sales commission;
• Fixed costs and expenses: indirect labor (e.g. production planning managers, quality supervisors, maintenance engineers and technicians, etc.), office supplies, attorneys' fees, board wages, payroll taxes and benefits, among others

It is worth mentioning that the direct costs and variable expenses are calculated as present value. The POC® seeks to determine the products contribution margins considering the budget price or the estimated production cost planning for period (e.g. month). In POC® system, fixed costs and expenses are not allocated to products because they are treated as indirect costs. These costs are covered by the total contribution margin, abdicating up of apportionments. Thus, the costing method that underlies the POC® system operationalization is the direct/variable costing (Foster and Baxendale 2008). The fixed costs and expenses go directly to the Profit and Loss Statement (Atkinson et al. 1997, Hansen and Mowen 1997). According to Garrison et al. (2006) and Horngren et al. (2006), the contribution margin is evidenced allows the value that each unit produced, product line, order, customer or segment provides the company to spare between its revenue and cost that actually has provoked. Costa et al. (2010) point out that the methodology used by the POC® system seeks to quantify the contribution margin (per unit product, per product type and total for the company), given a production plan, i.e., a product mix (types and quantities). Thus, the primary search is a set of individual margins that together (added) should be compared with the fixed costs and expenses in order to calculate operating income.

Another important function of the POC® system is to enable precisely the prices planning process. The method is iterative and permits to carry out simulations. Initially, it is considered the prices according to products market ("mark-up" or proportionate price), and the quantities to be sold (sales plan). It analyzes the price based on cost-volume-profit relationships by calculating the company breakeven point. If the result is not satisfactory, the prices and / or quantities can be altered, and the sales plan can be remade in a simulation way. It is worth noting that there are a variety of pricing models when varying the payments conditions. The POC® system builds formulation of the price in the following situations: formation of the spot price, from direct costs, taxes and contribution margin; formation of the spot price with various deadlines for payment of taxes and fees; price formation based on the criterion of contribution margin in the price; and also by supplying price, the system presents the resulting contribution margin (Costa et al. 2010).

The POC® system also allows viewing the mounting of products sub-assemblies and components. It makes possible the determination of the costs of individual sub-assemblies, their participation in the final cost of the product, and the aggregation of resources used (e.g. materials, labor, equipment, etc.), resulting in a spreadsheet of costs for the subset and products. Thus, it is possible to analyze, for instance, the outsourcing of some subsets because the calculus of costs is one of the results obtained. Various other levels of subsets compositions can be prepared following a basic characteristic of different production systems, for example, furniture manufacturing, in which materials are processed together and forming a set, which is then coupled to another set obtained by further processing and so on. Therefore, there is the possibility of analyzing several disaggregated production alternatives and its economic impacts on the company outcome (Costa et al. 2010).

Due to the wide range of analysis possibilities, the large number of successful deployments in Brazilian companies, the interdisciplinary and the easiness of POC® system parameterization and operation, this has been used as a teaching tool for teachers in undergraduate and postgraduate Production Engineering courses of some renowned Brazilian universities such as the University of São Paulo (USP), the Pontifical Catholic University of São Paulo (PUCSP) and the Federal University of Semi-Arid (UFERSA). Moreover, it appears that the use of POC® system has been widespread in Brazil, because there are experiences of universities in other regions of Brazil, such as the federal Institute of Rio Grande do Sul (IRFS), Faculty of Engineering of Minas Gerais (FEAMIG), Federal University of Triângulo Mineiro

(UFTM) and Federal University of Ceará (UFC). By observing the experiences of using the POC® system as a teaching method, there is a change in the condition of the student in the teaching-learning relationship that is facing a problem situation (real or simulated) under the heading tutorial teacher, organized in small groups, and researching ways to solve the problems.

In this context, the following section presents a didactic case study that illustrates the educational use of the POC® system in economic modeling of an operation from the perspective of decision making. It is intended that, by presenting and discussing the main features of POC® system, the scholars involved with operations management teaching may be faced with a useful tool to assist them in the teaching process considering the management accounting interface.

Didactic Case Study of the POC® System Operationalization

This case study aims to show how can be done cost / prices analysis and economic modeling of a company with manufacturing operations considering a limited number of products types: a pizzeria. The case of pizzeria is based on the Costa et al. (2010) and is explored here because we believe that the process of making a pizza is familiar to all teachers and students, and recurrently used in undergraduate and postgraduate Brazilian courses on cost subject, especially in the perspective of management accounting and operations management. In this way, it was transposed, in simplified form, the knowledge requirements of an industrial production process by choosing the simple process of manufacturing a pizza, along with the necessary resources to do so. This is a classic example of production where there is a common part to be mounted for all products: the subsets / sub-assemblies. From these basic subsets can be produced different product configurations that can understand like different "customization." Despite being a relatively simple production process, a pizzeria serves perfectly to illustrate how to analyze and plan the resources usage (materials, labor and equipment) in a manufacturing environment in order to achieve a satisfactory economic result for the company.

The pizzeria in question operates from Wednesday to Sunday (20 days per month on average) and its menu offers three choices of pizza: Portuguese; Margarita, and Mozzarella. The three pizzas have two subsets: pasta and sauce. The following resources are used as well: materials (flour, eggs, cheese, tomato, ham, basil, oregano, salt, oil, etc.); manpower (2 pizzaiolos and 1 assistant); and equipment (1 wood burning stove). The following productive operations are performed: sauce preparing, preparation stocking, pizza assembly, pizza baking, pizza finishing. It should be noted that this case study presents the main analysis features and functionality offered by POC® system, i.e., it is not intended to exhaust the POC® full operationalization. For additional insights, it is recommended to consult Costa et al. (2010) and manipulate the system from the tutorial which guide the POC® operation in its free version, available online (PPE, 2013). Henceforth it will be worked elements of decision analysis from the use of "managerial problems or questions", i.e., scenarios will be developed considering that the pizzeria manager requires important information about the company or should make decision using POC® system. Note that, in order to not make the study repetitious, the results are presented for only one of the products.

First, the pizzeria manager presents the following question to be answered: "How can I visualize the composition of the products both in terms of resources usage but also in terms of operations requirement in the production process?" The POC® system responds the manager's questioning by displaying the production/assembly diagram of each type of product. Figure 2 shows a view of a part of the production/assembly diagram for "Pizza Mozzarella" obtained from

the registration of all resources and operations used in manufacturing process (items described in Portuguese):

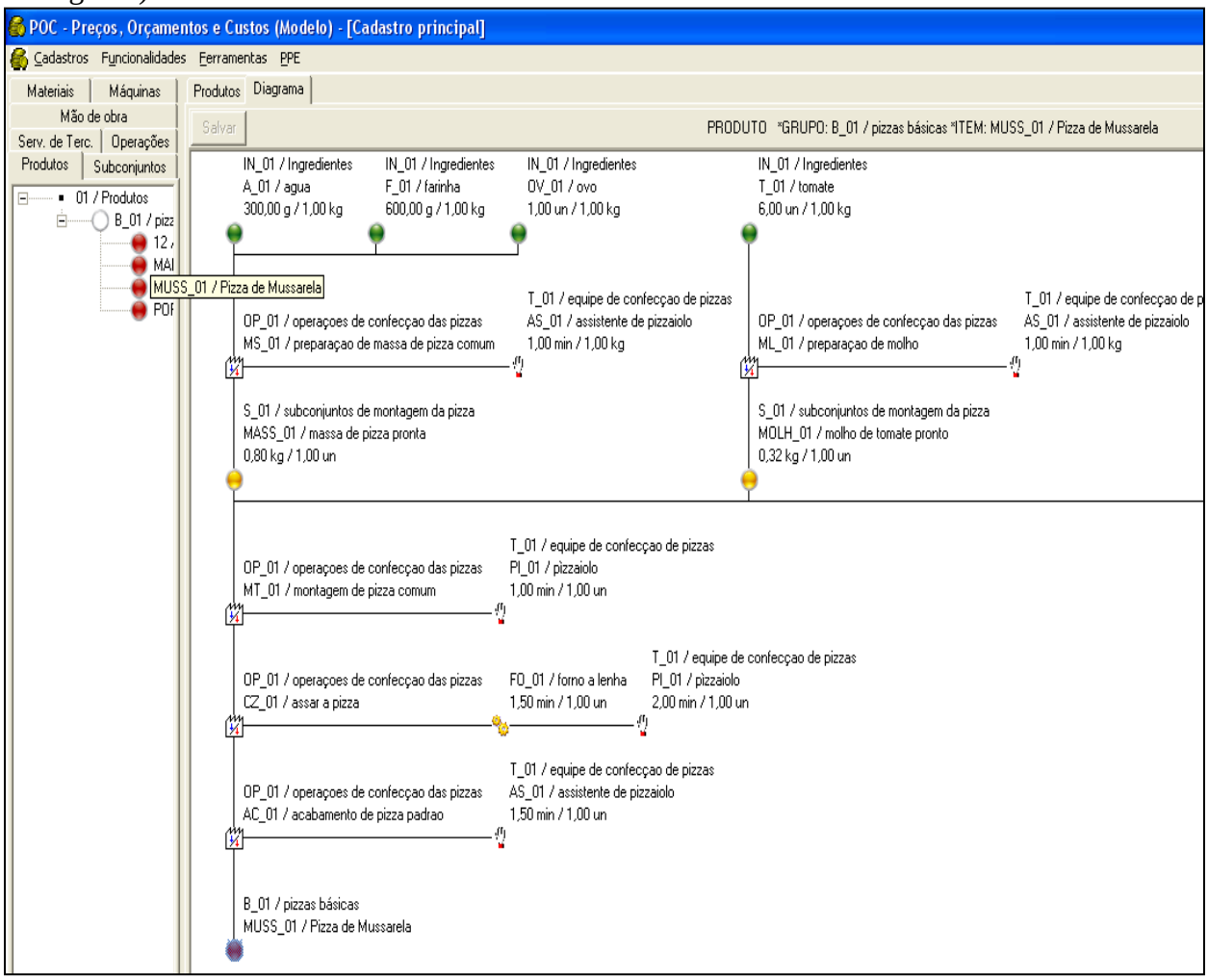
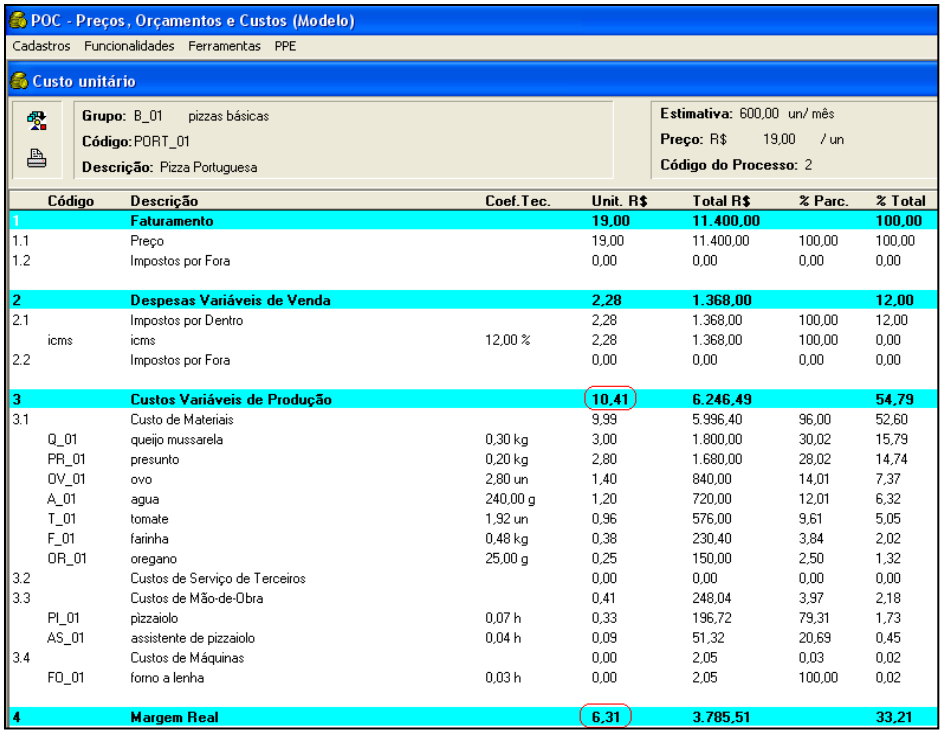


Figure 2 – production/assembly diagram of "Pizza Mozzarella"

It is worth mentioning that the POC® interface for entry and displaying data/inputs can easily be used as a tool for changing parameters or adding / deleting each resource consumed by products and productive processes. Once visualized the distribution of resources throughout the products manufacturing process, it was supposed that the pizzeria manager is trying to understand the company behavior in economic terms. Initially, the following questions are posed by the manager: "How much does each type of product which my company provides cost? How much does each type of product generate in terms of contribution margin to help cover fixed costs/expenses in order to generate profit for the company?" The POC® system answers these questions by offering the view of cost and contribution margin per unit and per each product type. Figure 3 shows the calculation of the cost per unit for the product "Pizza Portuguese". It is worth mentioning that, for teaching purposes, the tax "inside" has wrapped a rate of 12% over the gross revenue.



Código	Descrição	Coef.Tec.	Unit. R$	Total R$	% Parc.	% Total
1	**Faturamento**		**19,00**	**11.400,00**		**100,00**
1.1	Preço		19,00	11.400,00	100,00	100,00
1.2	Impostos por Fora		0,00	0,00	0,00	0,00
2	**Despesas Variáveis de Venda**		**2,28**	**1.368,00**		**12,00**
2.1	Impostos por Dentro		2,28	1.368,00	100,00	12,00
icms	icms	12,00 %	2,28	1.368,00	100,00	0,00
2.2	Impostos por Fora		0,00	0,00	0,00	0,00
3	**Custos Variáveis de Produção**		**10,41**	**6.246,49**		**54,79**
3.1	Custo de Materiais		9,99	5.996,40	96,00	52,60
Q_01	queijo mussarela	0,30 kg	3,00	1.800,00	30,02	15,79
PR_01	presunto	0,20 kg	2,80	1.680,00	28,02	14,74
OV_01	ovo	2,80 un	1,40	840,00	14,01	7,37
A_01	agua	240,00 g	1,20	720,00	12,01	6,32
T_01	tomate	1,92 un	0,96	576,00	9,61	5,05
F_01	farinha	0,48 kg	0,38	230,40	3,84	2,02
OR_01	oregano	25,00 g	0,25	150,00	2,50	1,32
3.2	Custos de Serviço de Terceiros		0,00	0,00	0,00	0,00
3.3	Custos de Mão-de-Obra		0,41	248,04	3,97	2,18
PI_01	pizzaiolo	0,07 h	0,33	196,72	79,31	1,73
AS_01	assistente de pizzaiolo	0,04 h	0,09	51,32	20,69	0,45
3.4	Custos de Máquinas		0,00	2,05	0,03	0,02
FO_01	forno a lenha	0,03 h	0,00	2,05	100,00	0,02
4	**Margem Real**		**6,31**	**3.785,51**		**33,21**

Figure 3 – Calculus of costs and contribution margin of "Pizza Portuguesa"

After viewing products costs and contribution margins, the pizzeria manager needs guidance to deal with the following situation: a customer orders the production of 100 units of "Pizza Mozzarella", and is available to pay cash up to the price R$ 12.00 per unit. Knowing that taxes are 12% over the gross revenue and there is sufficient processing capacity to manufacture the 100 "Mozzarella Pizzas" requested (fixed costs remain constant), the manager makes the following questions: "Should I accept or not the exceptional order? In accepting, how much does the company would gain or lose?" In order to answer the questions, the POC® permits to check whether is feasible or not to accept it from an economic standpoint. Figure 4 shows the parameterization of the POC® to generate the budget of the order under analysis:

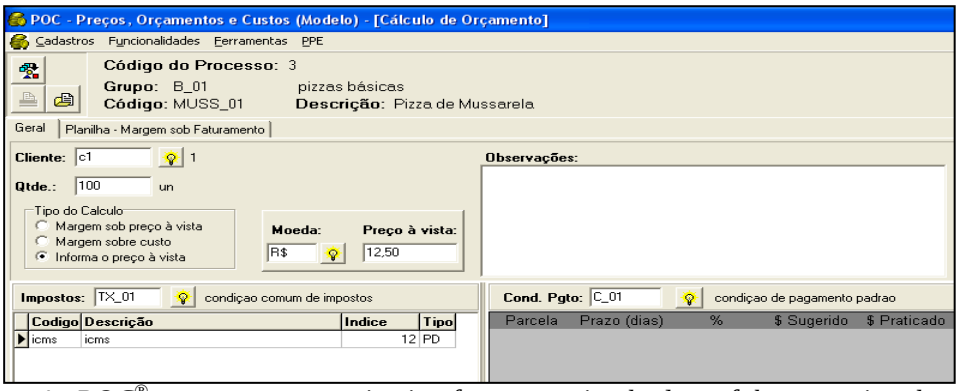
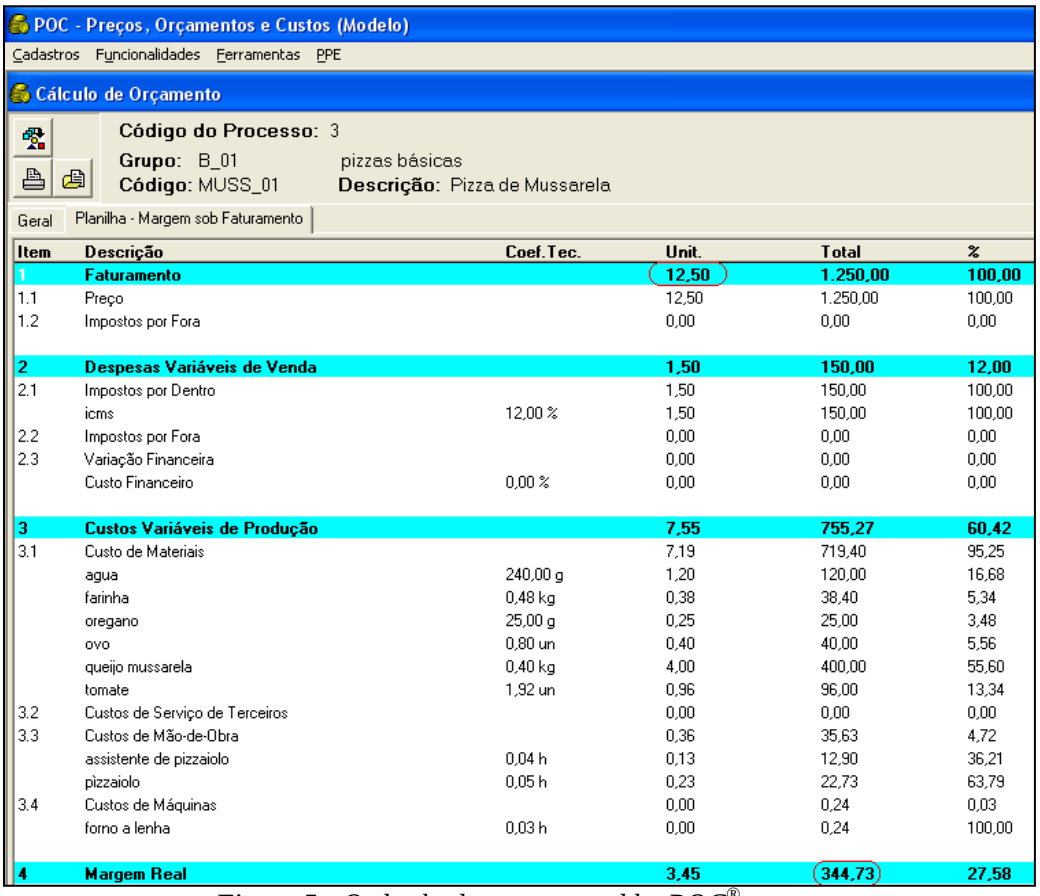


Figure 4 - POC® system parameterization for generating budget of the exceptional order

Figure 4 shows seven variables for parameterization. The first refers to the customer who may be new or already registered in the system. The second refers to the order quantity of items (100). The third relates to the calculation logic. As in the current situation the client already

establishes the maximum price he can pay, then it should be selected the type of calculation "inform the spot price" (in Portuguese: “informa o preço a vista”). The fourth parameter concerns the currency used in the analysis (R$ - Brazilian real). The fifth variable refers to the price the customer is willing to pay for the product (R$ 12.50). The sixth variable refers to taxes over gross revenue (12% of Brazilian tax ICMS, equivalent to the VAT). The seventh and last parameter relates to the payment way (cash). After parameterize all variables, POC® system performs the necessary calculations to generate the budget of the order, as shown in Figure 5:


POC - Preços, Orçamentos e Custos (Modelo)

Cadastros Funcionalidades Ferramentas PPE

Cálculo de Orçamento

Código do Processo: 3

Grupo: B_01 pizzas básicas

Código: MUSS_01 **Descrição:** Pizza de Mussarela

Geral | Planilha - Margem sob Faturamento

Item	Descrição	Coef.Tec.	Unit.	Total	%
1	**Faturamento**		**12,50**	**1.250,00**	**100,00**
1.1	Preço		12,50	1.250,00	100,00
1.2	Impostos por Fora		0,00	0,00	0,00
2	**Despesas Variáveis de Venda**		**1,50**	**150,00**	**12,00**
2.1	Impostos por Dentro		1,50	150,00	100,00
	icms	12,00 %	1,50	150,00	100,00
2.2	Impostos por Fora		0,00	0,00	0,00
2.3	Variação Financeira		0,00	0,00	0,00
	Custo Financeiro	0,00 %	0,00	0,00	0,00
3	**Custos Variáveis de Produção**		**7,55**	**755,27**	**60,42**
3.1	Custo de Materiais		7,19	719,40	95,25
	agua	240,00 g	1,20	120,00	16,68
	farinha	0,48 kg	0,38	38,40	5,34
	oregano	25,00 g	0,25	25,00	3,48
	ovo	0,80 un	0,40	40,00	5,56
	queijo mussarela	0,40 kg	4,00	400,00	55,60
	tomate	1,92 un	0,96	96,00	13,34
3.2	Custos de Serviço de Terceiros		0,00	0,00	0,00
3.3	Custos de Mão-de-Obra		0,36	35,63	4,72
	assistente de pizzaiolo	0,04 h	0,13	12,90	36,21
	pizzaiolo	0,05 h	0,23	22,73	63,79
3.4	Custos de Máquinas		0,00	0,24	0,03
	forno a lenha	0,03 h	0,00	0,24	100,00
4	**Margem Real**		**3,45**	**344,73**	**27,58**

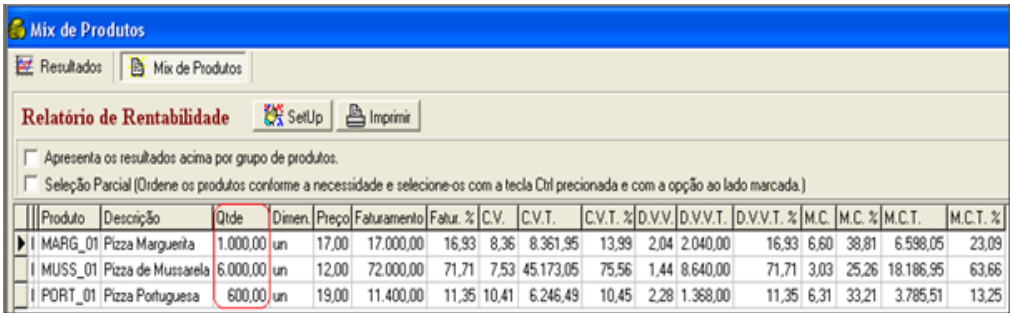
Figure 5 - Order budget generated by POC® system

Based on Figure 5, the pizzeria manager can conclude that is economically feasible to accept the order for produce and sale of 100 "Mozzarella Pizzas". The order would generate a total contribution margin of R$ 344.73 which would help cover fixed costs and expenses, and generate profit for the company.

After analyzing the economic results of an exceptional order, the pizzeria manager is addressing the business results considering a complete period of analysis (e.g. month). The products selling prices are estimated at: R$ 17.00 per "Pizza Margarita", R$ 12.00 per "Pizza Mozzarella" and R$ 19.00 per "Pizza Portuguese". In this scenario, the following questions are raised by the manager: "How do I know how much will I earn in period by producing different product mixes?" Moreover, how much does the pizzeria need to obtain in terms of gross revenue in order to achieve the breakeven point in each mix products defined?"

The POC® system allows the realization of economic analysis of different product mixes in both the numerical report form, as well as in graphical form. Figure 6 shows the economic

results generated (in terms of costs and contribution margins per unit and per each product type) by a product mix determined by the pizzeria manager for the next month planning (1,000 units of "Pizza Margarita", 6,000 units of "pizza Mozzarella", and 600 units of "Pizza Portuguese"). It is noteworthy that the POC® system enables the definition of others product mixes and selling prices. Thereafter, it can be simulated economic results (for individual products units / types and for overall business) in terms of products contribution margins and company profits.



	Produto	Descrição	Qtde	Dimen.	Preço	Faturamento	Fatur. %	C.V.	C.V.T.	C.V.T. %	D.V.V.	D.V.V.T.	D.V.V.T. %	M.C.	M.C. %	M.C.T.	M.C.T. %
▶	MARG_01	Pizza Margarita	1.000,00	un	17,00	17.000,00	16,93	8,36	8.361,95	13,99	2,04	2.040,00	16,93	6,60	38,81	6.598,05	23,09
	MUSS_01	Pizza de Mussarela	6.000,00	un	12,00	72.000,00	71,71	7,53	45.173,05	75,56	1,44	8.640,00	71,71	3,03	25,26	18.186,95	63,66
	PORT_01	Pizza Portuguesa	600,00	un	19,00	11.400,00	11,35	10,41	6.246,49	10,45	2,28	1.368,00	11,35	6,31	33,21	3.785,51	13,25

Figure 6 - Products contributions margins for a specific product mix

Where:
C.V. = Variable Cost (per product unit)
C.V.T. = Total Variable Cost (per product type)
C.V.T. % = Total Variable Cost Percent (sum = 100%)
D.V.V. = Variable Sales Expenses (per product unit)
D.V.V.T. = Total Variable Sales Expenses (per product type)
D.V.V.T. % = Total Variable Sales Expenses Percent (sum = 100%)
M.C. = Contribution Margin per Unit
M.C. % = Contribution Margin per Unit Percent (over selling price, sum = 100%)
M.C.T. = Contribution Margin per Product Type
M.C.T. % = Contribution Margin per Product Type Percent (over product type revenue, sum = 100%)

The POC® also provides the economic outcome (in terms of net income/profit before income taxes) for the period under analysis for the mix defined, plus the multiproduct breakeven point in terms of gross revenue, as shown in Figure 7:

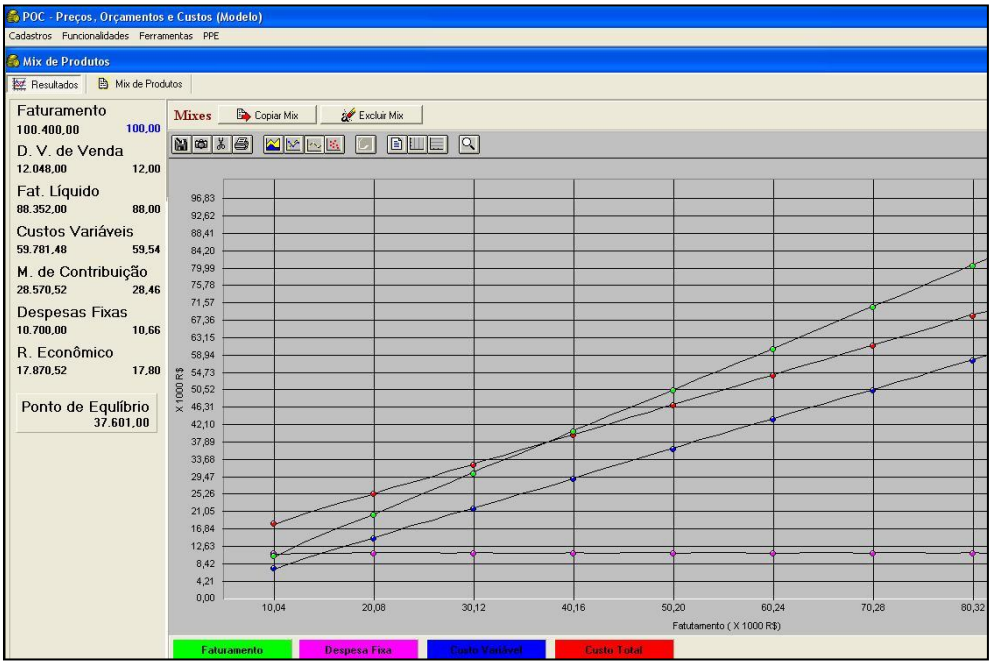


Figure 7 - Economic results for the company considering a specific product mix

Where:
Faturamento. = Gross Revenue (for the company in the period analysed)
D. V. de Venda. = Sales Taxes and Expenses
Fat. Líquido = Net Revenue
Custos Variáveis. = Variable Costs
M. de Constribuição = Total Contribution Margin (for the company in the period analysed - e.g. month)
Despesas Fixas = Fixed Costs and Expenses
R. Econômico = Company Net Income/Profit (before income taxes)
Ponto de Equilíbrio = Breakeven Point (in terms of gross revenue)

Conclusions

The main contribution of this paper lies in the presentation and discussion of how the POC® decision support system can be used as a teaching tool in order to provided to student the knowledge required to structure and analyze cost information considering operations economic modeling perspective. From a didactic case study, we were able to illustrate and discuss the operationalization and the main features of the POC® system in the context of a company with manufacturing operations. Thus, the aim of the study was achieved.

It is noteworthy that POC® has been fully deployed in several small and midsize Brazilian firms with significant results in different production systems. It was relied decisions and analysis on profitability, pricing, product mix, and outsourcing of products, sub-assemblies and activities, always seeking improvement for the company operations in the management accounting interface. The central question addressed by POC® is the proper structuring and quantification of the prices and the relevant costs. A foremost question in the manager agenda relies on the adequacy of their selling prices to the company cost structure. The main effort of the study shown here was to try clarifying the appropriateness of POC® costing process for decision-making. This issue is widely discussed nowadays, mainly because of widespread competition which characterizes both Brazilian and international scenarios. This is a problem that transcends a particular area and, even when dealing with cost issues, the subject is vast and complex.

Although there are signs that the use of POC® system by teachers and students is growing, there is the need to perform a statistical study to measure the breadth, depth, capillarity and intensity of use of this tool in institutions related to higher education. For the development of such study, it is recommended to carry out a survey with the participation of teachers and students who have passed or intend to go through the experience of using the POC® system as tool to aid in the teaching-learning process.

Finally, this study is thought to provide to the operations management academic community a useful alternative to enhance the teaching-learning process in relation to the structuring and solving decision-making problems related to industrials costs and prices considering the management accounting interface.

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