TECHNOLOGY INFORMATION

ANALYSIS OF INDUSTRIAL COSTS: TWO COMPARATIVE METHODS

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Two methods of analyzing industrial costs are compared: the industrial accounting method and the multiple allocation method.
The latter method is performed with the use of the "Budget Master", produced by "Expert System", Modena. The comparison highlights the advantages of the Budget Master system.

1 - INTRODUCTION

An accurate determination of direct costs in ceramic tile production is a problem of increasing concern to firms finding themselves in a saturated and highly competitive market. The old systems based on approximations which were adequate when margins made allowances for errors, now carry considerable risks. To wait until the end of the year to see how profits stand has at times proved a fatal mistake: no estimate has been made and the firm may end up in the red, due to an inaccurate evaluation of costs.
This situation has been created by the joint action of a number of factors which have taken ceramic manufacturers by surprise. In fact, for many years, it just took good business sense to guarantee positive results. Now, even though good sense remains the most important ingredient for the successful running of a business, of itself it is no longer sufficient, for three reasons:

- operating margins are gradually dropping, despite continuing technological development;
- the range of products has been greatly expanded and the number of items represented in a firm's catalogue continues to rise, forcing the company to undertake increasingly demanding production programs;
- the direct cost of producing individual items may vary considerably depending on a large number of factors which arise in different ways and, at times, are difficult to predict immediately.

Then there is also an external factor, linked to the ability of the market to select products with greater added value. It is certainly true that the average consumer ordering tiles from his local dealer has developed a remarkable knack of selecting tiles that are increasingly difficult to manufacture and that demonstrate the best cost/quality ratio.
Direct production costs and operative margins have become factors of fundamental importance and must be recognized prior to production, given the ever increasing speed with which products are created and then eliminated.
Determining these parameters is not a simple task, given the complexity of the industry as it has become today. The ceramic industry cannot, unfortunately, be compared with the metal and mechanical industries or with manufacturing industries in general: the ceramic industry has in fact remained one of the last to embrace all stages of the manufacturing cycle, starting with the processing of raw materials, right up to the packaging of the finished product ready for distribution on the market. No other industrial sector has retained this characteristic, typical of the craftman's trade; in all other sectors, for some time now, the production of semi-finished items has been consolidated into specific industrial activities. It cannot be denied that even in the ceramic sector, this metamorphosis has already been underway for some time but the vast majority of operators in the sector still prepare semi-finished products internally.
Several production phases are still typically artistic and are based on the skill of the operator and the efficiency of the industrial plant.
These are some of the reasons why the task of determining costs is riddled with traps which can adversely affect the running of the business as a whole.
A number of different approaches can be adopted to calculate direct production costs. The fact that, after years of discussion and debate, a standard method

has still not been established, means that the proposals made up to now have not fully satisfied the needs of businesses in the sector.

2 - TRADITIONAL INDUSTRIAL ACCOUNTING: PROS AND CONS

Perhaps the most highly debated and tested method is the traditional industrial accounting method, originating from the large manufacturing industries. This system, adopting the conventional accounting principles, was introduced to the sector about twenty years ago and was met with great expectations.

It is basically a method that provides for the recording of all cost factors concerning individual products. The principle in itself is straight-forward, but its application to the ceramic sector has become ridiculously complicated. The fact is that despite the best of intentions, there are in fact no limits to the precision and available solutions applied to the findings. With the purpose of making the results more reliable, firms have built up quantities of red tape of ministerial dimensions that force producers to fill in endless forms with data relating to every stage of production. In each department, the number of pieces processed each day, the number of working hours, the quantities of materials used, the amount of energy consumed, waste materials and so on must be noted, in an increasing amount of detail. The concept in itself is not wrong; it is the application of the concept to a ceramic factory that has become over-complicated. So complicated that it is no easy task to make the totals of all the daily figures tally with the total figure for costs incurred. This alone however, does not create a great problem as over a length of time, differences can always be put back to make the figures balance. The real problem arises when estimates have to be made on very small quantities of products and this is even more the case when the product is new and there is therefore no information already available. The figure reached tends to be vague due to the adjustments that have been made to balance the books. Let's take an example: at the end of a quarter, the difference between actual consumption of raw materials and estimated consumption is 20%. All glazing costs must therefore be increased by 20% in order to make the stock entries in the accounts tally.

This method is certainly valid from an accounting point of view, yet it can be dangerous when calculating operative margins. This method in fact greatly favours production using spray-guns as these disperse above-average quantities of glaze, but penalize forms of production adopting granule methods where the quantities dispersed are very low.

Yet the biggest mistakes of all are made in the allocation of other cost factors such as manpower where the number of working hours and quantities of products are calculated. Let's take by way of example, a classic, simple product, product A (engobe and disk booth-applied glaze) which finds itself on the production line just when the presses break down due to extraction problems. The line comes to halt, the hours go by and production proceeds with difficulty. The product is doubly penalized, as the inefficiency of the production equipment is debited as a direct production cost. Naturally in this type of situation the maintenance team is mobilized and the problems are resolved, but the production of product A has already come to an end. Let's move on to product B, a more complex product (lots of applications, silk-screening, flaming) requiring greater resources but proceeding smoothly thanks to the action taken to resolve the problems encountered with product A. Product B is doubly benefitted. The cost factors turn out to be lower than those of product A.

At this point, it would seem that product A costs more to produce than product B and if these results are not adequately decoded, this may lead to serious mistakes in production programming decisions.

Up to a few years ago, these problems did not arise often as production times were fairly long and therefore absorbed these ill-fated effects. Today however, products remain on the production lines for short lengths of time, a few shifts at the most and it is therefore essential that firms press on with all their energy to deal with the findings and integrate them with all the information available, so that inefficiency of production equipment requiring action at an organizational level can be distinguished from problems linked to the product itself.

This problem is further complicated by the fact that the industrial accounts office is generally cut off from the rest of the factory and is therefore not in a position to make a critical evaluation of production data. One answer to this problem would be to fully automate the collection of production flow data and quantities of resources used. Today, with the use of automatic counting, weighing and detection systems, the production cycle can be monitored in real time and production can be managed on almost an entirely automatic basis. This solution is however only possible if considerable investments are made, which can only be justified as part of a total reorganization of the company. Such investments could certainly not be justified simply on the basis of supplying the accounts office with the information it requires.

One way out that is adopted fairly frequently is to take a sample in order to define the standard costs of each operating phase. The products are grouped according to the techniques used and to size and the standard production cost for each group is calculated, leaving out of consideration factors subject to variation such as glazing and packaging. This short-cut simplifies the

task considerably, yet there is a risk that the calculation is not sufficiently accurate.
In fact, it is risky to calculate the average cost per size without taking into account the fact that a technologically simple product results in a greater production output, requires less supervision and produces less waste than a more complicated product. A 20x 20 tile without any special applications can be glazed at a rate of 120 pieces a minute and only one person is required to supervise every two glazing lines; less than 5% of raw materials are discarded as waste. On the same line, a product requiring three spray-guns can be glazed at a rate of let's say, 70 pieces a minute, requires at least two supervisors and 15% of raw materials are discarded.
Failure to take these differences in technological difficulty into account naturally favours more complicated products which then find their way into the product range with more simple products without creating any suspicion. As long as the range of products remains fairly simple, the production machine manages to compensate for the increased resources required for complex products. As the range becomes more complicated, the resources available become inadequate and they have to be integrated either with increases in staff or with new investments. In this way, the direct costs of production are increased for all products. This somewhat perverse mechanism, once unleashed, supports itself, hiding from the firm the real cause of the increases in production costs.
An accurate analysis, on the other hand, should immediately identify the products which are most costly to produce in order that sale prices can be increased to reflect the cost.
For all these reasons, the conventional system of industrial accounting, which inspired great expectations when first introduced to the ceramics sector, has now been almost completely abandoned, leaving room for alternative methods which are proving to be equally over-simplified and equally imprecise.

3 - MULTI-LEVEL COSTS ALLOCATION - BUDGET MASTER

Fortunately another method exists that is practically immune to these problems and provides a less complicated system capable of producing excellent results.
At the end of the day what a business really needs to know is how the costs it incurs are attributed to the various products it holds in stock. This method is certainly older, dating back to the ancient principle of dividing total costs by the total number of square meters produced. The idea of allocating costs is therefore not new in itself, the real novelty lies in the ability to allocate at different levels, thereby taking the difficulty of the techniques used to produce each individual item.
The multiple allocation method, forming part of the Budget Master software package, solves this problem most effectively, providing the managing body of the firm with a highly detailed and reliable cost analysis.
In fact, by multiplying the incidence of individual cost factors affecting products in stock, the costs actually incurred are obtained with surprising precision.
The system requires the transfer of only a small amount of information, inserted in charts and tables that are easy to follow and entirely intuitive.
The data required are reduced to the typical entries made in a simplified form of accounts plan: all the costs factors encountered by the business each month and referring to products currently held in stock. These data must be entered at monthly intervals, using traditional accounting methods.
The firm needs to know how these expenses have been allocated to products in stock. The system must therefore be supplied with an inventory of the items held in stock, combined with details of waste materials. This information is then filed in a rational manner, so that printouts can be obtained of stock, according to the individual product or for a particular period. In each case the printout contains data categorized according to size, series and product, with all the relevant figure breakdowns.
The difficulty lies in allocating costs incurred in connection with materials produced in an inaccurate manner. Budget Master uses a three-level allocation system, for maximum precision. All costs relating to products in stock during the period under examination are allocated; the other cost items which do not relate to stock during the said period are calculated as accurately as possible.
The allocation method used is highly developed, to avoid errors resulting from over-simplification. The processing function is however performed entirely by computer and is not the responsibility of the operators. In fact, with this system, the amount of data required is greatly reduced but the information given is extensive.
First of all an allocation is made according to the particular production sector, then according to department and finally to individual products. The results of the allocations can be analyzed by means of tables, allowing comparisons to be made between actual findings which have been processed and those produced by other systems (Fig.1).
The business can be divided into as many production sectors as desired, in accordance with different cost absorption parameters. For example, Once-firing and Twice-firing, or Biscuit, Twice-firing and Monoporous Production; or modern lines and obsolete lines with different products. In this way, the difference in the costs of products in different sectors can be evaluated.

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Allocation of costs according to department and sector is made possible with information regarding the absorption rates applying to costs factors in each department. It is therefore sufficient to enter data relating to cost factors capable of allocation. These data will not be used as absolute values but in order to attribute a fraction of the overall costs to each individual sector and department.

Fig. 1 - Allocation of costs according to Department.

Sector	Dept.	Workforce Lit.	Energy Lit.	Methane Lit.
D	Firing	29.665.924	27.797.834	29.367.026
E	Firing	48.948.775	19.458.484	46.987.242
E	Pressing/ Drying	30.407.572	19.855.596	18.645.731
D	Sorting	59.331.849	10.589.651	0
E	Sorting	62.298.441	2.647.413	0
D	Glazing	44.498.886	12.839.952	0
E	Glazing	57.848.552	16.811.071	0

Let us take a look at workforce costs, by way of example. The department table can indicate the average number of staff in that department, specifying the salary levels applying to the various posts. In this way the system calculates the standard costs for that department which are then added to the cost figures for all the other departments in the sector to reach a total standard costs figure for the sector. The same figure can be calculated for the other sectors, thereby obtaining a presumed total workforce costs figure. This figure is compared with the actual costs incurred and each department is attributed a corresponding fraction of the total cost.

In this way, there is no risk of omitting any cost item. The amount actually spent will always equal the sum of the figures for the individual departments. The only risk involved in this system is that the allocations may not be perfectly accurate, yet there is certainly no danger of "secret costs". If, for example, it is not possible to provide a figure for expendable materials, as a break down of the figure for outside services, it is sufficient to insert the same figure in both the relevant boxes. Or if it is impossible to determine the cost of expendable materials used in each individual department, the same value can easily be given for all the departments and then divided equally.

The third allocation level involves individual finished products, according to the productive efficiency in each individual department. The table for the finished product (Fig.2) in fact contains information relating to production parameters in order that products requiring greater resources are penalized.

In this way, two products, for example, in the same sector but affected by different production parameters may have very different costs. In fact the product that can be pressed more rapidly requires less supervision during glazing, can be fired at greater speed and must therefore cost less to produce than a product which is similar but has less favourable production parameters.

Using this type of system, inefficient elements in the production cycle can be reflected in production as a whole and not just on the products that happen to be on the production line when the malfunction occurs. In practice, a production fault results in a reduced quantity of material sent to storage. The costs involved will therefore be allocated to a smaller number of square meters, thereby increasing costs incurred on all the products.

The finished product table contains a lot of other information relating to the series to which the product belongs and its size. In this way, products can be called up according to their size and series, thereby simplifying the analysis of results.

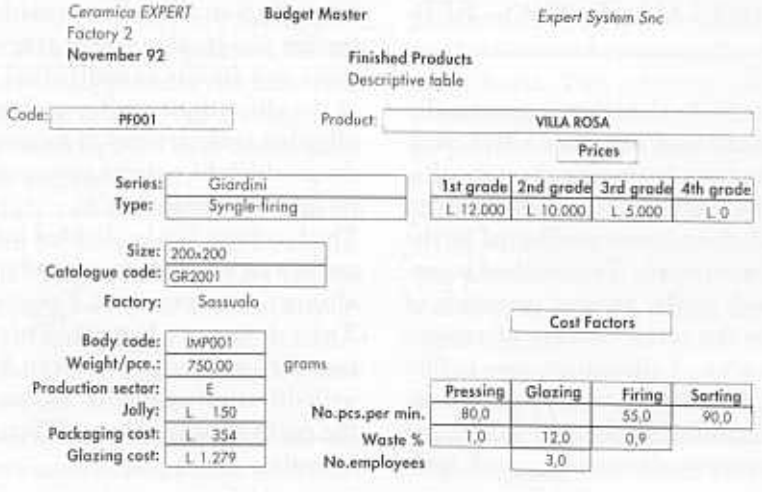
The sale prices of individual selections are also indicated so that the mean price can be calculated. The system can be adapted to any production situation, indicating whether the product in question is single-firing or twice-firing, and specifying whether the biscuit or body is produced internally or purchased. The program selects the correct method to calculate the cost of the base, as each case arises.

There now remain to be calculated the cost factors relating to expenses incurred by the business which do not relate necessarily to products held in stock. These factors are naturally:

— the body or biscuit;

— raw materials

Fig. 2 - Finished Product Table.



for glazes and screen-printing;
— packaging materials.

For all these entries, the most precise a priori calculation must be made if errors are to be avoided. For this reason, Budget Master contains an extremely detailed data bank designed to manage the inventory of all finished products and all packaging. All this however is based on real data used on the production line. In this way the production table can actually be used on the line.

The production table dealing with finished products (Fig.3) in fact contains all the information required for glazing, processed intelligently to allow even production costs to be calculated. For example, the table can be used to calculate directly the percentage of dry materials at any density value, starting with the composition of the glaze; the user can also give every type of application method a specific dispersion value. The cost figure calculated for the glaze therefore takes into account the type of application used.

Operating in this way, even calculations relating to the quantity of raw materials required for the execution of a production program are more accurate and the estimated consumption figures differ only slightly from the real figures.

Using Budget Master, all these problems have been resolved in the most precise way possible, to guarantee the closest resemblance between estimated costs and those actually incurred.

The finished product table allows the cost of silk screen-printing screens to be reflected accurately, debiting them according to the screen code. Each screen can be given a unitary price and an average working life which will then be debited only from finished articles produced with the use of that screen.

This table does not oblige the technician to provide the industrial accounting office with further information; on the contrary, it contains all the functions required to calculate these data directly from the parameters which are actually used on the glazing line. It does not therefore represent an additional obligation but rather provides an excellent opportunity to benefit from a system capable of printing tables in a modern and attractive form. It is then simply a que-

Fig. 3 - Production table for finished product.

Ceramica EXPERT Factory 2 — **Budget Master** — *Expert System S.n.c.*

November 92

Production card: VILLA ROSA

Product code:	**PF001**	**Series:**	**Giardini**	**Catalogue code:**	**GR2001**	**Size:**	**200x200**
Type:	**Single-firing**			**Factory:**	**Sassuolo**		

METHOD APPLICATION	GLAZE	Wght.(gr.):	Dens.(gr./l):	Visc.(sec.):	Screen code:	No.rowss	Residue	Dry
1 DOUBLE DISK 2p	S SL033 Engobe	13,0	1.450,0	40,0			0,2%	50,8%
The engobe must be applied underneath the glaze while it is still damp otherwise the line speed should be increased.								
2 BELL-SHAPED COATING UNIT 2 coats	S SL001 White base	54,0	1.850,0	45,0			0,3%	73,8%
Take great care with distribution of glaze. Check the unit feed regularly.								
3 FLAT SCREEN-PRINTING	S SL131 Pink screen-p.	3,0	1.650,0	70,0	AARET1	55HD	0,3%	100,0%
If the glaze does not fix, add fixing agent.								
4 FLAT SCREEN-PRINTING	S SL455 White screen-p.	1,5	1.650,0	70,0	AARET2	55HD	0,3%	100,0%
Idem. Make sure spreader is operating properly.								
5 FLAT SCREEN-PRINTING	S SL154 Grey screen-p.	1,2	1.650,0	70,0	AARET3	55HD	0,3%	100,0%
Screen gets dirty in low.								

stion of filling in the data already available on the table, rather than the more traditional sheet of paper, to set the system in motion. Data relating to glazes and bodies refer to the semi-finished table containing compositions of raw materials. This in turn refers to the raw materials file containing information essential for the calculations to be carried out.

We should point out that all the files and cards relating to allocated factors can be up-dated monthly. This means that variations in the cost of raw materials during the year can be taken into account. Let us suppose that a raw material Z costs 1000 lira up to April, rose to 2000 lire up to June and then dropped again to 1000 lira. When processing the progressive cost of products, only production for the months of May and June will be affected by the increase, in proportion to the quantity of products. For example, a tile that contains raw material Z but was not produced in May-June will not be affected by the increase, whilst the tile produced only in the month of May will feel the full effect of the price rise.

All this information can be easily transferred from the central computer system and can then be integrated with any missing data.

Budget Master is capable of storing data from 14 months of production on memory, divided into monthly files. In this way the data can either be processed progressively or referred to a single production month, taken from the period considered as a whole. The data relating to raw materials, unfinished and finished products complete the information necessary to allow Budget Master to process costs. The system is therefore extremely simple to operate, compared with the traditional method and the data obtained are much more relevant to what could be defined as the technological cost of each individual product. To facilitate the analysis of the incidence of individual cost factors in production departments and in relation to finished products, the result of the calculations is demonstrated in the form of tables filled with important information.

The table summarizing the cost factors for each product (Fig.4) represents an extremely detailed method of analysis as it reveals the specific incidence of every cost factor in every production department.

The system also supplies different types of summary tables which make a direct comparison between cost factors affecting all the products. The tables are organized according to the size and series of the product and it is possible to call up only the mean results according to series and size.

4 - CONCLUSIONS

The greatest advantage of this system is certainly the ability to execute simulations and make reliable estimates which can then be processed with equal rapidity. An important but often under-estimated factor is that the cost of a product varies depending on the range of products available. By using this system, an accurate estimate of the cost of a product introduced into the range can be obtained in just a few minutes and is therefore much more significant than a standard data item. All this information can be processed either every month or progressively and can be compared with a reference situation, for example with the firm's budget or with another hypothetical business situation with a different productive arrangement. Given the system's speed and simple operation, various production situations can be simulated and their impact on production costs verified. Variations in staff, range of products and machine capacity can be simulated in real time, to help the firm make the right decisions in fixing sale prices, scheduling production and in investments. The fact that this system is fully compatible with the firm's computer system and that all the data available can be transferred onto an electronic medium makes it an extremely sophisticated piece of processing equipment which may be made operative rapidly and in any business structure.

Budget Master is therefore a highly developed instrument for the analysis of direct production costs and for the evaluation of contribution margins, offering a better alternative to conventional industrial accounting methods.

Fig. 4 - Summary table of product cost factors.

VILLA ROSA - November (Factory 2) 200x200

	Workforce	Methane	Energy	Mainten.	Materials	Contractors	Waste %	Inc.waste	Total
Body					1781,3				1781,3
Press./Drying	137,4	84,3	89,7	22,6	55,2	7,3	1,00	22,00	418,5
Glazes					1278,9				1278,9
Glazing	225,4	0,0	76,0	45,2	50,1	9,7	12,00	529,79	936,2
Firing	163,9	157,4	65,2	25,1	40,9	9,0	0,90	44,29	505,8
Sorting	323,3	0,0	13,7	38,9	7,9	5,6	2,44	132,81	522,2
Other ops.					150,0				150,0
Packaging					353,5				353,5
Indirect costs	121,2								121,2
TOTAL	971,2	241,7	244,6	131,8	3717,8	31,6	12,01	728,90	6067,6

	1st grade	2nd grade	3rd grade	4th grade
Sale prices	12000,0	10000,0	5000,0	0,0
Stock 16000	78,13%	18,75%	3,13%	0,00%

Mean sale price	11406,3
Contribution margin	5338,7
Fixed costs	519,6
Operative margin	L. 4.819