

ECONOMY OF SCALE STRATEGIES VS. DIFFERENTIATION IN THE CERAMIC TILE MANUFACTURING SECTOR

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1. ABSTRACT

The Spanish economy has undergone strong internationalisation, doubling its opening-up rate in the last 25 years. This increase in trade relations has been especially significant in the ceramic tile sector, where 77% of turnover stems from exports¹. Improving the competitiveness of our companies is necessary to be able to compete in a highly competitive global market. The adoption of more appropriate strategies will determine whether businesses survive.

This paper analyses the impact of various strategies on the profitability of Spanish ceramic tile companies, distinguishing between the effect of the economy of scale strategy and that of other types of strategies, which are also analysed in this study, in accordance with the degree of influence on the increase in net profit margin on sales.

2. REFERENCE THEORETICAL CONCEPTS

To develop the theoretical model, it has been sought to introduce various important concepts: competitive strategies, the experience curve, the concept of economy of scale and the concept of economy of scope, which are discussed below.

Thus, according to Michael Porter¹, there are three generic strategies through which a business creates and maintains a competitive advantage over others in an industry. These strategies are: cost leadership strategy, differentiation and the focus or niche strategy.

Regarding the "experience curve", although the concept had already emerged at the end of the 19th century, it was not quantified until the mid-1960s by Bruce Henderson, founder of the Boston Consulting Group². It was quantified as a 25% reduction in manufacturing costs whenever the volume produced doubled. The curve was studied for other industries and products, this percentage varying between 10 and 30%.

This reduction of costs was moreover due to a huge variety of factors, such as the learning curve, replacement of the workforce by automation or technological sophistication.

Finally, it proved essential to examine the differences between economies of scale in a company and economies of scope. While economies of scale refer mainly to reducing average cost, linked to the increase in production scale of one type of product, economies of scope deal with reducing the average cost for a company in the production of several products.

In the ceramic sector, tile manufacturers do not just manufacture one type of product but are multi-product companies. Thus, there are companies with a product mix that may contain products such as: earthenware tile, stoneware tile, porcelain tile, extruded tile, special pieces, and large-sized slabs. For this reason, based on the equation described by Henderson, the above was further developed to fit the ceramic sector.

3. OBJECTIVE OF THE STUDY

This study aimed, on one hand, to determine the impact of various strategies used by Spanish ceramic companies on the profitability they each obtained, i.e. establishing, on an overall level, the percentage to which economies of scale or the adoption of other types of strategies explained company results.

On the other hand, the other types of strategies used by ceramic manufacturers were examined, to ascertain what these strategies were, how extensively they were used in the industry and which had the greatest impact on the income statement.

Lastly, the study aimed to provide a benchmarking tool, so that every company could compare itself with the sector's best brands and analyse the foreseeable effects of implementing a series of strategies in its own business environment.

With regard to previous studies in this sense, to be noted are those of Zi Wan (2004)³ and Leitner and Guldenberg (2009)⁴. In the present proposal, it is sought to go a step beyond those studies, not just by providing an understanding of which strategies affected operating income to the greatest extent, but also by discounting the effect of the economy of scale, i.e. by eliminating the percentage effect that the economy of scale and the learning curve had on company operating profits, in this case on those of the ceramic tile sector.

4. THEORETICAL MODEL

In order to carry out this study, the entire population of ceramic tile manufacturers was analysed, based on the 2017 census of the Spanish Ceramic Tile Manufacturers' Association (ASCER), according to which there was a total of 126 registered companies. However, the study required having the financial statements of the last five years to be able to estimate each company's average under normal performance. As a result, in the end, only the data of 98 companies from the last five years were available, which became the final population based on which all the analyses presented here was carried out.

In addition, as the companies were mostly concentrated in the Castellón ceramic cluster, factors stemming from the effect of country/currency, difference in raw materials or energy costs due to location, application of different legislation, etc., did not affect this study. The effect of economy of scale may therefore be considered mainly determined by each company's turnover.

4.1. INITIAL CONSIDERATIONS:

- As mentioned above, the study was carried out on the financial statements of the last five years, to estimate each company's average under normal performance.
- The analysis considered earnings before interest and taxes, usually known as EBIT. The purpose of using the EBIT was, on one hand, to eliminate the effect of debt and to analyse only the operating part, independently of the financial resources available to a company to carry out its strategy. The effect of taxes was also not considered, in order to eliminate another factor that introduces discrepancies and can distort operating incomes.
- EBIT was used, rather than EBITDA, because it was considered important to include amortizations for both material and immaterial fixed assets, as a result of the investments made to carry out the various strategies analysed in the study.

4.2. METHOD OF ANALYSIS

Average cost was defined as follows:

$$Cost_{average} = \frac{Fixed\ costs + \sum_{i=1}^n n_i Cost_i}{\sum_{i=1}^n n_i}$$

n_i : number of units manufactured of each product (monoporosa, stoneware, extruded, porcelain tile, etc.)

$Cost_i$: Variable manufacturing cost of each product

$\sum_{i=1}^n n_i$: Units manufactured of every product.

Total cost was defined as follows: $Cost_{Total} = N Cost_{average} = \varphi TO$

$$N = \varphi \frac{TO}{Cost_{average}} \quad \text{where } TO: \text{ Turnover}$$

$$EBIT = TO - N Cost_{average} = TO - \varphi TO = TO(1 - \varphi)$$

The net profit margin on sales (NPM) was defined as follows:

$$NPM = \frac{EBIT}{TO} = \frac{TO(1 - \varphi)}{TO} = (1 - \varphi)$$

Operating profit was determined as the sum of the company’s capabilities and strategies. Therefore, this may be summarised as:

$$NPM = \sum Business\ strategies = Economy\ of\ Scale + \sum Other\ business\ strategies$$

In view of the impossibility of differentiating between economy of scale (cost improvement due to increased production) and experience curve (cost improvement of a specific production), the joint effect of both were considered using Henderson’s Law. This allowed cost reduction due to increased production and improvement of knowledge to be assessed.

As the Spanish ceramic tile cluster is very concentrated, the effect of economy of scale (ES) and the experience curve (EC) were assumed to affect all companies equally. This effect was measured using cost elasticity.

$$Cost_{Total}(Considering\ ES\ and\ EC) = Cost_{average} N^\alpha$$

$$Cost_{Total}(Considering\ ES\ and\ EC) = Cost_{average} \left(\varphi \frac{TO}{Cost_{average}} \right)^\alpha = \left(\frac{Cost_{average} \varphi^\alpha}{Cost_{average}^\alpha} \right) TO^\alpha$$

$$Cost_{Total}(Considering\ ES\ and\ EC) = f TO^\alpha$$

Where $f = \text{cost factor}$

$$f = \left(\frac{\text{Cost}_{\text{average}} \phi^\alpha}{\text{Cost}_{\text{average}}^\alpha} \right) \text{ If elasticity is not taken into account, that is, } \alpha=1$$

$$\text{Cost}_{\text{Total}}(\text{Considering ES and EC}) = \left(\frac{\text{Cost}_{\text{average}} \phi^1}{\text{Cost}_{\text{average}}^1} \right) \text{TO}^1 = \phi \text{TO} = (1 - \text{NPM})\text{TO}$$

Calculating elasticity and average cost based on data from 98 companies that submitted their financial statements for the years 2011-2015, using the mathematical programming language R and the package GenSA, the result obtained was as follows:

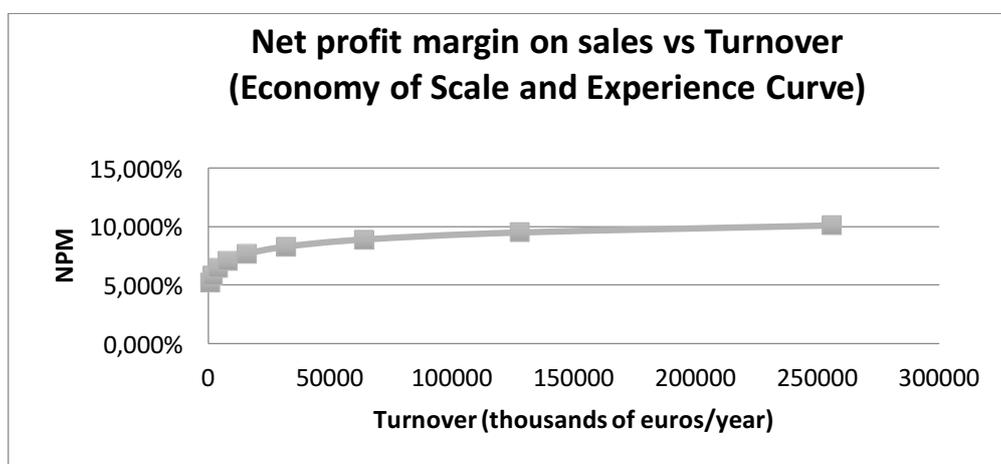
$$\text{Cost}_{\text{Total}}(\text{Considering ES and EC}) = f \text{TO}^\alpha$$

$$\text{Cost}_{\text{Total}}(\text{Considering ES and EC}) = 1.0135 \text{TO}^{0.99041}$$

With a correlation coefficient of: 0.9918

As may be observed, the level of prediction for the sector’s economy of scale and experience curve was very high.

On plotting the effect of the economy of scale and experience curve against the net profit margin on sales with different turnovers, shown in Graph 1, it may be observed that, as company turnover increased, the margin tended to increase less and less. As a result, at turnovers greater than those shown, the margins were observed to stabilise.



Graph 1

At this point, it was deemed of interest to verify how what has been designated the cost factor would perform, individually per company.

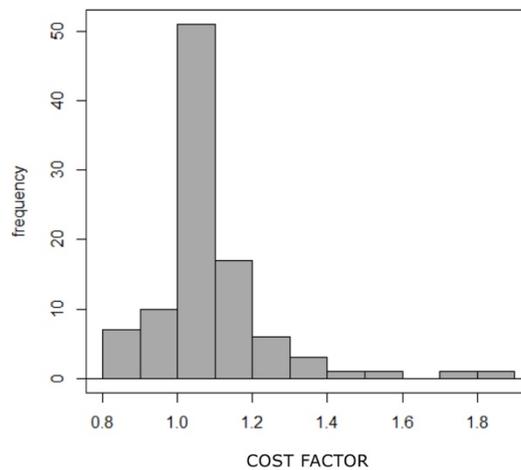
$$f = \left(\frac{Cost_{average} \varphi^\alpha}{Cost_{average}^\alpha} \right)$$

The formula would be:

$$Cost_{Total}(Considering\ ES\ and\ EC) = f_i TO^{0.99041} \quad f_i\ being:\ cost\ factor\ of\ each\ company$$

With a correlation coefficient of: 0.9985.

This correlation value indicates that the equation obtained completely explained cost performance as turnover increased for the Spanish ceramic tile sector. The following bar chart shows the companies, based on each company's cost factor:



Graph 2

In addition, it was sought to find the break-even point according to the cost factor. The break-even point or profitability threshold is the minimum number of units that a company needs to sell for profit to be zero. That is, when total cost and total revenue are equal.

Unlike classic break-even point calculations, in this case the economy of scale and the experience curve were considered in calculating the turnover required to reach the break-even point. Thus, in accordance with the study approach adopted, the break-even point would be given when:

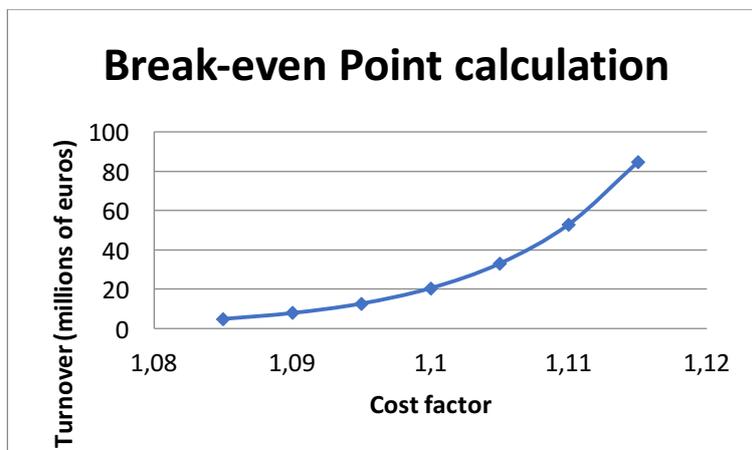
$$EBIT = TO - Cost_{Total} = TO - f_i TO^\alpha = 0$$

$$TO - f_i TO^{0.99041} = 0$$

Solving this equation for different f_i values yields:

f_i	TO (Millions of euros per annum to reach the Break-even Point)
1.085	5.0
1.090	8.0
1.095	12.8
1.100	20.6
1.105	33.1
1.110	53.0
1.115	84.6

Table 1



Graph 3

The real NPM (obtained from company data available at Companies House) was compared to the NPM resulting from the economy of scale. The difference between these may be explained by the “other strategies” that companies adopted.

The correlation obtained between the real NPM and the economy of scale NPM was 48%. That means that the economy of scale and experience curve explained 48% of company financial performance, i.e. of the net profit margin on sales. The remaining 52% was explained by the adoption of “other types of strategies”.

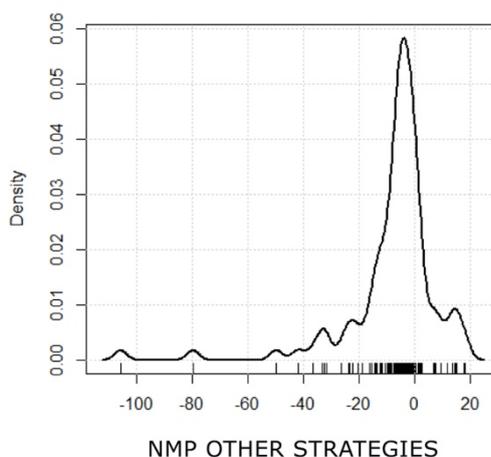
The calculation was made by solving the equation:

$$\sum \text{Other business strategies} = \text{NPM} - \text{Economy of Scale}$$

Each company’s effect of scale was subtracted from the NPM, bearing in mind its turnover. Therefore, only the effects resulting from the other strategies applied by each company were considered.

Regarding the “other strategies”, firstly, the normal performance of this variable was analysed, using the Shapiro-Wilk normality test.

The results are shown on the following graph and table:



Graph 4

Average NPM due to the application of other strategies:	-7.86%
Standard Deviation of NPM due to application of other strategies	17.20%

Table 2

It can be observed that there was an important group of companies positioned around the average in terms of profitability resulting from the application of other strategies (profitability, which is noted as being negative, namely -7.86%) and there are a series of companies with much more negative data, perhaps owing to the readjustment processes that have occurred in the sector in recent years.

Therefore, based on this average and this typical deviation and substituting in the formula:

$$\sum \text{Other business strategies} = \overline{\text{Other strategies}} \mp n \sigma$$

$$\sum \text{Other business strategies} = -7.86 \mp n \ 17.20$$

Where *n*: represents the number of times the standard deviation was considered

The analysis yielded the following scenarios:

Company performance	N
Companies with weakness in their other strategies compared to the sector average	Negative $n < 0$. The more negative this value, the greater the company's weakness.
Companies whose strategies coincide with the sector average	$n = 0$
Companies with strengths in their other strategies compared to the sector average	Positive $n > 0$. The more positive this value, the greater the company's strength.

Table 3

Considering all the companies as a whole:

$$NPM = \sum \text{Business strategies} = \text{Economy of Scale} + \sum \text{Other business strategies}$$

This may be expressed as follows:

$$NPM = \frac{TO - 1.0135 TO^{0.99041}}{TO} * 100 - 7.86 \mp n \ 17.20$$

Where:

TO: annual turnover

n: represents n-times the standard deviation corresponding to the effect of the other strategies. This indicates the company's strength or weakness in the applying differentiating strategies compared to the sector average.

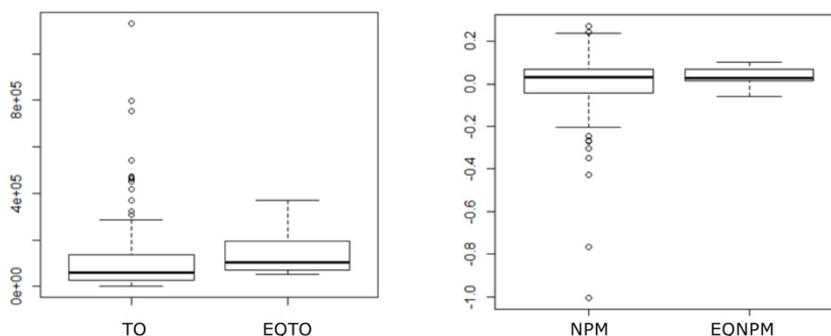
At this point in the analysis, the effect percentages of the strategies of economy of scale and other business strategies on the NPM had been obtained.

However, it was deemed necessary to go a step further and to try to determine which strategies would be found within those thus far designated "other business strategies". For this, the questionnaire from Zi Wan's PhD thesis (2004)⁵ was used as a basis, adapting it to the characteristics of the ceramic tile sector.

This questionnaire was sent to the 98 companies that made up the starting population of the present study, a total of 10 valid replies being received prior to the date of submission of this paper, a basis that will be extended until the official presentation date of the congress.

Based on the responses received, statistical inference was carried out in which the null hypothesis, which states that the two samples may coincide, cannot be discarded. For this, the Mann-Whitney-Wilcoxon test was applied.

In view of the results obtained, it cannot be discarded that the average turnover and the average turnover of the companies that responded **did not** coincide, nor that the average NPM and the average NPM of the companies that responded **did not** coincide. In addition, a box plot was constructed in which it can be observed how practically the average among all companies and the responses to the survey of the two analysed variables coincided.



Graph 5

Finally, based on the results, the values were normalised to enable them to be compared in equal conditions. The normalisation criteria were as follows:

$$\text{Normalised Value} = \frac{\text{Value of each company's } i \text{ strategy} - \text{Minimum value of that strategy}}{\text{Maximum value of the strategy} - \text{Minimum value of the strategy}}$$

For the normalised values the coefficients were calculated by multiple regression analysis.

$$NPM_{\text{other strategies}} = \sum_{i=1}^{i=21} w_i \text{Strategy}_i$$

The following section sets out the results of all analyses carried out.

5. RESULTS OF THE ANALYSES PERFORMED

From the above formula:

$$NPM = \frac{TO - 1.0135 TO^{0.99041}}{TO} * 100 - 7.86 \mp n \quad 17.20$$

using the sector's average yearly turnover, the following results were obtained, differentiating between the effect of the economy of scale on net sales profit margins and the effect of the application of other strategies:

TYPE OF BUSINESS	Sector average TO _{annual} (mil.€)	<i>n</i>	Effect of Economy of Scale $\frac{TO - 1.0135 TO^{0.99041}}{TO} 100$	Effect of other strategies -7.86 \mp <i>n</i> 17.20	Net profit margin
Company with weak differentiation strategies.	26.293	-1	8.09%	-25.06%	- 16.97 %
Companies with a differentiation strategy similar to the average.	26.293	0	8.09%	-7.86%	0.23%
Company with strong differentiation strategies.	26.293	1	8.09%	9.34%	17.43 %

Table 4

Using the average turnover of the 20 companies with the greatest annual turnover in the sector, similar, albeit less negative, data were obtained.

TYPE OF BUSINESS	Sector average TO _{annual} (mil.€)	<i>n</i>	Effect of Economy of Scale $\frac{TO - 1.0135 TO^{0.99041}}{TO} 100$	Effect of other strategies -7.86 \mp <i>n</i> 17.20	Net profit margin
Company with weak differentiation strategies.	84.801	-1	9.11%	-25.06%	- 15.95 %
Companies with a differentiation strategy similar to the average.	84.801	0	9.11%	-7.86%	1.25%
Companies with strong differentiation strategies.	84.801	1	9.11%	9.34%	18.45 %

Table 5

Finally, regarding “other strategies”, the following conclusions were drawn, based on the questionnaire, regarding each of the strategies applied:

*Ratings are from 1 if they did not apply the strategy at all to 10 if they applied it completely

	AVERAGE	DEVIATION	MINIMUM	MAXIMUM
Gaining a reputation based on the quality of the product/service	8.55	1.67	4	10
Improving the efficiency of production facilities	8.36	0.79	7	9
Offering better customer service than competitors	8.27	1.08	6	10
Emphasis on the reduction of delivery times	8.18	1.22	6	10
Focusing on more expensive products	7.91	1.68	4	10
Developing and maintaining a clear customer loyalty strategy	7.82	1.60	5	10
Versatile production facilities to manufacture different products in accordance with market demand	7.73	1.34	5	9
Having trained and qualified staff	7.73	1.51	6	10
Developing a recognisable brand in the market	7.64	1.80	5	10
Investment in new production processes	7.45	1.51	5	10
Research for the design and development of new products	6.73	2.23	1	9
Introducing new products or innovations into the market before competitors	6.73	2.04	3	10
Emphasis on developing mechanisms for control and information on the distribution channels	6.55	1.82	4	9
Personalisation of products	6.27	2.31	2	10
Competing in specific market/customer niches	5.82	2.79	1	10
Use of new methods of marketing	4.91	2.59	1	9
Focusing marketing on certain geographic areas of the market. (Geographic market niche)	4.91	3.01	1	9
Licensing certain products to other companies	3.73	2.06	1	7
Offering lower prices than competitors for products of a similar quality	3.55	1.67	2	6
Using a low-cost distribution channel	3.00	2.04	1	7
Developing strategies using multi-location in other countries (carrying out production processes in other countries)	1.36	0.89	1	4

Table 6

By calculating the coefficients through the application of multiple regression analysis, the following table shows the strategies that showed the greatest differences among ceramic tile manufacturers:

Strategy _i	Coefficient w _i	Std. Error	t value	Pr(> t)
Introducing new products or innovations into the market before competitors	0.18916	0.35803	0.528	0.65
Using a low-cost distribution channel	0.1252	0.19813	0.632	0.592
Competing in specific market/customer niches	0.03462	0.12015	0.288	0.8
Use of new methods of marketing	-0.04601	0.22997	-0.2	0.86
Research for the design and development of new products	-0.05106	0.12338	- 0.414	0.719
Licensing certain products to other companies	-0.05453	0.15902	- 0.343	0.764
Focusing marketing on certain geographic areas of the market. (Geographic market niche)	-0.07716	0.14345	- 0.538	0.645
Personalisation of products	-0.17567	0.35066	- 0.501	0.666

Table 7

Residual standard error: 0.08517 on 2 degrees of freedom

Multiple R-squared: 0.6186, Adjusted R-squared: -.9071

F-statistic: 0.4054 on 8 and 2 DF, p-value: 0.8536

6. CONCLUSIONS AND IMPLICATIONS FOR BUSINESS

The results obtained allowed the following conclusions to be drawn:

- An equation was developed that related turnover to the reduction of the business's manufacturing costs.
- Economy of scale explained 48% of the variability of the operating profits of ceramic tile manufacturing companies. The remaining 52% was explained by other types of business strategies.
- In general, the margins obtained in the sector annually in the last 5 years came from the effect of the application of other strategies; they provided negative results except in companies whose differentiation strategies remained strong.
- Companies were able to improve their profitability in three ways: increasing their turnover using economies of scale, developing differentiation strategies or more commonly, with a combination of both. Each company must know its position in the market, based on its turnover and efficiency in applying differentiation strategies from calculation of its n component. Knowing these values, the company will be able to select the most appropriate strategy or strategies for its size and strengths.

Regarding the combination of the strategy of economy of scale vs. Other differentiation strategies, the following scenarios were assessed:

- If the company presented a value $n > 0$, it was a company that applied strategies that increased the added value of its products and services with greater strength than the industry average.
 - If the company had an n -value close to or greater than 1 and a low turnover, the company's strategy should focus on achieving an increase in the volume of turnover by achieving economies of scale, without forgetting the rest of the strategies that allow it to obtain competitive advantages compared to the rest of the manufacturers in the sector.
 - If the company had an n -value close to or greater than 1 and a high turnover, it was in a position in which it was difficult to continue to apply economies of scale; in fact, it could cause adverse effects resulting from the company's inflated size, where the synergies generated with economy of scale are lost. The managers should evaluate which aspect of the business provided the greatest profitability. In this case, the difficulty would continue to lie in maintaining differentiation strategies that provided a sustainable competitive advantage.
 - Companies with an n -value close to 0 and an average turnover should adopt either an economy of scale strategy or a differentiation strategy or a combination of both, evaluating:

- Whether their investment in differentiation provided the expected return.
- Whether an increase in investment aimed at seeking products or services that provided value was going to translate into an increased net profit margin.
- Whether the increase in turnover would reduce the net profit margin, due to a reduction in the sales price that did not compensate for the reduction of costs resulting from an increase in the economy of scale.
- The risks associated with increasing turnover. New investments, needs for more capital, etc.
- If the company had a value of $n < 0$, it was a company that was weak in applying strategies that increased the added value of products or services. In this case, all the profit that the economy of scale brought was diminished by the type of product or service that the company offered. Its products or services had a lower added value than that of the competition. Therefore, its first steps should be:
 - Analysing whether the investment in differentiation was efficient.
 - Evaluating the strengths and opportunities of the business, to draw up a plan that would allow it to establish the product or service strategies to increase the added value compared to that of the sector average.

Lastly, regarding the data on “other strategies” obtained from the questionnaire, the following conclusion may be drawn:

- In order to improve operating profits, companies must maximise performance:

$$NPM = \frac{TO - 1.0135 TO^{0.99041}}{TO} * 100 + \sum_{i=1}^n w_i \frac{Value\ of\ i\ strategy_{company} - Min\ value\ of\ i\ strategy_{sector}}{Max\ value\ of\ i\ strategy_{sector} - Min\ value\ of\ i\ strategy_{sector}}$$

i: represents each analysed strategy

- The strategies applied to the greatest extent in the ceramic sector were as follows:
 - Gaining a reputation based on the quality of the product/service
 - Improving the efficiency of production facilities
 - Offering better customer service than competitors
 - And emphasising the reduction of delivery times

- On the other hand, aspects such as multi-location, seeking low-cost channels or offering prices lower than competitors were among the least used strategies.
- The strategy that increased the net sales profit margin of the company the most was that relating to “the introduction of new products or innovations into the market before competitors”, followed in second place by “use of a low-cost distribution channel” and in third place “competing in specific market or consumer niches”.
- It may be noted that strategies such as “the use of a low-cost distribution channel”, despite being one of the strategies that increased the company’s sales profit margin the most, was, however, one of the least used strategies among ceramic tile manufacturers. It is important to evaluate these cases carefully.

In short, every company must evaluate its strategies for improving profitability, based on its options for increasing turnover or on its strengths as differentiators that provide its products or services with added value.

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