PROPOSAL OF A NEW MODEL FOR THE OPTIMIZATION OF THE ORGANIZATIONAL PROCESS IN INDUSTRIAL COMPANY THROUGH THE APPLICATION OF THE ANALYTIC NETWORK PROCESS

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ABSTRACT

The evaluation process of a company presents many difficulties, especially with regards to the attribution of value to elements which are intangible by nature, such as the value of good management.

Thus, it is essential for companies to have tools that permit the evaluation and quantification of the elements of organizational and managerial nature.

The aim of this work is to analyze these issues by identifying and studying new indicators that take into account the characteristics and complexity of intangible assets.

Many models have been proposed, which focused on the enhancement of one or more aspects of the organization and business management.

In this work we have carried out through the multi-criteria decision making technique known as ANP - Analytic Network Process, a decision support system or a model dedicated to the assessment and quantification of the elements of organizational and managerial nature typical of SMEs in the engineering industry.

Keywords: ANP, Decision Support System, MCDA, Managerial skills.

1. INTRODUCTION

The model is a useful support to managers in the process of cultural revolution of the company management.

In fact, it is essential to have tools to highlight the strengths of the company which should be properly defended and supported as well as the weak points on which to intervene (Black and Gregersen, 2002).

In particular, we analyzed two different approaches, the first which shifts the attention to the monitoring elements of the so-called intangible assets, which are knowledge and skills that the company has (intangible resources), essentially establishing a set of indicators capable of measuring these elements.

The second approach, on the contrary, realizes the measurement of qualitative factors, not only the business activity in line with company-wide implementation of the concept of total quality.

Therefore it was, then necessary to identify variables which articulate the qualitative survey. These variables have been properly organized in a checklist divided into different hierarchical levels.

In particular in this work we have applied Multicriteria decision-making techniques that are suitable for such studies, in fact, they have been developed specifically to tackle problems where we must choose between a number of alternatives based on multiple attributes of various nature (Marakas, 1999).

The aim of our work is the realization of an instrument to measure the adequacy of the company with respect to qualitative parameters.

In particular, we have developed a model based on the Analytic Network Process to assess the managerial skills, in detail:

- **Business and strategic skills.**
- **Organizational and managerial skills.**

The method used allows us to evaluate different solutions and gives us the opportunity to choose the best one (Finan and Hurley, 2002).

The implementation of ANP allows us:

- To build a model that helps to measure and synthesize a large number of factors in complex decisions in an industrial plant.
- To take the best decision in relation to a multitude of targets allowing the decision maker the measure and the summary of the different factors / criteria or sub-criteria.

The assessment of qualitative factors, not necessarily subject to a numerical quantification is extremely delicate and in some ways too complex (De Felice, Falcone and Duraccio, 2000).

Thus, after having built the model to decrease the subjectivity and partiality of the evaluations made, we introduced the new indicators that take into account the characteristics and complexity of the main intangible assets:

- **GP index** - Global Productivity index (ie, system performance).
- **EA index** - Effective company Actions index (ie, make the right decisions).
- **CP index** – Company Profitability index (or ability to generate resources).

2. METHODOLOGY STRUCTURE

The accurate analysis of the quality of a company requires an analysis of the problem divided into elements which gradually decrease and are more easily measurable (Hult, Ketchen and Reus, 2001).

In order to create a discrimination between the elements, one of the most important problems that had to be overcome during the construction of the model was the identification of specific weights for the elements.

We concentrated our attention on the monitoring of the elements of a qualitative nature. We developed a model for the recognition of aspects of organizational management within the company. The steps we developed for the realization of the final model are:

1. Obtain the data, formulation and analysis of the problem.
2. Identify critical variables for the assessment (organized in a specific check-list).
3. Build multiattribute models. In particular, a model is proposed that provides for the allocation of various resources needed to quantify the organizational and managerial elements typical of a business.
4. Solve the problem using the ANP technique.
5. Construction of indicators summarizing the criteria, which are then combined to quantitatively assess each alternative. We performed a preliminary statistical analysis of these indicators and then carried out separate ranking for each criterion to study the behavior of areas in respect to individual aspects considered.

The goal was to develop a model able to describe how it should be organized according to a holistic concept, a company. The set of factors represented in the diagram, determine how the company should operate **(**Kanungo, Sharma and Jain, 2001).

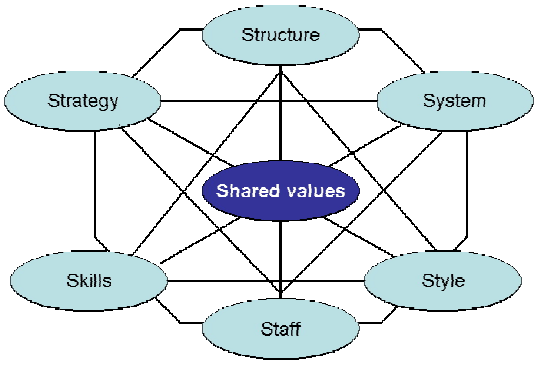

Figure 1: 7S model - holistic concepts

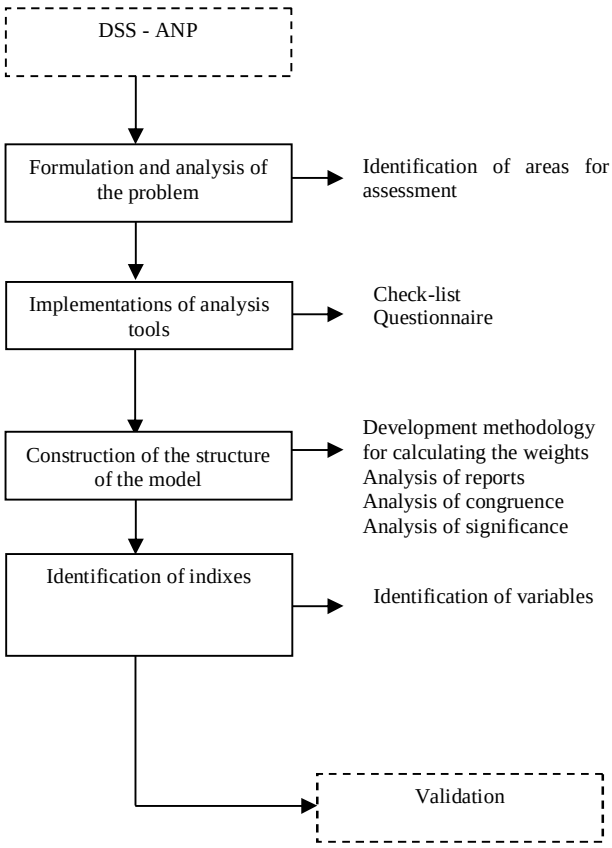

Figure 2: Phases of methodology

3. DEVELOPMENT OF METHODOLOGY

It is obvious that any analysis tool is to take note of the state of affairs and to measure the severity when it occurs (Olson and Courtney, 1997).

In fact, by knowing the problem you can find the solution.

At this point, we identified the areas of investigation relating to the organization and management of companies on which to focus our attention (Biggiero and Laise, 2003).

In this way we were able to identify a set of variables representative of the phenomenon in question worthy of consideration.

These same variables were organized into distinct and homogeneous groups according to the scope assigned to them.

Parallel to this analysis, we tried to identify an important discrimination between the variables in question, developing a methodology which would give different weights, and thus the priorities, the same variables.

The problem was addressed by involving experts in the field, explored their views and used them to assign weights to different variables.

3.1. Formulation and analysis of the problem

The analysis of the particular sector (engineering) led to identify that one of the main criticism is wide and low propensity to programming, a general approximation,

inadequate management and a company that remains more theoretical than an abstraction effective in practice, under which powers and responsibilities are focused, not always positively, in the figure of the entrepreneur (Humphreys, Ayestaren, McCosh and Mayon-White, 1997).

3.2. Implementation of analysis tools

To meet the challenge of managing an enterprise management means having tools that allow not only to have a precise view of the current situation, but mainly put in place the necessary measures that the situation requires (Lofti and Pegels, 1996).

In particularly, to establish a formal structure for the model we split the problem in different areas of inquiry and discover and emphasize the critical elements .

The problem, therefore, is twofold: firstly, it is necessary to identify the various elements of the phenomenon under study (in our case the essential elements of the organization and management of a metal) but at the same time we also need to try to quantify the presence of such elements within a business (Menkes, 2005).

Hence the creation of two different tools, **checklists and semi structured questionnaires.**

Check List

In particular, we used a check-list, formed from the variables identified and appropriately articulated on different levels, each incorporating progressively fewer elements.

At this point we prepared a questionnaire designed to enable us to detect those same variables in the company.

For each answer of the questionnaire there was a match score.

In practice, to obtain a rating of adequate quality standards the organization must have a proper management and an appropriate range of skills available to the entrepreneur.

This finding made sure that our investigation went along in two main strands: first we needed to deepen the theme of entrepreneurship, on the other hand it was necessary to clarify what factors could make the appropriate organization and management.

Specifically, then, it was necessary to create a list of variables to monitor.

Table 1: Check List

VARIABLES	
Business and strategic skills	**Organizational and managerial skills**
1 KNOW-HOW **Basic Training** Degrees Other securities Foreign languages **Further knowledge** Computer skills Knowledge of financial instruments Knowledge of bank risk Knowledge rules **Experience in the field** Activities in technical roles Activities in administrative roles Activities in managerial roles	**1. ORGANIZATIONAL CAPACITY** **Awareness of tasks and Individual responsibility** Presence organigramme Analysis of job profiles **Coordination capacity** Use of specific procedures Coordination meetings
2. CAPACITY 'OF BUSINESS DEVELOPMENT **Capacity analysis of market dynamics** **Analysis of external factors** Proper positioning of the company Identifying the strengths of the company **Market positioning and prospects business** Volume production the last three years Volume production next two years Quality Certifications Ability to diversify market Strategies of specialization Diversification strategies / action to the Global service Internationalization	**2. CAPACITY MANAGEMENT** **Planning and management control** System programming of activities System management control Checking the progress of work **Management of supplies** Criteria for the selection of Suppliers Quality control procedures **Human resource management** Staff training Adoption of an incentive system **Information System** Use of software for the management Using software to manage and control ICT deployment
3. STRATEGIC CAPACITY **Ability to establish financial strategies** Propensity to collaborate with banks Financing Project financing **Networking capability** Participation in consortia Propensity to cooperate Relationship for Innovation Universities	

In the check list we identified two main sections:

- **Business and strategic skills.** The fate of the small enterprise is inextricably linked to the ability of the entrepreneur: the emphasis has been on issues such as basic education.
- **Organizational and managerial capacity.** A key step consisted in taking as reference those elements that usually are considered as characteristic of a proper organization and proper management not just a building company but, more generally, any type of company.

We divided each of these sections into smaller elements, the expression of different areas which could, at least ideally, represent the two aspects of the subject.

The result was the splitting of the two sections, and therefore the check-list, on different hierarchical levels so as to determine the weights to be attributed to individual variables, each incorporating a number of elements, all pertaining to the same area of investigation and gradually becoming narrower.

These variables were then subject to verification of **congruence** (ie capacity to represent the object of analysis), **significance** (to verify the actual usefulness of these variables in determining the rating), and **relational checks** (in order to group similar variables and avoid repeatedly analyzing the same variable).

Questionnaire

The other essential tool of investigation used in our model is the questionnaire, the implementation which could only take place after completing the checklist.

The choice of the questionnaire is obvious: only the entrepreneur responding to the questions could provide the information necessary to draw a general picture of its modus operating within the company (Senge, 2006).

Among the various alternatives available, the choice finally fell upon a **semi-structured questionnaire** in which the questions are defined and not the sequence.

For the development of this instrument, however, we tried to allow those who had the task of providing a response to individual questions to be clear about the objectives of the questionnaire, trying to avoid any ambiguity that could undermine the effective validity of responses provided by the entrepreneur (Strebel, 2003).

The purpose of the questionnaire was to outline the profile of the manager in order to determine strengths and weaknesses.

We identified three distinct profiles: **blue, red and green.**

We interviewed the manager and we asked to choose 10 points in the questionnaire below that best represents them.

Table 2: Questionnaire

	PROFILE BLUE	PROFILE RED	PROFILE GREEN
HARD SKILLS	I comparisons I am practical I want evidence I arrive at a conclusion quickly	I am ordained and organized I love the details and facts I love order and categories I seek accuracy and precision	I make many suggestions I always find a solution I have different points of view I turn problems into opportunities
SOFT SKILLS	I am emotionally involved I am guided and I am motivated by personal values I am passionate I take commitments	I am sensitive and aware of other people I love to listen and observe I find posts and interpretations beyond words I relation with other people	I follow my instinct I imagine the future I explore possible scenarios I have new ideas
PROFILE DESCRIPTION	Not interested in the details. Very quick decisions. He lives in the past. **Characterizing words:** Action, Rating, Passion Comparison **Characterizing question:** WHAT IS RIGHT?	Interested in analyzing data to examine the situation. Not quick decisions. **Characterizing words:** Application, Facts, Information, Communication **Characterizing question:** WHAT IS TRUE?	He lives in the future. Innovator. **Characterizing words:** Ideas, improvement, change, vision **Characterizing question:** WHAT IS NEW?

Here below is an example of a profile to apply to our case study in which we marked the chosen options.

Table 3: Example of Answers to the Questionnaire

I comparisons (8) I am practical I want evidence I arrive at a conclusion quickly (2)	I am ordained and organized I love the details and facts I love order and categories (9) I seek accuracy and precision	I make many suggestions I always find a solution (10) I have different points of view (6) I turn problems into opportunities

I am emotionally involved (4) I am guided and I am motivated by personal values I am passionate I take commitments	I am sensitive and aware of other people I love to listen and observe (5) I find posts and interpretations beyond words (1)	I follow my instinct I imagine the future (3) I explore possible scenarios (7) I have new ideas

At this point we constructed the table of points that defines the details of the profile.

Table 4: Example of profile

	PROFILE BLUE	PROFILE RED	PROFILE GREEN	TOTAL
HARD SKILLS	2	1	2	5
SOFT SKILLS	1	2	3	6
TOTAL	3	3	5	

In the specific example the resulting "optimal" profile is a GREEN characterized by a balance of HARD SKILLS (with shades of both blue and green) and SOFT SKILLS (with shades of red profile).

Obviously the profile is just one example related to our case study.

There is no fair result and no wrong result (Igbavia and Baroudi, 1993). The validity of detection of the profile is closely linked to the specific needs (identified through the check list).

3.3. Construction of the structure of the model

The use of methods of multicriteria analysis is explained in the above-mentioned requirement to obtain a numerical assessment on the representative of the various components, highly qualitative.

Our aim is to construct a scale of priorities among the various actions that employers should put in at to improve the condition of its company (De Felice, Falcone, Silvestri and Petrillo, 2005).

We first define our problem (Initialization).

Made the checklist and the questionnaire corresponding to the retrieval of information, it was immediately noted that not all items were marked as important for achieving a better quality rating.

It was necessary to develop a methodology that allowed us to highlight the differences, especially in a non-numerical exaggerate disadvantage in the trial, companies which did not note abundant elements not considered of primary importance (Saaty and Peniwati, 2007).

In the end, we chose the technique ANP - Analytic Network Process.

The Analytic Network Process allows to outline a problem in network. This is one of the salient features of this technique. The methodology is particularly useful for the calculation of the weights to be attributed to the individual elements that define the problem.

The Analytic Network Process is a methodology which is a generalization of Analytic Hierarchy Process, (Saaty, 2001) a method to aid decision based on multiple selection criteria (MCDA, Multi-Criteria Decision Aid) developed by Thomas Lorie Saaty in the late 70s (Saaty, 2005) in fact, similar to the theory of AHP, the ANP is a multi-methodology, which is used to obtain scale of priorities by individual assessments.

Unlike the usual yes-no, by the logic or 0-1, the APN is a logical multi assessment.

The scale used in ANP allows different intensities and establishes priorities that indicate a range of possibilities for our preferences, compared to the classical zero (not preferred) or a (preferred) in traditional logic.

A single number is used to represent an evaluation of preference between two elements.

To date, there are many examples of applying the method to problems of evaluation in many different areas.

The first step of the methodology involves the construction of the network decision-making.

A network is a structure comprising multiple alternative decision-making and the objective assessment of general or goal.

All components of the network are compared in pairs with each other.

This comparison (Barzilai, 1998) is made in order to determine which is more important in relation to the overriding and to what extent the result of the comparison is the so-called dominance coefficient Aij, which represents an estimate of the dominance of the first element (s) compared to second (j).

To determine the values of the coefficients Aij it is necessary to express opinions of the elements compared (Leskinen, 2000). The ratings are expressed through the *Semantics scale of Saaty*, which brings together the first nine integers with as many opinions which express, in qualitative terms, the possible results of the comparison.

Table 2: Semantics scale of Saaty

INTENSITY OF IMPORTANCE a_{ij}	DEFINITION	EXPLANATION
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another

INTENSITY OF IMPORTANCE a_{ij}	DEFINITION	EXPLANATION
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	For compromise between the above values	Sometimes one needs to interpolate a compromise judgment numerically because there is no good word to describe it

The analysis conducted by the two survey instruments allowed us to identify the network that best describes our goal, or the improvement of entrepreneurial skills.

Furthermore, the comparison in pairs between the various components allowed us to assign weights to the individual elements of the checklist.

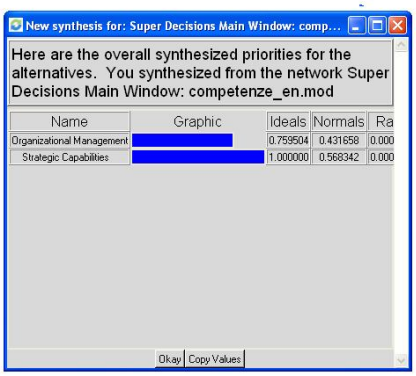

Figure 3: Priority vector - Synthesis Analysis

The analysis showed that the most critical parameter to monitor is the **strategic capabilities**, or a "good" manager should have an overall vision to be able to react to events and predict the future.

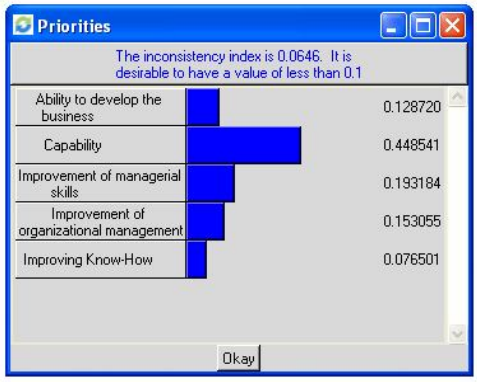

Figure 4: Index of inconsistency for the cluster Alternative

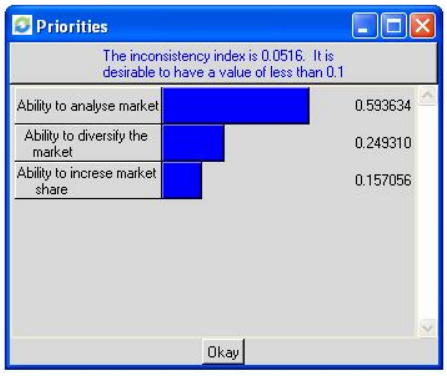

Figure 5: Index of inconsistency for the cluster Ability to develop business

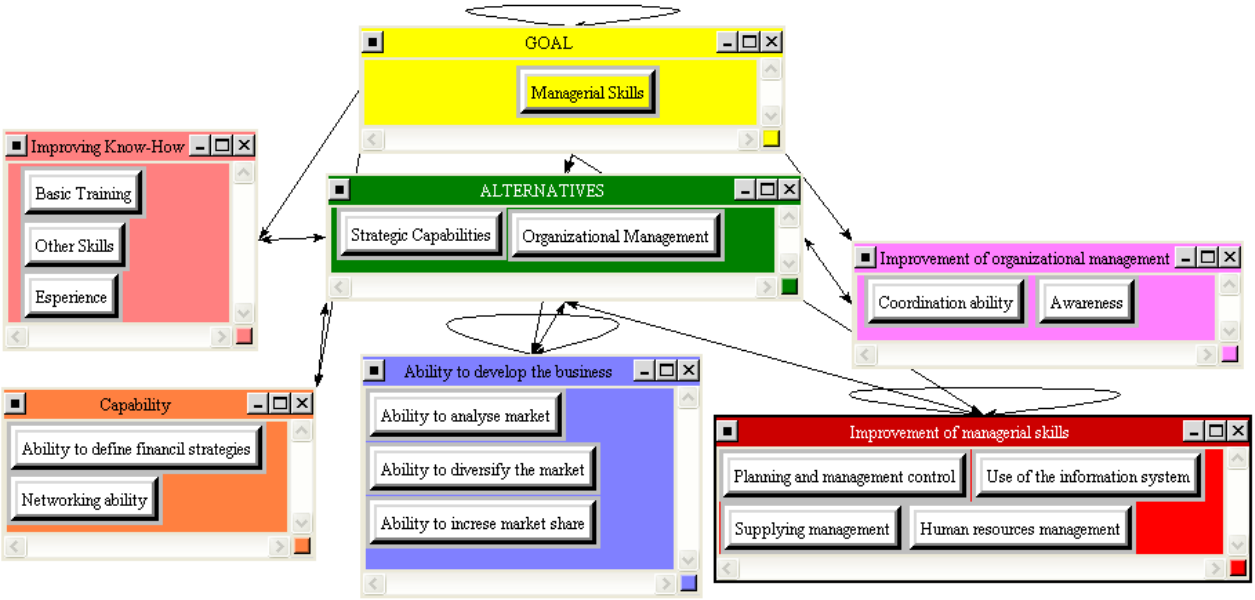

Figure 6: ANP Model

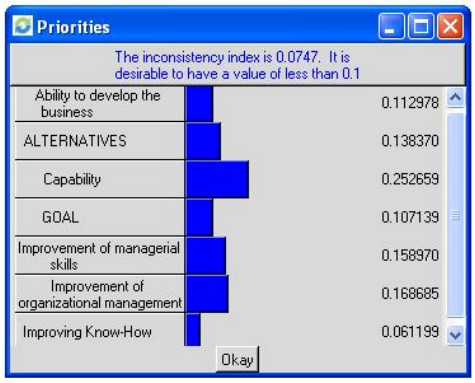

Figure 7: Index of inconsistency for the cluster Goal

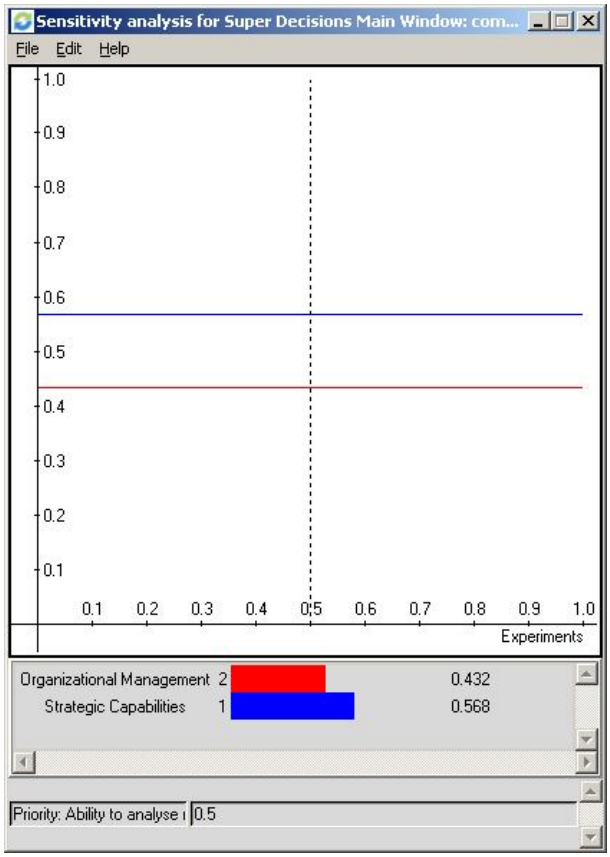

Figure 8: Sensitivity Analysis

The results show the prevalence of the human factor, and thus entrepreneurial skills, the organization formalized.

This is, in effect, an entirely predictable outcome considering that the scope of analysis is that SMEs in the engineering industry, rarely has formal organizational structures and its core is the figure of the entrepreneur.

The choice of weights, therefore, appears to be fully in line with the current situation of the sector, and of the Italian enterprise in general.

It is also clear that the amount of weight could certainly change if the size of the company changed.

Owing to the company size, the wise use of a distinction between different roles is a primary and, likewise, the means of planning and management become increasingly sophisticated.

Another element that certainly could influence the choice of weights is the story of the companies.

Certainly, in new companies, the spirit of new entrepreneur is the key driver and the main resource, in addition to the capital available for the development of the company.

Ultimately our aim was to construct a scale of priorities among the various actions that managers should put in act to improve the condition of its company.

We did not want, therefore, simply to compare different alternatives, but we highlighted the more or less importance of the variables we took into consideration when building the model.

All items in question were selected because they were considered significant in the determination of a trial on the qualitative aspects of the company.

3.4. Identification of indixes

To obtain a synthetic view on the qualitative aspects first reported and to allow benchmarking between businesses, similarly, the most effective seems to be to try to express that same opinion at issue in numerical form.

This is what we tried to do in our model, in the manner that is exposed below.

In summary, since the measure of performance is an issue for the company as a whole, at this point we completed the model by introducing some of the indices.

The indicators chosen are those considered significant in the determination of a trial on the qualitative aspects of the company, that is:

PG Index – Global Productivity (ie, system performance).

The PG index compares the change in production (index of quantity of production) with the variation of inputs (index of quantity of inputs).

The measure of "global productivity" is a partial measure of the performances of a production system, which must include additional parameters such as innovation, flexibility, quality, service.

In particular, we considered it appropriate to introduce the other two indexes.

EA Index – Effective Company Action (ie, make the right decisions).

The EA index is a measure of business investment in R & D than the market share obtained.

Finally, another index is introduced:

RA Index – Company Profitability (or ability to generate resources).

This index represents the net operating margin Report / Third party interest + Capital Equity.

It is also obvious, however, that not all these elements have the same importance for the determination of the proceedings in question.

Hence arose the need to create a system of weights that would make it possible to highlight and measure the global performances of a company.

In this respect we introduced evaluation criteria based on the scores tied to annual performance improvement that the company will record.

In the tables below you can examine the type of analysis chosen by us.

Table 3: Evaluation criteria

Parameter	% Annual increase	Score
PG Index	15-20	100
	25-35	150
	> 35	200
EA Index	15-20	70
	25-35	90
	> 35	110
RA Index	15-20	60
	25-35	105
	> 35	115

Table 4: Rating globale

Judgement	Range	Global Assessment
Low	0-230	**"Managing unsuitable"** Little ability to promote effective and efficient. Little aptitude for decision making
Medium	230-345	**"Suitable management"** Good management skills
High	345-425	**"Excellent management"** Synergistic vision of the various business aspects Ability to choose between the best alternatives

The control of corporate performance aims to bring the company to improve the ability to adjust its performance.

Establish objectives, budgets, operational plans, and then measure the performance.

We need a monitoring system to measure the degree of achievement of objectives.

This check will cover the overall result for a given period of time.

The monitoring of performance is used to influence policy making and implementation of the objectives only indirectly.

It sets general objectives that should be borne in mind when you take decisions.

There is an increasing need for systems of performance measurement able to give proper emphasis to the actual mix of inputs.

Often the common understanding of performance is compared to the efficiency of direct employment, which tends to take marginal importance compared to other inputs, its a "global productivity", as the productivity of materials, labour and indirect capital invested in stocks and resources.

Monitoring the performance allows us to consider:

1. The effectiveness of the company, that is doing the right thing.
2. Efficiency, that is optimize the ratio of resources consumed and results achieved;
3. The quality, the complex systems used by management.
4. Productivity or the ratio between input and output.
5. The welfare of those who work in the company.
6. Innovation.
7. Profitability.
8. Adaptability, the ability to address business changes.

4. CONCLUSIONS

This work is based upon the awareness that the success of an enterprise can not be the result of chance, it must rest on a solid foundation of sound management and organization on one hand, and on adequate knowledge and important skills.

Therefore we need an accurate and systemic interpretative model and measure performance to achieve the desired results.

The aim must be the development of measurement techniques and strong rating, able to grasp the "ranking" effective interest alternatives, and then measure the degree of proximity in respect to an ideal or satisfactory condition.

Indeed, while stressing the importance of good management, however adequate managerial tools and methodologies tailored to specific needs do not exist.

Therefore tools are needed to determine the skills gap (that is, training needs) that companies must overcome to improve their level of competitiveness.

The present work emphasizes the importance of an assessment that goes beyond the current methods usually applied.

We have therefore developed a model that integrates to qualitative as well as quantitative methodologies.

In particular the ANP made it possible to bind the rigorous quantitative and subjective sensitivity aspects.

The trial network will be assumed that any system is analyzed as a set of events or rather the ANP method is based on the recognition that a system is simplified, by reducing its complexity to a series of ever-smaller components, placed in the network .

In this way it was possible to establish a numerical relation (in the sense of allocating priorities and relative weights) between elements of the network.

The ANP leads to the development of alternative forecast scenarios by which the analyst can imagine the trend lines for developing the system of the subject, from the choices and the strategies selected by the relevant actors.

The ANP allows us to build a network between issue and areas of interest with respect to which the actor can " optimize" the process of allocation and planning.

Our intention was to create an assessment tool that could have a scope as wide as possible and then, at least in our expectations, independent of the type of company analyzed.

Ultimately we can conclude by saying that the model developed allows us to achieve excellence in various aspects of a business:

1. **Results orientation:** the Excellence is achieving results that satisfy all the stakeholders of the organization.
2. **Leadership and Constancy of Purpose:** The Excellence in leadership is visionary and inspiring, coupled with constancy of purpose.
3. **Process Management:** Excellence is to manage the organization through a number of systems, processes and interdependent and interrelated facts.

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