Identification of new strategic processes across the Balanced Scorecard. Nesting, key of success in the processes of thermal cutting of the steel

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**Abstract**

The identification as strategic of processes that previously were considered to be alone as necessary it is one of the most interesting aspects from the application of the Balanced Scorecard (BSC) to the organizations. To take the strategy as a reference offers the safety of which the taken decisions will always be coherent with the same one, breaking the barriers that appear on having implanted the above mentioned strategy.

This aspect is promoted in the teaching of the BSC for the qualifications of master inside the area of the strategic management, resting on the practical case of the business of thermal cutting of the flat product of carbon steel. In this specific case we have a process called *nesting* that turns into a key to obtain the Customer Value Propositions (CVP) of the clients.

It is important to emphasize the difference between exhibition realized for the university teaching and for the operative practical teaching inside the own workshops dedicated to the business in question. Different points of view and different extent of knowledge for the same strategic practice.

The Internal business perspective is a determinant of the concept in the university teaching. On the contrary, the teaching in real companies is based fundamentally on the Innovation and learning perspective.
Keywords
Strategy, Balanced Scorecard, Processes, Thermal cutting, Nesting

1. The Evolution of the Balanced Scorecard

From the publication in 1992 (Kaplan-Norton 1992) of the first article about Balanced developed by the teacher Robert S. Kaplan and the strategic consultant David P. Norton as a system of management of a strategy, many are the companies that began to use it.

From always the companies have worked with scorecards of measurement for certain activities or departments. Traditional and simple scorecards, where the difficulty of implantation was minimal and where the results of his follow-up were perceived immediately. The problem: these indicators can be interesting to measure this specific activity or department but it does not really mean that it is important for the success of the organization from a strategic point of view.

The BSC uses a measurement to tie activity and strategy (Kaplan-Norton 1996), obtaining an exponential benefit of the measured aims and, therefore, of the final result of the organizations.

When the employees have familiarized themselves with the system, the alignment of their efforts and actions with the strategies, defined fundamentally across their Strategy Maps (Kaplan-Norton 2001) have had a major degree of success. These results have led to re-defining his scorecards with a major degree of difficulty but with a major approximation to their strategies. The measurement of the activity did not correspond exclusively to the Financial perspective to be completed by the other three basic perspectives from which it is necessary to monitor the business with possibilities of success: Customer, Internal business processes and Learning and growth.

In three sequentially arranged books, Kaplan and Norton established the bases of an excellent result across the process of implantation with the BSC: the description (Kaplan-Norton 2004), the measurement (Kaplan-Norton 1996), and the management (Kaplan-Norton 2000) of the strategy.

Focusing on the perspective of the Internal Business processes of the BSC we find two fundamental differences with respect to traditional scorecards. On one hand, the traditional approaches are based on the improvement of the suitable practices across the improvement of the existing processes whereas the BSC identifies new processes that will be classified like strategic. On the other hand, the traditional approaches centre exclusively on the short wave of value creation whereas the BSC penetrates both into the short wave and into the long wave of value creation contributing to this last function the process of innovation.
The identification of a new strategic processes, it is one of the most important contributions that we find in the BSC since it authentically shows that the before definite strategy is the beginning for the implantation and management of it. In the traditional models there was no connection between strategy and scorecard. They measured what they did. On the contrary, BSC measures coherence with the definite strategy. It is necessary to bear in mind that the definition of these key processes needs an implicit training adjustment of a high percentage of people toward the new objective.

The new key processes can be new or not for an organization. If the process isn’t new the company may not give it the importance it deserves, before the study.

2. Practical case study: business of thermal cutting of the steel

2.1 Basic description of the business operation

The organizations dedicated to the generation of pieces of steel with base material with thick plate of carbon steel (flat product of thicknesses over 8 mm) have between its more typical processes those called thermal cutting processes due to the necessary heat contribution to carry them out. These processes are known technically as oxifuel and plasma cutting, which are different in several aspects, but for the development of our case of study we will always refer to oxifuel, though the model is equally applicable to both.

The pieces that customers request are reflected and transmitted to the suppliers of cutting with drawings. Those drawings are occasionally by hand, habitually with CAD files.

The cutting machines have several torches of cutting being one of them the drive torch. A machine with 4 torches can cut 4 equal pieces simultaneously in same vertically since they are joined by a bridge with the same structure.

In the figure 1 we can see the example for a 20mm thick piece with maximum dimensions of 800x600mm:

![Figure 1: Example of piece](image-url)
The operative offices get these CAD drawings and transform them into CAM files (Cuesta, 1995) in order to be read by the thermal cutting machines. The process of transformation from CAD to CAM files is called *nesting*, and consists of placing the drawn pieces on a surface of sheet (thick plate) in order to permit to cut them in the workshop.

Nesting example:

If the customer has requested 24 units for the CAD file, we can find the following nesting program:

As the figure 2 represents, the chosen plate is 6.000mm long and 2.500mm width. Three pieces would be cut every time: three pieces of the row A, and later three pieces of the row B, etc.

Every finished piece would be as shows in the figure 3:

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*Figure 2: Example of nesting*

*Figure 3: Drawing example*
2.2. Identification of new strategic processes

The strategic analysis that carries the question the general business of the workshops of thermal cutting has allow to detail and to confirm how the first difference between the BSC and the traditional scorecards it is key completely change the results of the above mentioned business across the identification of new processes that are re-defined as strategic, when till now they only had been considered to be necessary.

The nesting process is considered by many companies in the sector as a simple IT application that allows the transfer of a drawing to a 3 dimensional piece thanks to the thermal cutting process. If we were pragmatic it is what really is obtained: to turn a drawing into a real piece of steel.

Nevertheless, if we know more about this business and try to understand what processes are those that really contribute benefit and which are only tasks of support, we realized that the process of nesting is key of success, turning this task into strategic.

Once defined the general strategy of the organization and structured in our strategy map, see figure 4, we select a window of union between the internal business processes, our process defined as strategic (nesting), and some of the Customer Value Propositions.

![Figure 4: Window of our specific strategy map](image)

How does nesting contribute value to our clients? With three items: Competitive price, faster delivery time and adjusted offers.
2.2.1. CVP: Competitive price

The nesting process allows obtaining productive costs in order to offer competitive prices to the customers for their internal structures of costs. The relevancy of the nesting process is such in the costs that we do not find any other process but the purchase of the raw material with such importance for the development of the business. The difference between them is that the purchase is widely identified by the great majority of the companies as strategic whereas the nesting is named as strategic in this specific case of study.

The possibility of cutting a major number of pieces for unit of time as well as of transforming internal operations into external from the point of view of the optimization of the percentage of machine running reduces the cost needs and obtains the maximum capacities of the companies that are excellent in nesting.

To get a competitive price of the product we will need first to fit our costs as much as the company can, that is to say, to the possible minimum. If we observe the concepts that are negative value for our income and how they have importance in the general context we meet the following graphical information (figure 5) for average of expenses:

![Average of expenses](image)

**Figure 5:** Average of expenses

Acting in a coherent way, we will affect directly on both main concepts: Salaries (39,0 %) and Scrap (24,5 %). Though we cannot despise improve the others, any improvement that we make in these two will mean a positive jump of major importance for our business.

*What is the relationship between the salaries expense and nesting?*
Considering a machine to be an example with four torches, the cutting of four pieces would take approximately the half time than the cutting of two first and then the other two. It means that an appropriate nesting achieves less production time and more product cut. The ratio of hourly productivity multiplies positively. The consequence is a more accurate human resource and fewer needs of working hours. It means the expense of salaries that exactly the company needs.

Let's see an example of two different options for this piece (UAHE, 2001):

Weight = 65,1 kg
Length of cutting = 2,6 mts
Thickness = 20mm (speed velocity = 460mm/min)
Dimensions = 800x600

Observing the figure 6, the first row would be cut by the drive torch whereas other two rows would be cut at the same time by the second and third torch copying the path of the first one. The cutting time for this program would be the following:

8 u x 2,6 mt / 0,46 mt/min = 45,2 min

On the contrary, in the second option reflected in the figure 7, the time of cutting would be:

6 u x 2,6 mt /0,46 mt/min = 33,9 min
Reduction of 25% of the time of cutting and considering a cost for the plant of 120 €/h of cutting, we have the following economic result:

45.2 min x 120 €/h = 5424 €
33.9 min x 120 €/h = 4068 €

In addition, we realize an average of 15 programs per day of this type, so we could say that every day we would save approximately:

11.3 min/program x 15 programs/day = 169.5 min/day (2h 49 min) for time information
169.5 min/day x 120 €/h = 20340 €/day for economic information

What is the relationship between the scrap expense and nesting?

As we have defined in the first point, the nesting has a function of choice of the suitable plate for the workshop. The generation of scrap diminishes both for the choice of the ideal plate and for the suitable placement of the pieces in the plate. We can see this in the next example of figure 8:
In this figure 8, the best option to reduce the cutting time, we have the following result:

The weight of these 24 pieces is $24 \times 65.1 \, \text{kg/u} = 1.562,4 \, \text{kgs}$

The dimensions of the needed plate to cut them are $4.932 \times 2.500 \times 20 \, \text{mm}$ what mean that the gross weight is approximately 1960 kilograms. Therefore, the generated scrap is 20,3%.

$$\frac{(1.960,0 – 1.562,4) \, \text{kgs} \times 100}{1.960,0} = 20,3\%$$

Nevertheless another option of nesting that we observe in the figure 9 reflects a better result:

![Figure 9: Nesting](image)

The dimensions of the needed plate are now $4.279 \times 2.500 \times 20 \, \text{mm}$ and it means that the scrap is reduced as showed for the new $1.711,6 \, \text{kgs}$ gross weight:

$$\frac{(1.711,6 – 1.562,4) \, \text{kgs} \times 100}{1.711,6} = 8,7\%$$

If we consider an average price of base material of $332 \, \text{€/ton}$ (average price in 2002) and a price of sale for the scrap of $72 \, \text{€/ton}$ we are losing $260\, \text{€}$ with each ton that is transformed into scrap. Let's see, according to this information, the economic comparison of both programs from the only point of view of the scrap:

$$(1.960 \, \text{kgs} - 1.562,4 \, \text{kgs}) \times 260 \, \text{€/ton} = 103,4 \, \text{€}$$

$$(1.711,6 \, \text{kgs} – 1.562,4 \, \text{kgs}) \times 260 \, \text{€/ton} = 38,8 \, \text{€}$$
We save 64,6 € due only to this program. In addition, there is an average of 5 programs per day with this kind of nesting, so we could say that every day we would save approximately 64,6 € x 5 programs/day = 323 €/day.

The importance of nesting to achieve the competitive price as customer value proposition has been clearly shown with all this information. With all these examples we can say that the optimization of nesting process saves approximately 662 €/day for the company, 339 € due to salaries and 323 € due to scrap. Less cost for us means less price of purchase (competitive price) for the customers.

2.2.2. CVP: Faster delivery time

The nesting process successfully reduces in very improved ratios the delivery times of our orders because optimized programs cut major number of pieces in minor time.

Our customers need as limited as possible delivery times in such a way that they are capable of correctly attending to the needs of their customers. The process of nesting help to reduce the delivery time and to show it we can use the figures 10 and 11.

If we remember the values made for competitive price, the time of cutting in figure 10 was 45,2 minutes whereas the time for figure 11 was 33,9 minutes.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{n10.jpg}
\caption{Nesting}
\end{figure}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{n11.jpg}
\caption{Nesting}
\end{figure}
In addition, we remember that the workshop is cutting an average of 15 similar programs every day. So, we were saving 2 hours and 49 minutes per day. But, we can use this same information to show another point of view:

8 hours/day / 45.2 min/program = 10.62 programs/day against 8 hours/day / 33.9 min/program = 14.16 programs/day. If we had a production plan of 42 programs we could do the first example (figure 10) in 4 days of delivery time whereas for the second example (figure 11) we could do it in 3 days, reducing the delivery time by 25%.

42 programs / 10.62 programs/day = 4 days (figure 10)
42 programs / 14.16 programs/day = 3 days (figure 11)

Every 4 days the company is reducing the delivery time to 25% due to excellent nesting.

2.2.3. CVP: Adjusted offers

Adjusted offers are achieved when the companies know perfectly the lead time and the real costs of their processes. The process of nesting allows the companies to get that objective of information. In addition, an optimized nesting reduces always those key aspects so the offers to the customers are adjusted in both, time and cost. The customer satisfaction increases due to the improvement of the customer value propositions that appear in the strategy maps.

2.3. A new meaning of nesting process

Though the concept of nesting refers strictly to the process of conditioning of the pieces to cutting to a specific format of plate, our concept is much wider. We name nesting to the set of operations that there optimizes the utilization of the resources, from the search of the plate most adapted for every moment up to the instant in which the above mentioned program is cut in the workshop.

It is important to understand the meaning of “every moment” because sometimes the delivery time is long enough to be able to reduce the cost but on other occasions it is necessary to sacrifice cost to obtain the commitment delivery time. The most important is to achieve the customer value propositions as the customers know, as it was shown in figure 4.

Summarizing the different steps inside the process of nesting, we meet the following sub-tasks:
• Search of plates for every thickness to cut. It consists of knowing the available plates that exist in the workshop and its physical situation (length, width, and situation).

• Choice of the best option. It consists of proving the pieces to cutting with the list of the plates found in the workshop. The choice is that plate that is better to the punctual needs of the customers.

• Continually accomplishing nesting. It consists in looking for the best option continuously. The process of nesting of any piece does not finish for this piece when is located in a program. The piece can change its situation from one plate to another or from the first position to a new one because nesting in always searching for a better option with the new orders.

2.4. Operative decisions for the new strategic process

Once detailed the strategic need of the process of nesting, is necessary to write the operative decisions that the people that make this process should follow. In addition, the teaching of people who works in tasks related with it must be coherent with those decisions. But, although these points are numbered, it does not mean that number one is the priority and the last number is the least important. All of them are important and the people that do nesting should try to get as much as possible of all of them.

Getting the concept of Balanced Scorecard we can say that some points balance some others.

a/ To verify already existing programs. When we go to do nesting of a new piece first we have to verify if there is some already realized program where we could incorporate the above mentioned piece in such a way that we do not affect again in all those times that do not add value (find the plate, get it from the position in the layout and place it on the table of cutting). If possible, each plate that is under the table of cutting should transform its situation to pieces and scrap, nothing else.

b/ To cut the smallest plates first. When people do nesting they should consider the smallest plates first because these are the plates with the least value for the company. The value of a plate with dimensions of 8.000x2.000 mm has more value than 4 plates with dimensions of 2.000x2.000 mm due to several aspects such as: the bigger one needs less movements to work with it and in the big plate you can cut the biggest pieces than in the smaller plates.

c/ To cut the maximum number of pieces at the same time. To cut with the maximum number of torches it is necessary to reduce the expenses of salaries and the delivery time. Therefore, we have to cut as many pieces as we can at the same time.

d/ To make programs with the minimum movement in emptiness. More movements for the torches mean more time of cutting and more effort for the machinery. That is
why it is necessary to make programs with the minimum movement time. In the example of figure 13 we can see that the drive torch cuts the first and the fifth row whereas the torches 2, 3 and 4 cut the others below. The program cuts column A then cuts B and returns to C and so on. The emptiness movement (dashed line) is approximately 24 meters.

In the following figure 13 the movement in emptiness (dashed line) is less than in figure 12 with almost 8.6 meters.

We get the best program from this point of view in the figure 14 where the emptiness movement is approximately 7.2 meters. The drive torch cuts the first and second rows.
To generate programs with a constant directional sweep. The final aim is the possibility of being able to do work at the same time that the machine is cutting. To explain it better we can use the figure 13. In that program the machine works from the beginning of the plate to the end and then goes again to the beginning. There is no constant directional sweep. It is dangerous to work in that area with different directions of sweep and it is only possible to work under the plate when the program is finished. Nevertheless, the directional sweep is always the same as in the figure 14, from the beginning of the plate to the end. When the first group of pieces is cut, people can work in that area because the machine will be out of the workers way.

To chose the plate that takes less non productive cost. Let's suppose that a plate is at the bottom of a heap and other on the top. We have to choose the one that is on the top because it needs less time of logistic movement, non productive movement.

As we can observe each of the points can hit with others so that we have to make the choice that better matches to our final aim, the customer value propositions.

3. Teaching in the topic of Strategic management (master degree)

The utilization of the case in the educational classes of master has a double objective: theoretical and practical. From the theoretical point of view, there is necessary to make the students see the importance of analyzing the strategy of a business, the keys of the strategic view of any company in order to be really efficient in the labor of decision and management. What we show with this case of study is the importance of the identification of key processes that can be different from those that up to this moment the organization considered as really important. It is there where the Balanced Scorecard can contribute knowledge of management to the executive. From the practical point of view, it is very important to show how the theoretical concept works into real companies and how it contributes to improve the earnings of the company. The competitive field where the companies work as well as the internal reality of the same one is not a static situation but it is always changing. The Balanced Scorecard with its double-loop learning helps executives to change their assumptions continuously.

In our case of study, the nesting process did not appear as strategic, not even important in the business of thermal cutting of carbon steel plates. Nevertheless, the proper analysis showed that it was strategic and everything should change around it. The results were much better than before and, the most important, coherent with the strategy of the business.
4. Teaching in the real operative of business of thermal cutting

The use of this case of study in the own company presents totally different characteristics. As well as the internal business process is the most important perspective for the students of master degree, when this case is used in real companies the learning and growth in the proper perspective to run with the training of people. When it is clear that nesting is the new strategic process for a company, the following logical step is to identify all the people who have a relation with their tasks in the process of nesting. Some of them should be trained with the new orientation in order to help really to the company with their effort. This is a work based in the translation of the strategy to the operative.

Some people that were working in a specific task will change their work and some others will continue in their jobs but with a new orientation, doing the same but with a different objective. The Balanced Scorecard, through the strategic map, will help in overcoming the barriers that usually appear in the phase of implementation of the strategy.

5. Conclusions

We have countless improvements with the Balanced Scorecard as a management system of the strategy to the management role. Those improvements ranging from the simple ordering process implementation and management to break the barriers (vision, people, resources and learning) that hinder the implementation itself. Of these, one of the most important we have is in the perspective of Internal business processes.

Traditional scoreboard focus on improving the measurement and control of existing processes defined as key. By contrast, the Balanced Scorecard identifies new processes as strategic, whose excellence in execution will allow the company to get the customer value propositions. This concept is very important to the training of future managers and directors necessary function.

Applied to the concept training, find two very enriching variants such as applied to university student (master degree) and which is carried out in the real companies. In the first case, the student needs to know the concept and its application for future implementation on their part. In the second one, it is associated with the new function of some people according to the level of strategic retraining the new process required.

In both cases, we have worked in the business process called nesting for thermal cutting of steel flat product. This process, necessary for carrying out the transformation of plates into pieces, was identified as strategic for the redefinition of
strategy in a real company. The use of this case of study in both groups (students and workers) is a clear example of teaching university-business through the case of study.

6. References


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