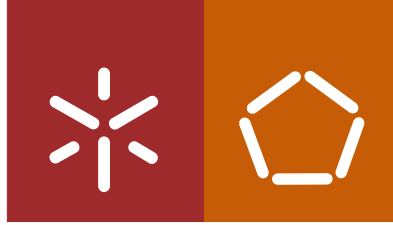**Universidade do Minho**
Escola de Engenharia

Itilde Landim Martins

**Using Balanced Scorecards to Evaluate
the Data Warehouse System Utility**

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Universidade do Minho
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Using Balanced Scorecards to Evaluate the Data Warehouse System Utility

Master Degree in Systems Engineering

Developed under the supervision of:
Professor Orlando Manuel de Oliveira Belo
Professor Claudio Alves

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Resumo

Utilização dos *Balanced Scorecards* na Avaliação da Utilidade de um Sistema Data Warehouse

O principal objetivo deste projeto é fazer uma avaliação da utilidade dos sistemas de *data warehousing utilizando balanced scorecards* como ferramenta de gestão de desempenho e de utilidade. Este processo é descrito pela análise das quatro perspetivas dos *balanced scorecards*: perspetiva financeira, dos clientes, dos processos internos, e da aprendizagem e crescimento. A avaliação tem como objetivo medir e otimizar o grau de utilidade que a implementação de um sistema *data warehousing* proporciona às organizações. Os *Balanced Scorecards (BSC)* são uma ferramenta recente e eficaz, com grande potencial para ajudar as empresas a evidenciaram as informações mais importantes das suas estratégias. Esta ferramenta de gestão estratégica, identificada muitas vezes como gestora de desempenhos, quando associada a um sistema de *data warehousing* permite medir e melhorar a sua utilidade, com base numa estratégia claramente articulada e em sintonia com a estratégia organizacional. Esta ferramenta associada ao sistemas de *data warehousing* permitirá às empresas articular a sua estratégia de negócios, alinhar o negócio de acordo com a sua estratégia, identificar os seus principais indicadores de desempenhos e acompanhar o seu progresso. Isso tudo com o intuito de proporcionar aos gestores uma melhor plataforma para o desenvolvimento dos seus processos de tomada de decisão.

Abstract

Using Balanced Scorecards to Evaluate the Data Warehouse System Utility

The main objective of this project is to evaluate the usefulness of the data warehousing systems using balanced scorecards as a management tool for performance and utility. This process is described through the analysis of four perspectives of balanced scorecards: a financial perspective, customer, internal processes, and learning and growth. The evaluation aims to measure and optimize the degree of utility that implementing a data warehousing system provides to organizations. The Balanced Scorecard (BSC) is a recent and powerful tool, with great potential to help companies highlight the most important information in their strategies. This strategic management tool, often identified as the manager of performance, when combined with a data warehousing system allows us to measure and improve their utility, based on a clearly articulated strategy and in line with organizational strategy. This tool combined with data warehousing systems enable companies to articulate their business strategy, align business in accordance with its strategy, identify the key performance indicators and monitor their progress. All this, in order to give the managers a better platform to develop their decision-making processes.

Índice

Abbreviations

A

ABM - Activity-Based Management

B

BSC - Balanced Scorecards

D

DBMS - Database Management System

DW - Data Warehousing

DWS - Data Warehousing System

E

ERP - Enterprise Resource Planning

ETL - Extract, Transform and Load

G

GCH - Human Capital Management

I

IT - Information Technology

ISS - Information System Success

M

MBNQA - Malcolm Baldrige National Quality Award

MIS - Management Information Processing

Q
QMPMS - Quantitative Models for Performance Measurement System

T

TAM - Technology Acceptance Model

TTF - Task Technology Fit

S
SIM - Society Information Management

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Chapter 1

Introduction

1.1 Management Information Systems

Many transformations occurred inside business environments causing large changes in their own organizations. With the goal to improve competitive conditions, products and services quality, and consequentially the profit, today's companies' managers need new alternatives that allow them to evaluate their own performance. There are a lot of technical and scientific researchers, like Kaplan and Norton (Kaplan & Norton, 1997b), Headley (Headley, 1998) or Norreklit (Norreklit, 2000), that verified the faults and the weaknesses of traditional management information systems. Such transformations have made business management processes facing new challenges, which impose to managers to work with the new decision models, large numbers of methods, and techniques and approaches. This tests managers' ability in the accomplishment of such goals, making them to see what is relevant, and most importantly how to implement these "new management tendencies" and get positive results (Catelli, 1999). At this point, researchers observed weak relationships between objectives and strategic goals. They also noticed that such weakness did not allow a correct strategy evaluation, saying that it's an indispensable factor for todays' companies' success. Kaplan and Norton (2000a) affirmed that short-term indicators, which were used in traditional systems, are not enough to measure business performance, because they only provide conclusions

for historical perspectives. Another point was the probability of such indicators does not consider the organization of the own assets, which increasingly bring a greater contribution and a greater added value (Garcia and Alvarez, 2000).

Nowadays, we must note the fact that companies are forced to survive in a very competitive and globalized market, with new managing business trends, such as innovation and quality of employees, which make possible to organizations update their management information systems. For companies that deal daily with a lot of business issues, with vital decisions to be taken, all this leads to new strategic challenges, arising from globalized activities and higher demands of customers. According to Salas and Garcia (Salas & Garcia 1999), to follow economic developments, companies need to improve their economic efficiency. But others authors, such as Kudo (Kudo, 2003), affirm that the performance optimization will only be achieved with innovation, creativity, differentiation and strategic management models, which imposes the need to implement new performance evaluation systems inside companies. Companies' managers must understand the new challenges of today, as well as the culture of a poor performance evaluation on older companies.

The concept of Balanced Scorecards (BSC) has being used as a methodology that allows for managers to evaluate systems performance. Currently, a high amount of companies have already implemented them, and those who have not done yet are planning the implementation, just because the practice of modern methods is based in management strategy (Pedro, 2004). In this project, BSC will be applied to evaluate the utility of a Data Warehousing System (DWS). They will provide the translation of the vision and the strategy of a set performance measures that will help DWS implementation in business scenarios. Thus, it's important to design a DWS project sustaining its main objective using BSC for evaluating it.

1.2 Using Balanced Scorecards for Evaluating the Utility of a Data Warehousing System

Kaplan and Norton (Kaplan & Norton 1992) asserted that Balanced Scorecards are a common management tool used in business by enterprises to evaluate their business performance when using modern practices such as a management-oriented strategy. Later, Pedro (Pedro, 2004) complemented this idea saying that almost all public in general and private companies are using or planning to use the BSC methodology to evaluate their own performance.

In the globalized world we live, recognized frequently as the knowledge world, data is growing-up more and more inside organizations multiplying their data-sources day after day, the ease of gathering and transforming large amounts of data into relevant business information, are today one of most difficult function to execute for any company. To make data useful for themselves, they need to use strategic plans to support strategic decisions, in order to get very competitive advantages. Of course, that appropriated technology tools must support this. The objective is to let companies organize all that data, in order to get some additional information and contribution in the development of strategic actions for business support. These data sources normally produced by Enterprise Resource Planning (ERP) systems and other additional external sources, make companies to make significant efforts and investments in the use of tools and methodologies such BSC. The goal is simply to optimize, monitor and follow systems utility.

BSC (Kaplan & Norton, 1992) were developed by the Professors Robert Kaplan and David Norton in the early of 1990s, as a result of a study they conducted in several companies. At the time, they aimed was to improve the concept of control system beyond of the traditional financial indicators in many ways, including information like the follow:

- Financial and non-financial.
- Internal and external.
- About business performance.
- About current results and the future of the companies.

According to Pedro (Pedro, 2004), BSC goals go far beyond of what can be extracted from a set of business indicators. The author says that when the methodology is applied properly, it enables organizational transformations towards the specialization of the processes, such as:

- Creating an integral vision of the organization and its current situation.

- Looking forward and in a proactive way.

- Aligning the organizational structure.

- Establishing initiatives towards prioritizing a strategic direction.

- Influencing the behaviour of key people.

BSC can be viewed as an interactive construction process performed by organizational managers, and guided by experienced consultants. All the perspectives must support each other, and the weakness of one perspective may bring a negative influence on all other company strategies implementation. For many years, databases were the only source for information storage used by companies to support their decision-making processes. But, over the years, it was noted that it was not enough to sustain by itself a business decision.

DWS have emerged as another component to store information aiming to provide a very specialize data source, containing historical data, integrated and non-volatile, which faithfully represent the current state of an organization, helping to support more effective decision-making processes. In DWS technical communities there are essentially two different approaches for implementing a DWS. W. Inmon (W. Inmon, 1996) presented one, which is more focused on data, whilst R. Kimball (R. Kimball, 1998) presented a second one, which is more focused on DWS projects. Both approaches are useful and valid. However, the approach promoted by Kimball has gained greater acceptance by professional of the domain. DWS have become a technology-based structure in decision making for companies' managers. Yet, the utility of a DWS continues to be quite unmeasured in most practical cases. The cause of this is that information technology managers do not have adequate resources to evaluate the benefits of a DWS. Therefore, it's necessary to have some means and measures to evaluate such utility (Kaplan and Norton, 1993). These authors agree that most managers concerns are about how to monitor and ensure that their goals and strategies will be achieved by implementing a BSC methodology. In a period where the strategic agility deserves a high level of investment, a lot of doubts are emerging, namely:

- How we confirm that a strategy set is correct?

- How we check if it does not need corrections to its settings?

In this context, BSC appear as a support tool to optimize and monitor the progress of decisions-taken in order to evaluate the utility of a DWS. In the center of BSC are the definitions for the strategic approach adopted or what you pretend to adapt. Around of a BSC are identified four points that must be work together to ensure and guaranty the success and accomplishment of the goals established. Those points are: financial, internal processes, customers, and learning and growth (Kaplan & Norton, 2001). However, Bensberg (Bensberg, 2003) claims that the financial perspective describes the financial characteristics that must be achieved with the implementation of BSC, so that the strategy considered be a success in the evaluation of systems utilities. This is a preparation for the development of a financial plan that will show the amount of resources that must be invested and the return of the investment planned. The same author also said that internal processes involve processes inside the companies that need to work together for accomplish targets. This point also involves understanding current processes, identifying the interdependence areas and construction processes in a specific way to comprehend new demands.

On the customers' perspective, the author pronounces that we must worried in answering "how" customers, internal and external, will understand the new products and services strategy. Thus, it is essential that the project team will apply a considerable effort to work out some expedite ways to increase an accurate perception of customers about advantages. Finally, in the last perspective - learning and growth - the author stated that those are issues that involve the evaluation of internal knowledge and capability in developing new projects. The project cost involving BSC is obviously variable, and it's determined by factors such as firm size, the information technology tools involved etc.

According to Oliveira (Oliveira, 2001) using BSC impose a clear rule that must be followed: all strategic goals must have their own objectives, indicators, targets well defined and explicit, so that measures can be objectively quantified. Kaplan and Norton (Kaplan & Norton, 1996a) added that one of the reasons that can lead to the implementation of BSC is the need to evaluate the utility of a DWS, and achieve positive results. The accuracy of model will reside in the establishment of the cause-effect relationship between the strategic objectives set by the organization. In addition, BSC links also promote consistency between objectives and indicators, targets and actions, which are needed to reach them.

1.3 Organization of the Document

Beyond this first chapter, this dissertation it was organized into four more chapters, namely:

- **Chapter 2** – *Balanced Scorecards*. In this chapter it will be presented the most relevant theoretical aspects and the terminology used with *Balanced Scorecards*, as well its principles, mains objectives, and how it must work as a methodology for clarification and communication of a management strategy.

- **Chapter 3** – *Data Warehousing Utility Evaluation*. This third chapter presents some essential concepts to understand the utility of a DWS, discusses some relevant strategies and methodologies to measure and assess its performance, and presents a specific set of cases of using BSC, giving a particular reference to its application in Portugal.

- **Chapter 4** – *Evaluating the Utility of a DWS*. Here it will be presented and discussed BSC implementation in the evaluation of the utility of a DWS. A specific case study was selected, and all the steps followed in the BSC application process are described and analysed.

- **Chapter 5** – *Conclusions and Future Work*. A brief summary of the work done is presented in this chapter, as well as the main conclusion, discussing general characteristics of BSC application, its advantages and limitations according what it was performed in the context of this study. Additionally, some recommendations for future work are also pointed out.

Chapter 2

Balanced Scorecards

2.1. Some initial concepts

According to Pinto (Pinto, 2007), business managers for a long time are evaluating their performances based exclusively on some financial indicators such as profit, cash flow, profitability, return of investment, etc. This author added that although in the 50's years managers realized they had to go a little bit beyond financial indicators, but the "boom" of awakening only happened in 80's years with a profound revelation in business models, economy and company management. The non-financial indicators, such as the value of a brand, the customer relationships, the organizational culture, among others, are clear aspects to take into consideration in the evaluation of the performance of an organization.

After that, companies could no longer fail considering just non-financial indicators in their evaluation processes. This outcome was reported by Robert Eccles (Robert Eccles, 1991). This author said that the revolutions begun long time before the 80's years. For him, for a long time, managers from different business contexts, have had a great progress thinking about how was best way to evaluate their own performances. They realized that the best way to succeed required a new system for evaluating performance. From there, the managers come to recognize that this new concept of performance evaluation had several focus like indicators for financial vision, and

that in union with others concepts could be better for the processes mediations. Thus, we can conclude that at the beginning of the 1990s companies had already made up their criticism about new business concepts, new competitiveness perspectives, and the importance of building new strategies to evaluate performances. In this context, companies now were able to escape to trends and some of them have already adapted to new forms of performance evaluation. But, Pinto (Pinto, 2007) states that the most important thing to consider in this process were the doubts that started to emerge, and some pertinent questions like:

- How to follow these changes?
- What kind of methodologies to use?

With that, started to emerge news methodologies in the market with the goal to help business managers to solve their own problems in evaluating performance. However, face to this new challenge, managers had difficulties with the complexity in managing their own companies. They wanted simple but robust and consistent models, so they can handle changes.

At this point, the managers of those big firms who have high business level, a lot of employees, hundreds of information systems, realize that the *Balanced Scorecard* arise in the right time, and it may be help in the resolutions of they own problems.

BSC initial concepts emerged in 1992 by Kaplan and Norton (Kaplan & Norton, 1992). At that time, those concepts were very poor when compared to the current ones. The objective set at the time by Kaplan and Norton was to group performance indicators in four perspectives: financial, customers, internal processes, and finally learning and growth. Kaplan and Norton introduced the cause-effect relationship after the release of their first book, in 1996. This relationship was described by the authors as an "if then" relation (Kaplan & Norton, 1996). In that book, Kaplan and Norton showed that performance indicators must follow the managers' strategy. But the book did not present a clear reference about the cause-effect relationships, how they must be applied, or if they must be applied only for the strategic objectives, or not. With the publication of the second book, new concepts have emerged about strategic maps. After this, BSC were been known for all worldwide companies as a strategic management methodology. This knowledge increased a lot the level of acceptance of business managers. Many authors have been studying BSC since then, through entities that makes programming and certification tools of *Balanced Scorecards Collaborative Information Technology*. This phase of BSC matches with the time when managers present major concerns about how to monitor, ensure and confirm that the strategic objectives are

being met, at a time when the followed strategy faces a noted contrast with questions like: "How to ensure that the strategy advanced correct?" and, "How to verify that the default strategy does not need corrections?"

The methodology of Kaplan and Norton began to be tested by several companies between 1992's and 1996's. After that period, in 2001 the methodology won a remarkable evaluation over the world, and in the next year it was already possible to present a list of several companies that adopted the methodology. In one of their conferences, Kaplan and Norton said that BSC was the result of a study called "Measuring Performance in the Futures Organizations" conducted during one year, and based on the foundations who show that financial indicators are not enough to evaluate business performance, and create values for business future. David Norton, an executive of Nolan Norton Institute at that time, who worked with Robert Kaplan, a Professor of the Harvard University, led the study. A comparative scorecard used by an American company, Analog Devices, supported the study. Besides financial indicators, this company also used customer satisfaction and product quality indicators to evaluate its performance. The strategy used by Analog Devices, together with other ideas, contributed significantly to the emergence of BSC. The study required that business performance have to be aligned with the strategies defined by the company. So many managers were sure that financial indicators used for many years by several companies were no longer appropriate to the new context of the business world. This was reinforced by the concepts of BSC, which support that it is necessary to integrate and "balancing" many indicators during any business performance evaluation process. The model presented by BSC is seeing as an easy methodology to use, and easily understood by managers. But, at the same time, it was also characterized as a model with great consistency, especially for being identified as a model capable to cause interaction between all the indicators involved.

Kaplan and Norton (Kaplan & Norton, 1997a) said that BSC are much more than a simple relationship between markets, because this methodology allows for a better clarification and communication of a strategy defined by a company. After this, BSC has never stopped since 1996's. Kaplan and Norton published another article in a prestigious American Magazine, titled "Using the Balanced Scorecard as a Strategic Management System" [Kaplan & Norton, 1996b]. The BSC methodology becomes a centre of an organizational management system. At this time, many authors and researchers have based their studies in the work of Kaplan and Norton, developing their ideas about BSC. The concept of a BSC spread a lot, having many definitions and different opinions from many researchers. For Oliveira et al. (Oliveira et al., 2000), for instance, BSC are a

methodology that allows companies to outline a path to follow, trying to trail a strategy, not walking away from it. Following this line of thought, Josep Huertas et al., (2001) said that BSC are a methodology that establishes a balance between a path set by a company and a proposed strategy. Later, Ramos and Gonçalves (Ramos & Gonçalves, 2002) added that BSC identify the situations to invest, what it takes to create added values, which markets to conquer. For theses authors this is a methodology that provides to business a bather defined view about the external and internal economy. But for Feijóo and Souto (Feijóo & Souto, 2000), BSC are constructed using financial and non-financial indicators, having the goal to achieve consistent results taking into account all dimensions of the methodology.

BSC is focused on multiple perspectives, very distinct and connected with business activities, which provide the advantage, that it cannot make confusion inside those multiple perspectives (Betancourt, 1999). With this, as many others authors, Kaplan and Norton (Kaplan & Norton, 1997) complemented their definition adding that BSC makes the "balance" between the short term objectives and long term objectives, such as the evaluation of financial indicators and historical information of forecasts, and between different views (internal and external). After all, the use of non-financial measures is not a new concept. General Electric Company use them since the 1950's years (Norrekilit, 2000). But this is not the only concept that is not new. According to (Davila, 1999) at the beginning of the twentieth century, several companies that invested on innovation were already using innovative control systems combining financial and non-financial indicators. The difference between these systems and BSC are the cause-effect relationship, because each measure is part of a selected element in the chain of a relationship, allowing for managers to know the meaning of the strategy that the organization has adopted (Kaplan and Norton, 1997; Rocha, 2000). Kaplan and Norton (Kaplan & Norton, 1997a) affirmed that BSC consists in a set of dimensions that make rapid and complete approach to the business of a company. This set of dimensions is part of the financial and non-financial measures. So, financial dimensions can bring conclusions like the taken actions. The non-financial dimensions can bring conclusions related to customers' satisfaction or internal processes improvements. BSC have the advantage for allowing managers to make organizational studies based on four different perspectives: financial, customers, internal processes, and learning and growth. Pinto (Pinto, 2007) said that these perspectives must answer to the following questions:

- In order to be financially successful, how we must be seen by our investors?
- To accomplish our vision, how we must be seen by our customers?

- To satisfy our investors and customers, in which processes we have to be great?
- In order to achieve our vision, how can we develop capacities for changes and growth?
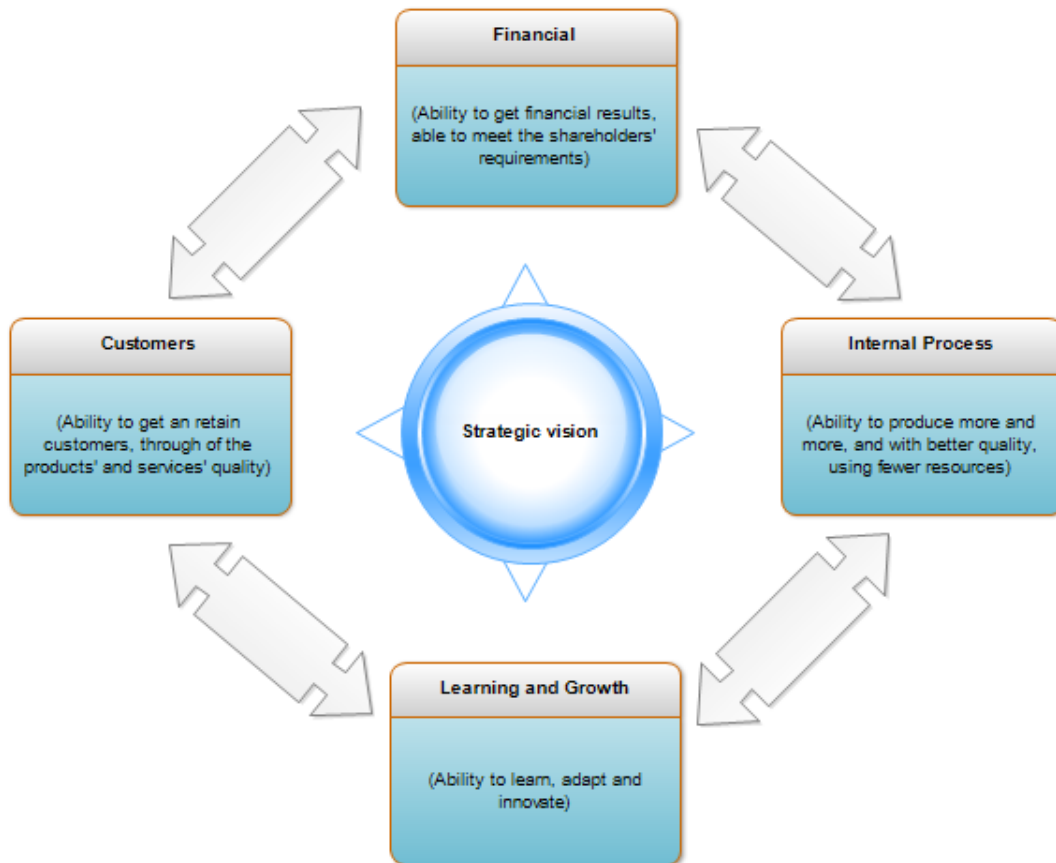
Figure 1 – Balanced Scorecards - adapted from Kaplan and Norton (1996b)

BSC allows for reducing the amount of the traffic aiming using the system with the necessary number of dimensions, which makes managers to focus their attentions in what it is indispensable for business, allowing managers to satisfy their own needs. BSC also allows for managers to use a single management system where they can join multiple perspectives, or separate the organizational goals to evaluate separately, enabling a greater customer orientation and improving products and service quality. In another scenario, BSC provide managers to do analysis integrating all the important analysis dimensions, trying to study if one dimension back progress bring positive or negative consequences for the others. This result can only be achieved with the cause-effect relationship. For Gendron (Gendron, 1997), BSC allow you to define and reconstruct the strategies defined in order to follow some path defined, and also transfer a long-term strategy for several business areas, at specific points to be achieved. But Negre and Urieta (Negre & Urieta, 2003) see

BSC as a set of management strategy indicators, this provides essentials aspects to link the managers' objectives. They are the mission and vision, and the short-term and long-term objectives.

In (Fernandez, 2002) it is referred that a strategic vision can be achieved through the implementation of BSC. The author also affirmed that with BSC implementation companies could develop and communicate the adopted strategy. According to Salas and Gracia (Salas & Gracia, 1999), a BSC implementation must take into account two key points in the construction of its objectives. These two key points are: to translate the business strategy, and to translate the business vision. BSC must do precise translations with the objective that these may be evaluated (Bourguignon et al., 2004). BSC are part of a strategic formulation, allowing for managers to articulate the objectives of companies with human resources, contributing to motivations and trainings (Salas et al., 2001).

The BSC are much more than the four perspectives, because these perspectives provide information about the most important aspects about the company. A BSC allows managers to known the business strategy story through long-term objectives of the financial perspective, relating them to the other perspectives (customers, internal processes and learning and growth), as well as their objectives (Kaplan & Norton, 1997b).

Some other authors performed many experiments in several companies, confirmed that besides business performance evaluation, the BSC methodology can also be used as a management system, since it allows for the strategic processes identification. When a company presents the four performance perspectives well balanced, the company can be considered that will meet strategic objectives (Campos, 1998). The strategic vision is the centre of BSC. It controls all the strategic system. Although, and in addition to the strategic vision, the system still needs the four perspectives. The most modern companies are using BSC as a strategic management control system, since the methodology aroused the interest of managers through as a new way to approach business using the referred four perspectives.

The four BSC perspectives can be analysed separately or together. The perspectives are used to link long-term indicators to short-term indicators. Many companies that use BSC as a control system, based mostly in a single indicator (finance), they cannot measure the business progress (or failure), evaluate human resources, customer relation, and other factors that are important to measure. For each one of the four perspectives, companies must use their strategic vision in order

to align the process of strategic objectives formulation for these views (Olive, 1999; Roy & Wetter, 1999). In this context, Campos (Campos, 1998) said that BSC prioritize their services, and with this prioritization in the first place, the strategy must be defined. And when it is defined correctly the management systems alignment problems can be solved whit the orientation between the strategies defined by long-term, and the results obtained in short–term objectives. Olive, Roy and Wetter (Olive, Roy & Wetter, 1999) point out the following topics as the main advantages gained by implementing a BSC methodology:

- Allow managers to more easily control their own performance.
- See in separately way the advantage of human resources for the company.
- Review the customer relationship with the shareholders based on new information and communication technologies, relating future benefits.
- Mentalize the organization' investors, shareholders and stakeholders that not all investments will bring benefits, profits to the company and in the same time reduce costs.

A BSC translates the business strategic vision based on measurable objectives accordingly to four perspectives (financial, customers, internal processes, and learning and growth), differencing them in order to articulate their organization processes. If we observe this sequence of organizational perspectives, we can see that there is a line of thinking in the organization. The financial perspective is followed by the customer perspective, then by the internal processes perspective and, finally, by the learning and growth one (Mâsih, 1999). The biggest concerns referred by most managers about BSC perspectives are (Kaplan & Norton, 1997b):

- The four perspectives predefined by the authors Kaplan and Norton, are enough?
- There is possible to add more perspectives, or we need to use always the same perspectives?

In one of the conferences about BSC, presented by Kaplan and Norton in 1997s, it was stated that the four predefined perspectives have given satisfactory results for companies, because they have been adapted for many others in different business sectors (Kaplan & Norton, 1997b). The authors also asserted that the four perspectives must be considered as a methodology, and not as a factor that must be followed correctly. This, because there is no mathematical model from which can be shown that the four perspectives must be followed and if they are enough.

Kaplan and Norton said on (Kaplan & Norton, 1997b) that so far they had not found examples of companies using fewer than four perspectives. However, taking into consideration the types of companies, the objectives and the business types, maybe it will be necessary more than four perspectives, in order to complement the existing ones (Kaplan & Norton, 1997b). There is an example cited by many authors in the literature to illustrate the creation of a complimentary perspective. The example is about a situation that a chemical sector, which had a big concern for environmental issues. This company add a complementary perspective, in order to measure its performance. According to managers of the companies for such sector, the environmental performance is an essential reason for the success or failure of their companies.

The original Kaplan and Norton's methodology, with four perspectives, brings more added values to companies, when compared to companies that prefer to add more perspectives, which can bring disadvantage and contribute to creating disorder among many different perspectives (Olve, Weteer & Roy, 1999). Something that must be clear, is that managers choose the perspectives they want, but, the four perspectives allow managers to focus their attention on what is really important to their company. Another important concern about the perspectives of BSC is that indicators must be aligned to the measures used in each one of the perspectives. Many authors indicate that each perspective must contain at most a set of four or five indicators to measure, because many indicators of measurement can cause a huge set of indicators, complicating the process of collecting the final results.

2.2. Principles of Balanced Scorecards

To translate a strategic vision into measurable results, BSC must support its processes accordingly three fundamental principles, namely: cause-effect relationships, results and performance indicators, and the relationship with financial objectives.

2.2.1 Cause-Effect Relationships

This cause-effect relationship is what makes the difference between BSC and similarly methodologies, not differentiating that use multiple performance indicators or those that only use financial indicators (Kaplan & Norton, 1998a). This is the most important aspect in the development and certification of a strategic process. Figure 2, shows the chain of operations for this type of relationship in the BSC context. Cause-effect relationship works almost like a study where the main objective is to confirm if BSC are able to achieve some predefined objectives for

the company strategy. The objectives predefined by a company and the introduction of BSC should help it to achieve its final goals – the company strategic vision. In addition to cause-effect relationship another purpose emerges: the description of company's history for stakeholders.

This type of relationship between these multiple perspectives was developed right from the beginning, aligned with the first ideas about BSC, monitored throughout his journey and evolution. Initially many innovative companies that have implemented the methodology had a lot of problems in implementing the cause-effect relationship, since many of the relations were not perceived, much less reported (Pinto, 2007). This author adds that with the advent of BSC, new concepts were emerged, as was the case of strategic maps. Kaplan and Norton classified these maps as an equivalent to the methodology itself, bringing a crucial advantage for the methodology, as regards the spread and success of BSC, and also to exclude some problems of their implementation and initial relation.
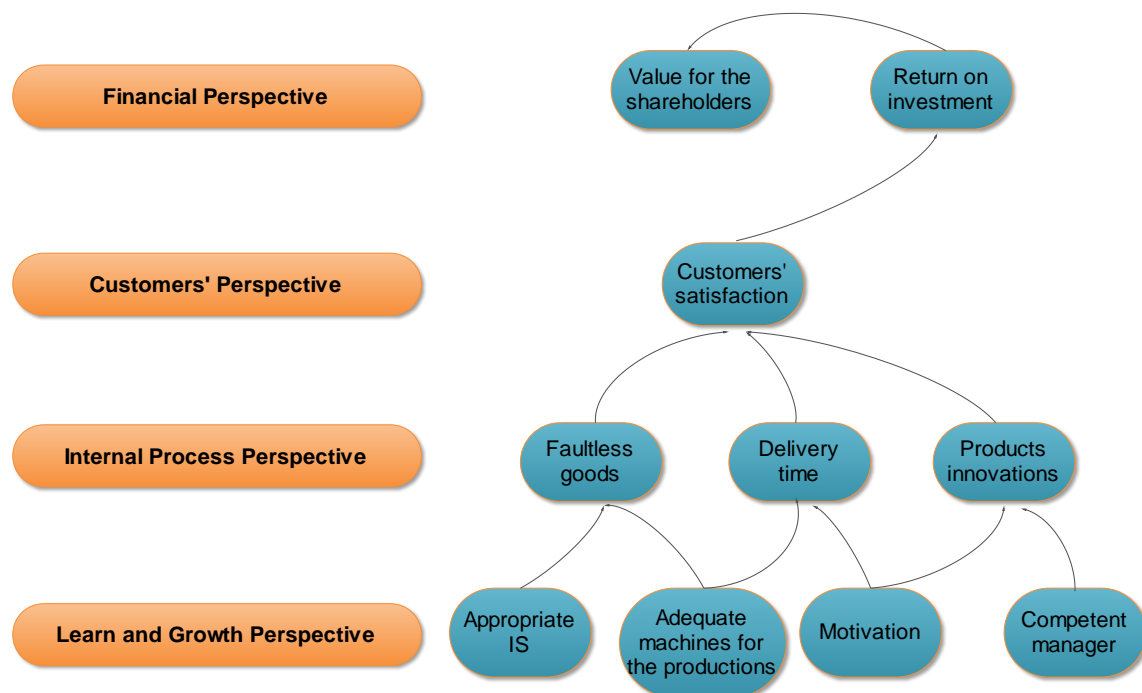
Figure 2 – The cause-effect relationship **-** adapted from (Kaplan & Norton, 1998a)

Norrekilt (2000) said that cause-effect relationships are a thinkable idea allowing for managers to make prognostics of financial and non-financial indicators. He added also that the biggest problem using cause-effect relationship in BSC is trying to build casual relationships.

2.2.2 Results and the performance indicators

Two types of performance indicators must compose the final results of a BSC: lagging indicators and leading indicators (Figuiredo, 2002). For this author, such indicators together are part of a combination required to translate the strategy into objectives. If this combination does not conferring, researchers will be unable to prove the results achieved. The BSC methodology refers to the "balance" between the established paths for different types of business objectives: short-term and long-term, financial and non-financial, leading and lagging indicators, based on the study of internal and external performance (Kaplan & Norton, 1996a).

One of BSC' objectives is to analyze the business strategy in a logical way, based on the strategic objectives predefined by a company, which will consequently result in performance indicators. In this context, the strategic objectives construction and the performance indicators of BSC are identified as the central action in implementing this methodology, and one of the main objectives is precisely to align the development of the strategic processes with the reality of business. Following this line of thinking, the strategic objective can be defined as: "A purpose is a consistent explanation, which lists the ways to go and everything you need to perform, so that construction of strategic goal is possible" (Santos, 2006). The author referred also that the lagging indicators are characterized by evaluating only successful events already in the past. BSC have another advantage over existing methodologies: they complement the insufficiency of the assessment made by the indicators (lagging indicators) (Santos, 2006). Thus, we can say that the inducers indicators (lead) are the cause or the origin, and the indicators (lag) are the effect or the purpose.
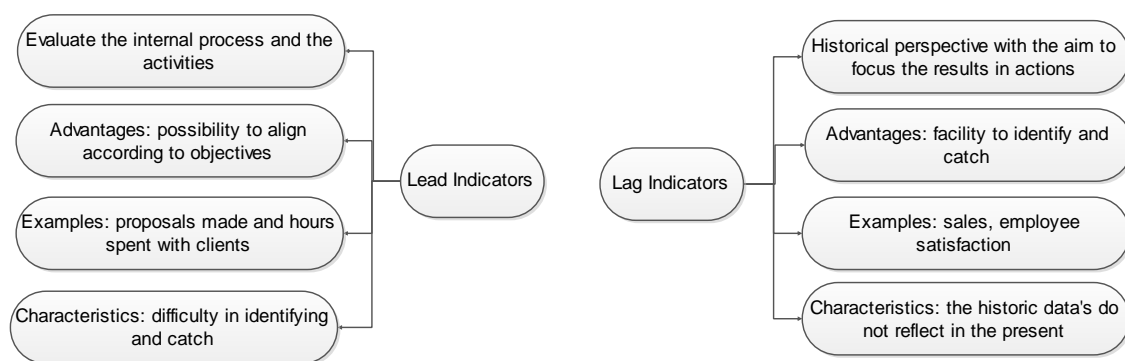
Figure 3 - The results of performance inductors – extracted from (Santos, 2006)

2.2.3 Financial Objectives Relationships

For Giollo (Giollo, 2002), today's companies have more concerns about the quality issues or differentiations between services and products sold, and the customer satisfaction. But, for other authors, including Kaplan and Norton, all these factors are important, but alone they are not enough to evaluate business performance.

They are very critical authors defending eliminations of financial indicators, because in most cases involving customer satisfaction, they will be involved contributing positively to the final result and these results are consequentially unreal. BSC must attach more importance on the chain, financial results, and also in the recovery of the invested capital. Giollo (2002) also refers that another important factor is the relationship that must exist in the quality projects, reengineering and delegation of the competence, once these factors relate directly to financial indicators. BSC should also connect and analyze all the guidelines, casual or not, between BSC measures and financial objectives.

2.2.4 Balanced Scorecards Objectives

BSC are a methodology used as a management system in a business strategy. One of the essential objectives of this methodology is the translation and clarifications of strategic objectives, communications and alignment of objectives and indicators, as well as the alignment between strategic ideas and the learning feedback (Kaplan & Norton, 1997a).

Figure 4 – The objectives of BSC - adapted from (Kaplan and Norton, 1997a)

The results that all the managers will want with the implementation of BSC are that the company will be exactly the reflex of predefined strategy (Kaplan & Norton, 2000). However, to achieve this reflation, all company's constituents, from human resources, managers, suppliers, etc., must be aware of the objectives and working accordingly. But for collective objectives we need a plan for effective communication strategy, aiming clarifying stakeholders about the impact that each one of them has in company, and how to use it in favor of the final goal (Kaplan & Norton, 2000a).

Based in several studies of companies that implemented BSC having satisfactory results, Kaplan and Norton (2000a) identified five points in common in the companies that were studied, namely that they:

1. Convert the strategic idea in operational processes.
2. Align the company with its strategy.
3. Restructure the strategic objectives as common goals.
4. Identify the strategic objectives as a continuous process.
5. Responsible managers for mobilizing changes.

The conversion of a strategic idea in a strategic measurements and specific objectives is the first step to be performed during the implementation of BSC (Giollo, 2002; Olson & Slater, 2002). The strategic vision is the core process of the BSC methodology (Moore et al., 2001). [Kaplna & Norton, 1997b], many managers will never reach a consensus about the strategic objectives that they want to adopt. (Carvalho & Azevedo, 2001), also says that many of these case of no agreement on the managers part has theirs origins in factors related to business history and culture. BSC make quite evident such situations, which consequently turns out to be the solution of the problem itself. An important factor to focus here is that the strategy, in most cases, is developed by a set of managers for all departments, which in such situation demystify the problem so that all constituents of companies do not participate in the decision-making process (Kaplan and Norton, 1997b). The development of a shared vision concept is essential for the development of a strategic and a continuous process (Madeira, 2000). In this context, the strategic objective becomes a common concern for all human resources inside a company, participating in important decisions for the strategic management based on the teams (Kaplan & Norton, 1997b).

2.2.5 Communication and connection between the strategic objectives and strategic indicators

There are a several ways to communicate the strategic objectives to the human resources of a company. The most trivial ones are warnings, warning letters, newsletters, notifications, or the most innovative and commons videos and emails used nowadays (Rocha, 2000). (Oyon & Mooraj, 2001), (Figueiredo, 2002), and (Giollo, 2002) add that such communication must be made to all company's constituents, explaining the objectives intended with the planned strategy.

Many managers demystify the overall strategic objectives in departmental objectives, in order to simplify communication for employees (Niven, 2003). The author adds that employees will have more opportunity to review the concepts behind the strategy, and face the predict changes in the future. (Kaplan & Norton, 1997a) claimed that BSC provide a healthy dialogue between employees and managers, as well between them and top managers. In conclusion, we can say that at the end of this strategic communication process, in a long-term, there will be a link between all the constituents of the company.

2.2.6 Planning Objectives and Alignment of Strategic Initiatives

BSC will bring more advantages for the company to lead them to achieve a positive change. Strategies must not be presented for a period not exceeding five years, and if the company achieves the desired goals, they will be an added value to company (Figueiredo, 2002). The strategic objectives are all interrelated. The learning and growth objectives reinforce the objectives of internal processes, being these two the basis for the strategic objectives of customers. Without all these goals will be no possible to achieve the financial targets (Giollo, 2002). BSC help managers in the integration of the strategic plan and developing the budget plan (Kaplan & Norton, 1997a). (Carvalho & Azevedo, 2001) and (Giollo, 2002) reinforce this adding that when planning strategic objectives, companies have the opportunity to quantify the results they want to achieve in long-term, making the identification of resources that will be necessary for the goals met, and analyze the financial and non-financial indicators.

2.2.7 A Shared Vision

After all we presented discussed till now, we can only reach one conclusion: BSC are a company's shared vision. Goals, targets and indicators of BSC have the primary function of communicating these objectives, aligning the company to monitor focusing on strategy. According to many authors, including Kaplan and Norton, the shared vision of BSC is a central point for a learning strategy. This has an important advantage for companies, which is the fact that defines and clarifies the objectives that all companies need.

2.2.8 Strategic Feedback

At this stage, a BSC development must be cultivate a feedback process to strategy, in order to make a clear analysis, a thorough evaluation, and finally the evaluation of the changes in assumptions incorporated in the business' strategy. Many examples of strategic feedback may be cited when applying cause-effect relationships, because they allow managers to establish short-term and long-term goals. These goals, at the end of a period, allow managers to check through the feedback they have received, if they have been accomplished or not.

2.2.9 Strategy for All

Base on the book presented by (Kaplan & Norton, 2000a), "The Strategy-focused Organization: How Balanced Scorecard Companies Thrive in the New Business Environment", the understood concept resides in the sentence: "strategy for all". Later, in a next publication, they brought the new and revolutionary concept of strategic map. The central idea here was to make companies realize that strategic management adapts to all of them without exception. This idea (Kaplan & Norton, 1997b) was the second, best view of the application of BSC as a methodology to communicate strategy, and not as a methodology to evaluate strategy.

2.3 The Four Perspectives of Balanced Scorecards

BSC are composed for four perspectives, which are considered as the pillars that serve as the foundations for a future business success.

2.3.1 The Financial Perspective

From very early, corporate managers realized that the prospect of a financial business strategy is one of the most important sectors. The building process of BSC is one more incentive for companies, which helps them in the adjustment of business financial objectives. All others perspectives of BSC use the financial perspective to measure itself. Any measure that is selected must be a constituent of the cause-effect relationship, so it can be combine with the best performance in the financial perspective across the strategy' communication of a business sector. (Kaplan & Norton, 1997a) A BSC should tell the story of the strategy of the company that was followed. This story should be started by the long-term objectives for the financial perspective, making relations with the sequence of actions that must be considered with regard to financial processes of each one other perspectives (customers, internal processes, and learning and growth), that at the end of long-term can achieve the desired economic performance. However, many companies adopt the strategy where common goals are divided into departmental objectives. Thus, each business unit will be responsible for achieved a return of "x%" on the invested capital across the company. From another point of view, an organization can implement an economic plan, where each department is forced to achieve periodically his economic added value (Kaplan & Norton, 2001). Kaplan and Norton considered this second principle as feasible, consistent and fair, taking into consideration that departments' managers can be evaluated based on the measure used to evaluate the return.

The authors also stated that the drawback of this guideline is that inside de financial perspective, it cannot be recognized when a different department of company is using different business strategies, or a different measuring unit. So, it's necessary that one measure and one objective used in a business unit must be appropriated for other department. With that, it is presumed to be necessary that department managers identify the appropriate financial measure that will implement the strategy at the beginning of the financial perspective development for BSC.

The goals and the financial measures have a dual role: describe the required performance of the financial perspectives with the implementation of the strategy, acting as the main objective for common measures and objectives to all other BSC perspectives (Kaplan and Norton, 2000a). In private companies, the desired objectives are those who answer the following question: "How should we be seen by our investors?" (Pedro, 2004). According to this author, the financial perspective gets a different approach in accordance with each company involved. So, this approach may be differentiated, taking into account if the company is a public or a private nonprofit organization.

Kaplan and Norton affirm that financial indicators emphasize immediately the results of the actions consumed, referring also that financial indicators allow mangers to see if their strategies are contributing to better results or not. The financial objectives are redefined in every life cycle of a particular company (Kaplan & Norton, 2000a). They described this life cycle in three distinct phases: growth, maintenance, and return. According to those authors, these life cycles, classification is essential for BSC development, and that must be well-matched with the predefined strategies. For theses authors, many companies make mistakes during the process of articulating goals. One of the most common mistakes is that managers forget to link financial goals with other variables, which are not belonging to the financial strategies (Kaplan & Norton, 1997b). BSC select and remove this fail, aligning the objectives and targets with financial indicators that are based on tangible values, since these are essential to produce financial results. The alignment between the objectives is done through the cause-effect relationship. This is the most basic and essential characteristic for managers during a BSC implementation process.

2.3.2 The Customer Perspective

In the customer perspective of a BSC company managers must define the customers segment that they want to cover accordingly the availability of their products and services, and identify the markets where they wants to approach. The customer perspective is as important as the financial perspective. Once the segments identified, it's the customer perspective that will produce the component of profits for the goals defined by the financial perspective. This allows managers to commit the mediation of results, relating them to customers in a particular customer segment of market through several aspects like customer satisfaction, customer retention, or profit. In addition, this perspective also enables managers to make a clear identification and evaluation of added values targeted to these segments (Pinto, 2007).

Before, companies could afford to focus on their internal capabilities, through the relationships between product performance and technological advancement. But, it didn't take a long time for business managers realize that companies who did not know their customers, sooner or later their competitors will take their customers, offerings products and services that satisfy better their preferences. Many companies spent much time worrying about their suppliers and trying to have the greatest relationship between the company and its suppliers, forgetting that they are suppliers of its customers. Bensberg (2003) calls for not contesting the validation of statements that inspire employees to meet customer needs. It is more than obvious that companies need to offer products

and services that are valued by their customers, in order to obtain the financial performance required at the end of a long-term period. Following the customer perspective, managers must evaluate the assumptions that, besides finding and satisfying them, are crucial points for companies, namely, the translation of the strategic mission into objectives, which must be based on markets and clients. So, in this context, Bensberg (2003) also stated that companies who want to be "everything to every customers", in the end they cannot be "anything for any customers". He also said companies need to recognize their customer segments and potential customers.

Kaplan and Norton (2001) considered that the final report of this perspective should allow mangers to have a clear idea of its segments and markets niches that they intended to approach, and what is the core values that aim to satisfy their customers. These are the strongest points representing marketing, logistics and research needed to develop viable solutions contributing to the business success. However, whatever is the business context or the nature of the profit, the mediation techniques that must be used to evaluate the customer perspective are retention of customer, customer satisfaction, profitability, and customer market share. These mediation techniques can be viewed in Figure 5. Following this line of thought, it's important to note that company's managers must define the objectives they want to be satisfied for each one of the mediation techniques, and what assumptions to be followed for achieving these objectives.
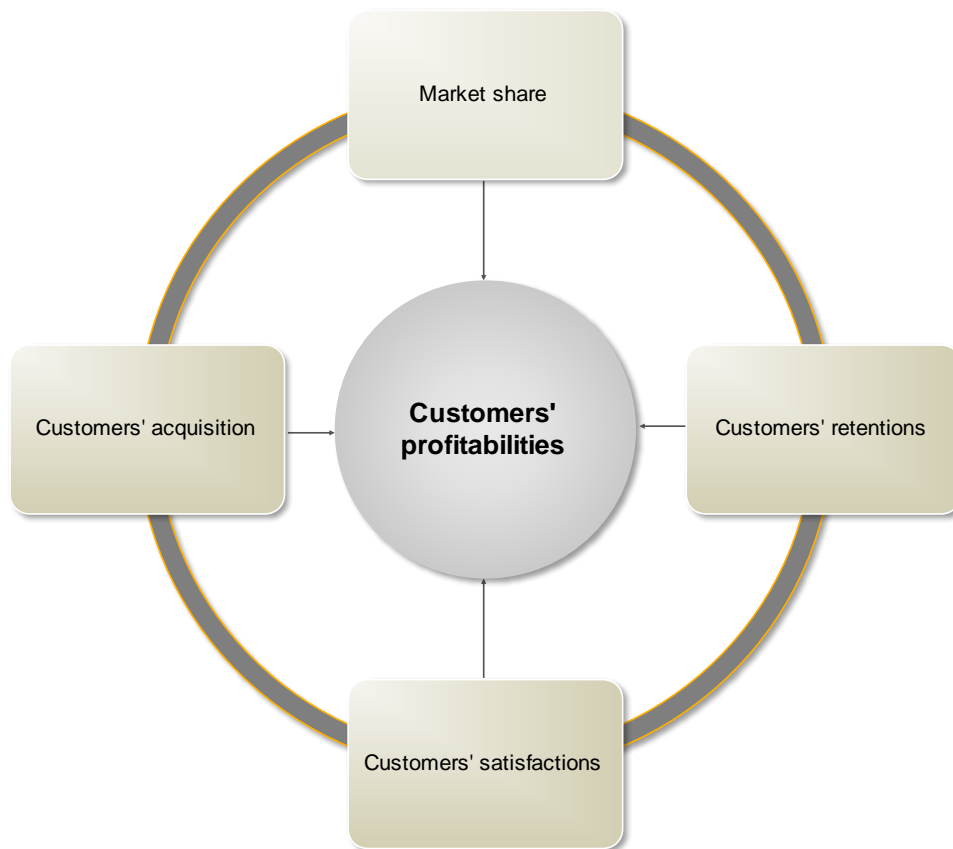
Figure 5 - The relational schema of the customers' perspective - adapted from (Kaplan and Norton, 1997b)

2.3.3 The Internal Process Perspective

In the internal processes perspective business managers identify the most critical processes, in order to accomplish the objectives of customers and investors. Here, managers develop objectives and techniques for the mediation, and make the formulation of objectives for customer and financial perspectives. The formulated sequence allows managers to focus on internal processes objectives, which will take that line to investor and customer objectives (Bensberg, 2003).

The performance evaluation techniques used in the most companies aims to improve existing processes (Kaplan & Norton, 2001). With BSC it's recommended that managers make the definitions of complete values-chain for internal processes, identifying early in the innovation processes (makes the identification of the customer needs, taking into account the current and future products or services developed, to meet their needs), then transaction processes (products

and services that were delivered accordingly the orders of customers), and ends with the post-sale (including post-sale services packages, which complete the cycle of products and services offered to customers).

According to a several authors, such as Richard Gane, Nigel Haigh and Andy O'Brien (2002), the origin of objectives and mediation techniques used for internal process perspective is mostly centered in the difference when we make the comparison between the BSC methodology and others more traditional to evaluate company performance. Managers to control and improve existing sectors and responsibility centers used those older methodologies. In such context, it must be noted that older methodologies produce dependence and limitations on the measure used in financial reports published monthly. Here, added values come from the fact that companies do not use exclusively the reports of financial results as the basic information for evaluation and control. Companies also use quality measures such as production, productivity and the production cycle, as a complement of financial information. (Bensberg, 2003) said that this complementarity in performance evaluation was a huge step forward against the dependence on financial reports, as the only existing information to be used on performance evaluation processes. As well as other criteria it can help to improve the performance of each sector in dealing with integrated business. Thus, these new evaluation forms enable new guidelines, which states the importance of performance measurement and business processes. For Kaplan and Norton, companies of our days have several measures that could be used to evaluate performance, which means a significant advancement compared with other oldest performance measurement systems (Kaplan & Norton, 2000a). But, with the new studies presented by innovative firms, managers were told that even these most current systems had limitations, since non-financial information only by itself do not allow managers to greatly improve economic performance (Kaplan & Norton, 1996). Since all companies want to improve the quality of their products or services, reduce the cycle of production, and at the same time increase the production's level and reduce costs with its processes, it must be noted that the excessive concentration in getting gains in the productions cycles, quality, productivity and costs, does not encourage companies to make individual abilities.

All companies use a particular set of processes in order to generate values for its customers and produce financial results. In this context, it is important to note that a generic value chain serves as a model for companies to adopt and build the Internal Process perspective (Bensberg, 2003). Three general processes compose the chain: innovation, operations, and after-sales services. During the innovation process, the department in charge of this function search for new needs and

emerging trends in their customer segments, planning the development of products and services that meet the needs and monitors trends. This is the way that almost all companies make to evaluate their performance.
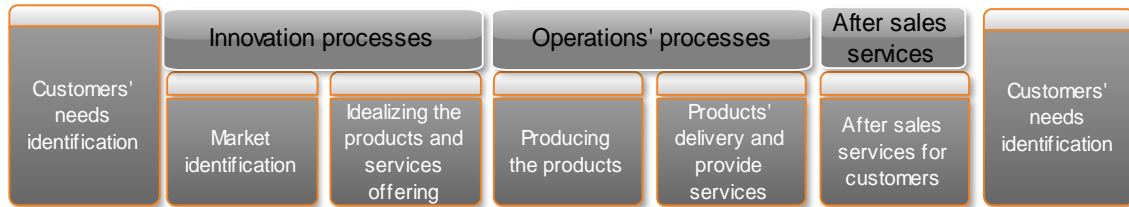
Figure 6 - The internal processes perspective (value-chain model) - adapted from Kaplan and Norton (1997a)

The excellence that companies must present in their operational functions reflects in the reduction of their production cost and delivery services. These two points are the indispensable objectives for a good strategic practice. However, the values-chain presented in Figure 6 does not confirm if that is the most significant, because it shows that operational excellence can have more them the referred components. It can include components based on customer satisfaction and others indexes (Bensberg, 2003). Additionally, the third task in the values-chain is directed proportional to after-sales or service and product delivery. These aspects are covered in internal processes of BSC just if they are important for the companies, assuming that many companies have strategies targeted at this point. As an example, there are a lot of companies operating in devices sales area, technologic systems, or innovations, which offer a lot of updating programs to their customers for using devices and systems, it is made without embarrassment, ensuring that the added values for customers can be the speed on execution tasks, or other benefits. For sure, in the internal processes perspective, managers make the identification of critical processes, and from that they look for the excellence to meet customers and investor's needs. BSC, unlike other conventional methodologies, allow managers to analyze requirements for the performance of internal processes, linking requirements in accordance with the expectations of a particular external participant (Kaplan and Norton, 2001).

2.3.4 The Learning and Growth Perspective

According to (Kaplan & Norton, 1992), the planned objectives and measures selected in the customer and internal processes perspectives must consolidate the default objectives that companies want to meet and achieving success expected. However, multiple changes in business circumstances and the markets changes may be the reason who force companies to be prepared and response those changes, offering customers new products or service, every time there is a new need. Either in the learning and growth perspective as in the internal processes perspective, innovation is the keyword for business success. In both case, in values-chain of both perspectives the innovation is the most strong point that managers must achieve. There are authors that consider the perspective of learning and growth as the future perspective, because this perspective is focused on the skills of company's employees having the goal to encourage, promote and motivate. Here, the added values come from what each employee must develop more of their skills, and learn more and more the innovative techniques, which make them feel more prepared to perform their functions on the company. Those learning processes referred before serve as a guarantee for the innovation process, which is, of course, extremely important (Bensberg, 2003). On the other hand, Pinto (2007) referred that today's companies' managers have a great concern for individual productivity. In this case, companies offer their employees opportunities to learn and develop professionally, contributing to increase the innovation processes at same time they contribute to increase the productivity. Bensberg (2003) specified another point following this perspective, which is the fact that it offers learning and growth to employees. The author considers this advantage as an indirect way to keeping employees in company for much time, contributing consequently to increase the productivity. It is very difficult for managers to increase productivity or even maintain it, with high rate of input and output of employees. In this sense, the output of an employee out of company means that there is an output of an invested capital in their learning.

Chapter 3

Data Warehousing Utility Evaluation

3.1. Data Warehousing Systems Essentials

From very early company managers realized that they need more than paper and write to manage their own company. After a long run, they confirmed that the evolution in information technology has allowed a greater level of sophistication in management processes, and its use to meet business requirements provides us with more knowledge, productivity and profit.

The evolution of the *Data Warehousing Systems* (DWS) is divided into four phases (Ward and Peppard, 2002):

1. 60's - Data processing was the era of information processing.
2. Information systems and management support;
3. Strategic information systems;
4. Capacity management systems.

In the early 70's, a new methodology has emerged as a new type of software called a *Database Management System* (DBMS). Soon this software, which allows us to implement databases, starts to be used. It was used by a large number of companies, with the purpose to using a single data source for the entire business processes (Inmon, 1997). With advances of the *Information Technology* (IT) sector, in the years next, new idea was emerged, with the possibility to use such

data for other purposes. These others purpose is intended to meet the *on-line* transaction processing, high performance, such MIS *(Management Information Processing)* or Management Information Systems, in our days called Decision Support Systems, where the center is the *Data Warehousing.*

Table 1 – The Evolution of Data Warehousing Systems – adapted from (Ward, 2002)

Phases		Characteristics
60's	Data Processing	[Peppard Ward, 2002] Data Processing was the era of information processing. This is associated with the emergence of the first computers, which allowed managers to have more control of their business, and binging productivity gains, once the processes have become automated and the information processed.
70's-80's	Management information system	The second phase started in years 1970's and it was characterized by systems development, with the aim to support companies data register, and information processing, which allowed managers to perform queries and analysis of their information.
80's-90's	Strategic information system	In the third phase we can find the strategic information systems. Here we can underline the high importance given to management information systems. The strategic information systems just emerged because of the attributed to management information system. And then strategic information systems became the basis for decision-making processes for the company managers.
2000's	Capacity information system	The fourth and the last phase, companies already had information systems, which served as the base in strategic decision making for businesses.

Inmon (1997) was one of the first to identify the term data warehousing to refer to large repositories of data. He also emphasized that a *data warehouse* (DW) as a set of database contents, integrated, non-volatile and variable in time, which serves to assist decision-making activities. Based on this definition, Inmon (1997) complemented his idea with the following characteristics for a data warehouse:

- **Organized by content -** a DW is based on business content; it is an organized system populated based on the data that transactional business applications use to deal.
- **Integration -** this is considered one of the most important characteristics of a DW; the integration occurs during the data uploading, from the transactional environment to the DW.

- **Non-volatile -** in transactional environments data are constantly updated; in data warehouses data are loaded (usually in large quantities) by ETL *(*Extract, Transform and Load) processes, staying there for future querying; these data can be accessed during *ad hoc* querying processes promoted and supported by decision-makers, serving as a strategic basis for decision making process.
- **Variable in time -** in a data warehouse data is stored based on a specific time; data refer to a precise period of time well defined, allowing managers to access easily to analysis processes over different application scenarios about a particular subject.

The structure of basic DWS example was presented by (Inmon, 1997), and it is organized as described in figure 7.
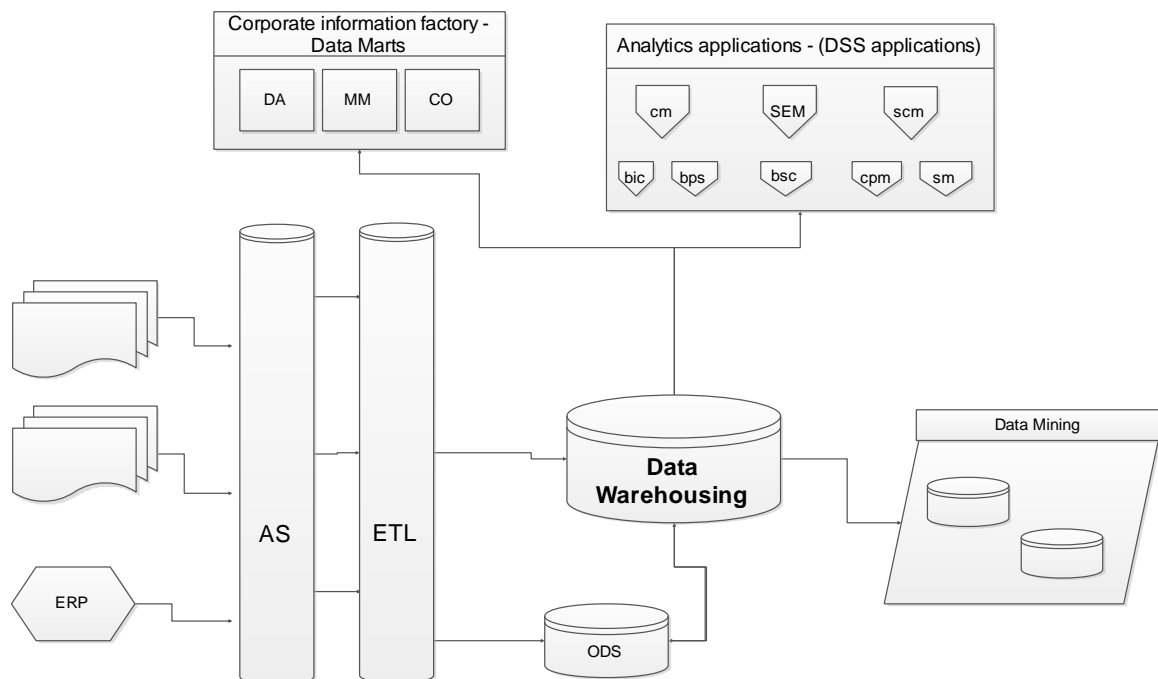
Figure 7 – A DWS functional architecture according to Inmon **-** adapted from (Inmon, 1997)
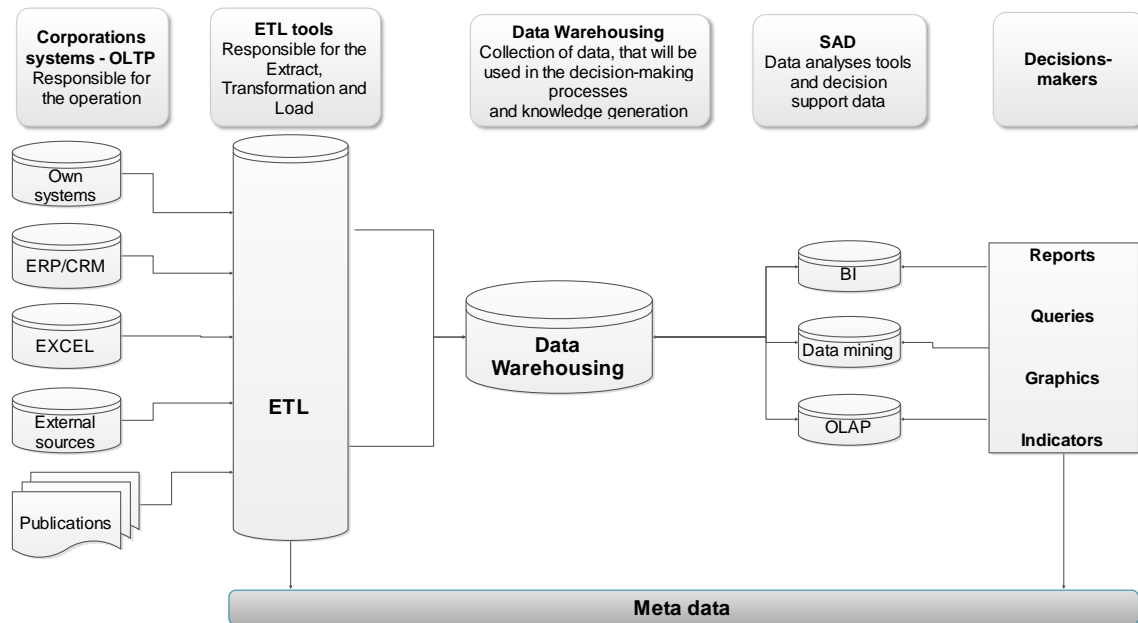
Figure 8 - Overview of a Data Warehousing System - adapted from (Inmon, 1997)

As shown in the Figure 7, the main purpose of a DWS is to create an abstraction layer, where are considered all characteristics already listed before, reflecting all the issues related to an initial plan, requirements analysis and also a strategic business overall view. In this context, a DW can also be defined as a large database, directed to the strategic needs of organizations and decision-making support.

3.1.1   Data Granularity

The main purpose of a DW is to store data in many levels of granularity, making it easier and agile for the decision-making processes at different management levels (Barbieri, 2001). A DWS implementation process depends directly of the level of granularity of the data, once this factor affects directly the amount of data to be stored. Another important factor that affect the granularity is the type of queries that are launched over the DW, which means that the amount of data stored in DW must be built based on the level of detail for those queries. Therefore, queries that require higher levels of detail that that the ones that were defined, risk to be not responding. Inmon (1997) also notes that the most important factor during a DW implementation is the granularity of data. He said, "*The granularity is associated with the level of detail presented in the data units inside DW's structures. The higher is the level of detail, lower is the granularity level. The less is level of detail, higher is the level of granularity*" (Inmon, 1997). In most cases,

companies use two levels of granularity, which must be structured and developed in two layers: one for the data superficially summarized, and another for historical data, that should have more detail. During the development of those two levels of granularity, we can support different queries having a satisfactory level of performance. The analytical processing abilities are proportional to the data summarized, which is frequently compact and ease to access. However, in situations where it is needed a highest level of detail, we have the possibility to analyse historical data. However, this process takes more time and it is more costly to companies (Inmon, 1997).

3.1.2   Metadata

Metadata is the data about data, inside a DW environment. Usually, it is used for:

- Assessment repositories used during the location of components in DW. The repositories are need to help OLAP analysts in the localization and in the selection of appropriate data sets, or appropriate queries to validate and generate business reports.
- Support the process of moving data from operational environments to DW environments.
- Document algorithms used for synthesis process and data derivation.

According to Kimball and Ross (2002) metadata is divided into distinct groups. These groups can be differentiated and identified based in the format of data, having the purpose to meet individual needs for technics, groups of users, managers and also business requirements that led to the DW implementation. For *technics,* metadata sets information about data storage, such as: data sources, current data state (active, history, deleted), statistical reports about data usage, and error reporting and data auditing from DW. The metadata that involves managers can include information used to perform maintenance and the security of the information stored in the DW. This information may look like tools definition, schemes and dimensions hierarchies, requirements for extraction and transformation processes (ETL), cleaning tactics, remove *(purging)* and data backup*,* or user profiles. The business metadata contain information that allows for users to get an overview of the terms and business definitions stored in DW, providing support for interest areas, business requirements and information that make the DW operational.

3.1.3   Some Concepts and Definitions about DW

In simple words, a data warehouse is a large database with the ability to store data from multiple sources, having the aim to integrate the information in a single data repository, based on the business and functional information of a company (Rezende & Abreu, 2003). For Kimball et al., (1998) a data warehouse is "*a collection of tools and technical design, which when applied to specific user needs, and specific databases, will allow the planning and the development of a data warehousing*". The authors underline their definition, saying that a data warehousing system is a place where users can access their information. The main objectives of a DW can be defined through the required objectives and the goals defined by companies' managers. After the emergence of concepts, presented by the authors considered the "fathers" of DW, and the implementation of DW in a lot of companies, several approaches to plan, design and implement DW emerged. Wayne Eckerson (s/d), consultant in the Seybold Group, refers a DW as a process of transforming "fresh" data into usable information by managers and decision-makers of companies, with the aim to assist in decision making processes, providing the best possible information in useful time. DW also allows managers to take advantage of opportunities, seeing things based on its history, subject of analyses and business oriented. Finally, presents the notion of a DW accordingly Laudon and Laudon (1998), which refer a DW as a database that includes tools and methodologies capable to store current and historical data that can be turned into useful information for the company. Many opinions, always a "same" definition.

A DW is a set of new concepts and tools that are indispensable in providing the necessary information to managers, in order to help the companies to survive in markets increasingly competitive [Orr, 2000). This is a system that has a set of rich management tools that allow for aggregating data in an integrated and oriented data repository in order to fulfil users' needs. According to Davis (1999), a DW is a process, and not a product that is used to organize the data and transforms it into information following and a set of predefined business rules. DW provides the means to joint data from multiple sources, in order to meet business requirements, answering questions about it, and help to make appropriate decisions. A DW is feed "extracting" data from different data storage systems, such as standard databases.

3.2 The Utility of a Data Warehousing System

Nowadays all companies recognize the importance of a DWS. But in the past, things were a little bit different. Companies did not have information, and many of them, especially those operating in the market during the years 90's, were about to leave the market. However, it is when managers awakened to the DW implementation reality, and realized that could be a way to save their businesses. Cases like this, were reported in one of Gurovitz's articles (Gurovitz, 1997), when he made a study that demonstrated the strategic importance of a DW could bring to businesses. In that study, the author presented the "miracles" provided with a DW implementation. Two of those miracles can be described as the follow:

- The first is a fact that happened in the banking sector, more specifically in the Itaú bank. The bank used to send more than 1 million bags to potential customers and investors. The return got did not exceed 2%. With the implementation of a DW, based on the stored data, the bank start to send the mailings only to the potentials customers and investors who presented more probabilities to answer. With this upgrade, the return rates increased about 30%, decreasing the delivery costs significantly.

- The second analysis was the discovery made by Wal-Mart, which was capable to connect the relation existing between diapers and beers, and also between the Barbie dolls and chocolate bars. The conclusions that company reached were achieved only because of the analyses that were made over sales records and a consequent strategic adaptation to business. As result, these products were placed side by side on the stores and sales have increased significantly.

In today's companies managers must be aware that having information required for management is not the key to competitiveness. The focus must be directed in answering the question: how that information must be used? In all business sectors it is essential to have a connection between the available information and the predefined business strategy, in order to contribute to the improvement of the conditions that sustain competiveness with other companies. One of the biggest problems that companies face in the information period is how to transform huge amounts of data into useful information that can be used latter in the definition of the business strategy.

Since the early of the 2000s years, several authors (Cooper, 2000) (Watson at al., 2001) (Watson at al., 2002) (Heun, 2000) (Whiting, 1999) presented a set of studies that enumerated and provided several advantages, concepts and requirements for a *data warehousing* implementation

process. One of the requirements who they presented was the costs, since this system requires a high level of initial investment with its implementation. Thus, current managers were concerned with two fundamental aspects about the implementation of such systems. The first was the investment required for the implementation and for system maintenance of the system. According to (Gagnon, 1999) for the implementation of a "normal" DW, it is required, in average, about 2 million U.S. dollars, an amount that a lot of companies do not have. The second main concern it is the use and the advantages that the system will bring to the company. Kelly (1997) presented a study showing that from one third to an half of all the DW, at the beginning of its implementation, failed the objectives. In the same context, another study was presented by (Voelker, 2000) where it was presented a statistic contained references to about 60% to 90% of the DW implemented fails in terms of the utility required. A latest study was presented by Conner (2003), which showed a failure rate of 41% of all DW implemented. Trowbridge (2000) stated that it's important to say, at the same time, even with this high failure rate, the number of companies that are implementing DWS increases day after day. By its turn, Agosta (2004) added that the tendency is to increase more and more the number of companies who will implement these systems in future. Through time, independently from its size, companies have started to present their interest in implementing DW. From that moment we can find a lot of references that many companies had implemented DWS when it was not really necessary, and others, who had large business rate did not. So, it's now the right time to ask if companies truly need a DWS?

We all know that running a business is not an easy task, especially in times of crisis, where economic conditions bring more complicate aspects to any situation. The challenges that managers face, doing more with fewer resources as possible, difficult a lot the process of make better decisions. Therefore, the real need to implement a DW emerges naturally, because with a system like this managers have immediate access to the most current information available, in the right time. This makes a big difference in business. In this sense, (Guerra & Andrews, 2011) refers than in order to underline the real need of DWS implementation, like everything else, it is not only about advantages for companies. The author points out to the cost factor, which is huge, and in a crisis, these costs continue to grow on a large scale.

In contrast, (Guerra and Andrews, 2011) said that managers cannot afford the luxury to make decisions based only and exclusively in financial statements, making comparisons of results obtained during a certain period of time with a certain budget established for that period. For these authors, business managers need to have specific skills that help them to respond in the

right time the most basic questions imposed by their business strategies. In such situations, a DW give them the ability to answer the questions disposing subject-oriented and specialised data ready to be used. This information allows managers to make examinations of new trends, and at the same time alert them to opportunities and problems through a permanent feedback about the decision efficiency (Shin, 2003) (Vatanasombut & Gray, 1999) (Watson & Haley, 1997). As mentioned already, the cost for planning and implementing a DW is very high, and it is very important to note that the return on investment used in the construction of the system is sometimes quite slow and perhaps it will never be reached (Gorla, 2003) (Johnson, 2004).

From the perspective of the information stored and also of the number of users, the DW development is a continuous process. Managers are "forced" to recognise the DW as a system that do not brings only mare costs to business, but also as a system that is needed to support decisions made every day in companies. DW promotes a clearer decision-making space, which can be easily reinforced and proved through system usage (Shin, 2003).

Sakaguchi and Frolick (1997) presented some characteristics of a DW, like standardization, evaluation and system security, but DW main characteristic still is the strategic support that it provides to business. With a DW implementation, it is easier for companies to accomplish at least one goal, or more, and whit that create competitive advantages against their competitors. Following this line of thought, one of the greatest advantages of a DW is the higher level of information quality (Watson & Haley, 1997) it provides us. Another advantage is that it offers a large quantity of information and values, which allow for companies to evaluate performance and progress of their activities (Sakaguchi & Frolick, 1997). A DW in conjunction with their users can improve business productivity and achieve better decisions. Additionally, it increases improvements in business processes and competitiveness. DW allows a higher business return, increasing profits and improvements in business processes and customer relationships, decreasing general costs (Sakaguchi & Frolick, 1997) (Vatanasombut & Gray, 1999) (Watson & Haley, 1997).

3.3   Strategies and methodologies for performance measurement

3.3.1   Methodologies description

Performance management is a set of procedures that aims to manage the implementation of strategy adopted by a company (Cokins, 2004). These procedures are part of methodologies, and it show how strategic plans are turned on results. Or perhaps a bigger perspective, which combines several evaluation methodologies and improvements that have been a great demand by companies. The methodologies are the source of a huge variety of technical solutions that are being made available in the markets. Managers can select and implement them based on the complexity and scope of their management plan for a specific strategic performance. Some of these methodologies have been developed for a while. Others are more recent. Figure 9 presents the methodologies that can be used to evaluate effectiveness and performance.
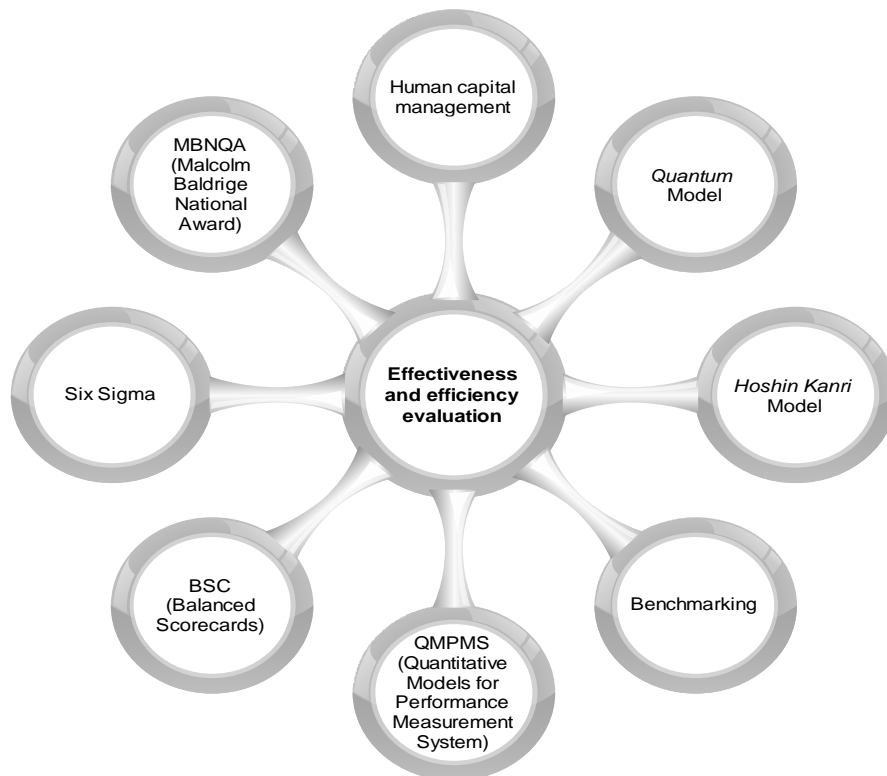
Figure 9 - Methodologies used to evaluate the effectiveness and performance - compiled by the author

The methodologies referred in Figure 9 are the most frequently used in the evaluation of performance. They are:

- *Benchmarking.*
- MBNQA *(Malcolm Baldrige National Quality Award).*
- BSC *(Balanced Scorecard).*
- *Six Sigma.*
- *Quantum* Model.
- *Hoshin Kanri* model.
- Human Capital Management.
- QMPMS *(Quantitative Models for Performance Measurement System).*

Lately, companies have shown a growing concern regarding to the implementation of integrated solutions in order to evaluate their performances. They have several reasons to show that, such as the evolution and changes that systematically occur in business, economics and business management, in general. Usually, the factors of changing are:

- Change in the relations between tangible and intangible factors.
- The importance of human capital.
- The information value.

In this sense, next it will be presented how these methods can contribute to the improvement of management performance.

The Quantum Model

According to (Hronec, 1994) there are a lot of companies that lose considerable time in developing they business mission, and ultimately end-up distancing the most important details involved with the development of a consistent set of performance indicators. The author said also that performance indicators should be derived from the presentation of a mission, being vital signs of a company. Nowadays, companies need constant improvement of their processes, bringing more value to their products and services.

The *Quantum* Model can be defined as (Hronec, 1994): "*The level of accomplishment that makes the optimization of services value in companies, and for their constituents: customers, employees, shareholders, managers, etc.*" The optimum value of the constituents of a company is a key factor

in the evaluation of the performance. The implementation of this model allows for calculating and optimizing business value to customers, employees or shareholders. It brings considerable benefits. Hronec (1994) stated that the performance of the *Quantum* Model is measurable, being the model developed based on three groups of performance indicators:

- Quality, which quantifies the value of products and services.
- Time, which quantifies the value of processes;
- Cost, which quantifies the economic position reflected in the value of the company.

Human Capital Management (GCH)

This is a methodology based on human capital, one of the most important intangible value of business activities. In this methodology, the most relevant point to emphasize is the difference between tangible assets (buildings, machines, or products) and intangible assets. Tangible assets are the first to become not usable and lose value over time. Intangibles have the potential to grow, adapt and develop over time. The way that company managers managing their human capital, supported by appropriate technology, has a fundamental function in the performance management model.

Hoshin Kanri Model

The term *Hoshin Kanri* is Japanese. The translation of the word *Hoshin* means "politics". However, in business context, this is related to the strategic vision or "leadership vision". The word *Kanri* means "management" or "control". The meaning of these two words together, *Hoshin Kanri* means a process that plans and executes a leadership vision. The *Hoshin Kanri* model (Akao, 1997) is considered as a methodology for managing changes, in critical business processes. However, the author made some observations about the changes in business systems. As an example, he referred the importance of evaluating a system as a whole, verifying the needs for adjustments and changes, the development of key indicators, with the aim to promoting in the organization, or the atmosphere that covered the company compression like (political, economic, social and market). The author also underlines the importance of providing the necessary resources to achieve business objectives, and adapt to the level of work that the company presents. The unfolding process that must control the all system and the management quality is done through the *Hoshin Kanri* model. This model main objective is to create the quality assurance for companies

in general, executing the management process using strategic indicators defined by companies. The author also suggested the use of a planning model covering the relationship between strategies, guidelines, targets and actions. For this author, the development of guidelines, goals and control for the *Hoshin Kanri* model is entirely different from others that consider traditional models. This model is able to adapt, and it has a long-term planning, based on information monitored by organizational systems, able to handle the changes.

Benchmarking

The benchmarking has emerged in the *Xerox Corporation,* in 1979. Essentially, it is considered as a management methodology that has the objective to identify and incorporate the best practices in an environment that is in a permanent evolution. A more complete definition of benchmarking was introduced by (Watson, 1993), which said that it is: *"The continuous input of new information to an organization";* and "*The continuous process to evaluate and compare the company's business process in relation to world leaders to get information that helps the organization to implement actions to improve performance*".

However, for (Czuchry et al., 1995) and (Lema & Price, 1995) the importance of implementing the concept for organizational competitiveness in business sectors (or services) has been increasingly accepted by managers and academics. (Tutcher, 1994) defined benchmarking in the following steps:

- A structured methodology that aims to achieve the goals and objectives, which are relating to the corporate mission and vision, and also allows manager to create real indicators that enables improvements for business, and helps to motivate the teams.
- A methodology that provides opportunities for working group development through the use of knowledge, and provide more opportunity to experiment, and creates pride in the workplace, because the company offers the best product, service or practice.

By its turn, (Spendonili, 1993) presents the definition of benchmarking as a methodology that allows for the development of plans for the short-term and long-term objectives, as well helps to predict the tendency for the main business areas, allowing for the functional learning *"think outside the box"* and comparing competitors or others companies with best business practices. So, benchmarking is a methodology that enables improvements in products, services and companies operations.

In this sense, this approach as any other method for performance evaluation must be synchronized with the strategies related to company improvement. However, the definition of the objectives for benchmarking studies would be a natural result to identify perspectives, and priority areas for improvements. Following this, (Carpinetti, 2002) presented another methodology that allows for identifying benchmarking projects. As well, (Welch & Marnn 2001) mention that the evaluation process starts with a main phase, which will be the identification of a set of indicators, and the development of critical analysis for the current company situation (Welch, 2001). Once the indicators are defined, the targets will be established for improvement defined, and the action plans should then be implemented (Bendell, 1993).
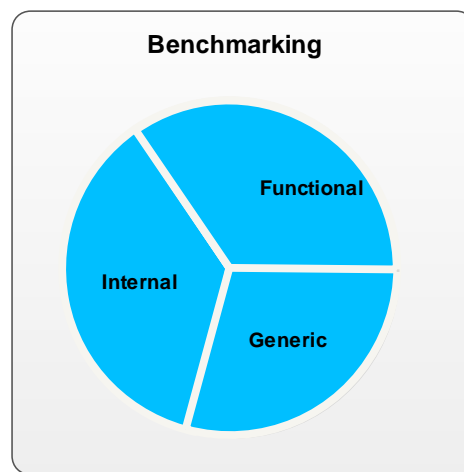
Figure 10 - Classification of Benchmarking - adapted from (Camp, 1995) and (Spendonili, 1993)

Figure 10 shows the several benchmarking components (Camp, 1989) and (Spendonili, 1993), which can be categorized as:

- **Internal**, which consists in a research activity where the aim is to find similarities in business operating units.
- **Functional, c**ompanies of different sectors that perform specific activities that can be reconstructed and improved.
- **Generic**, where we analyse similar processes between companies.

Malcolm Baldrige National Quality Award (MBNQA)

For (Pannirselvam & Ferguson, 2001), the *Malcolm Baldrige National Quality Award* (MBNQA) is an integrated methodology that has seven key perspectives in which is related to performance principles. They are: leadership, strategic planning, customers, marketing, evaluation, analysis and management knowledge, focus workforce, and management process and results. All these principles are intended mainly to guide the organization to an excellence performance.

Six Sigma (6)

Six Sigma (6) (Antony & Banuelos 2002) and (Mitra, 2004) is a methodology that through quality management or reengineering try to improve the internal processes of a company, and consequently develop their products or services, minimizing wastes. It also increases customer-value, which in turn increases business value, taking into account the vision and the mission of each company. According to (Antony & Banuelos 2002) and (Mitra, 2004), this methodology is a metric used to improve quality. The methodology enables continuous improvement, which in turn reduces the variability between processes and resources inside business processes, with the use of statistical tools. Six Sigma emerged in the years of 1980s, a time *Total Quality Management* presented a high level of implementation in companies. During the 90's, reengineering processes *(Business Process Reengineering)* was emerged and a several experiences of its implementation in companies has been made.

These two methodologies (quality and reengineering) have they own "ups and downs". In case of a reengineering process, it involves radical improvement *(do* not *automate, eliminate)* which used to be associated with the exclusion of employments in companies.

Regarding to quality, the deeper criticism states that this method is efficient in business sector, but not in strategic sector. According to these circumstances started to emerge several questions such as:

- Quality at what cost?
- The customers are prepared to pay for quality?

Then emergence of a system called *Six Sigma,* which has have a growing use by companies, shows the evolution of management quality, and the concerns about companies operational processes of

validating the reducing inefficiencies. This methodology has resulted in a new concept of *Lean Management.* These two tools work in association. To get the quality that you need to have efficient operations and processes, you need to join those two concepts, who results in a new concept that we call *Lean Six Sigma.*

The difference between management quality systems and *Six Sigma,* is that this financial factors include costs and profitability. *Six Sigma* methodology only accepted selected projects after its go through a detailed costs analysis and profitability analysis. Therefore, it is important to note that the quality presents costs that in this case must be profitable.

Quantitative Models for Performance Measurement System

According to (Suwignjo et al., 2000), the *Quantitative Models for Performance Measurement System* (QMPMS) is a methodology used to identify factors that affect the performance of a system and their relations. This methodology quantifies the effect of such factors on the performance measurement, being the results presented quantitatively.

Activity-Based Management

The *Activity-Based Management* (ABM) methodology is a constituent of management accounting, and it is not only or exclusively a part of one project, which has the aim to improve the company performance. It is important to note that the ABM outputs are great inputs to strategy maps development. This methodology provides information about the product unit costs, and services unit costs. This information is based on facts *(fact-based data),* and are part of an indispensable mean to get an end, or discovering the real causes for the performance measurement problems. The information acquired through ABM implementation can support decision-making processes with a relevant and high impact on business performance. The ABM is part of an indispensable tool that allows for the evaluation of traditional annual budgets in companies, or for business forecasts.

This methodology allows companies to adapt in a short period of time, to the external environment, particularly regarding to how it allocates resources. The ABM methodology also provides a special relationship with the financial company sector (cost structures), and so it must be located in the BSC financial perspective. Although the information that this methodology

provides causes impact in all company. For that, the ABM is considered a precious component to support all areas of performance inside a company.

3.5. Methodologies for the Evaluation of the Utility of a Data Warehousing System

The evaluation of the utility of a DWS can be understood as a systematic procedure where we answer a set of questions about the value and importance of a particular theme, propose or project. According to (Aguilar and Ander-Egg, 1994) the concept of evaluation presents a large variety of meanings, since it can be used in different contexts and in large set of human activities. The authors stated that the evaluation is a procedure applied in social research, methodically planned and directed, aiming to identify, acquire and make available the information collected in credible resources. They also said that this information and data must be relevant and enough to support the merits and the importance of the different projects' components. All results and conclusions obtained from evaluation improve decision-making processes, making them more coherent and rational. However, Aguilar and Ander-Egg (1994) underlined the importance of differentiation of control and evaluation. These authors defined the control as a result of the confirmation process, and evaluation as a process where the main objective is to evaluate and examines such results. In this sense, the evaluation process is quite subjective and full of meaning for one who performs it, which makes it more complex to be made. An evaluation process should be made based on the following principles (Cohen & Franco, 1993):

- According to the time of performance, power an *ex ante* or an *ex-pot,* and the evaluation process carried out before or after project implementation.
- Taking into account the project implementation, the evaluation can be internal or external.
- According to the projects size, evaluation is done using different strategies for smaller projects or larger projects.
- Based on user evaluation results, different decision-makers, require different results.

Figure 11 (Dias, 2001) shows a number of factors related to the several ways to evaluate information systems utility, namely: tools user friendly (tacking into account if they are functional or ergonomic factors); the systems utility for users; specially factors such as information effectiveness where decision-making processes are based; the importance of the systems for users; and finally, the confirmation of non-interruption or failure during systems use.

After these considerations, the author considers that the level of an IS acceptance, for their users, being these direct or indirect, depends on the following characteristics:

- The value added, understood by users in the use of the information acquired about system costs and the importance of information during decision-making processes.
- The system utility that is directly related to the utility of the information, with easy access to the system (data coverage and functionality), to the ease of use, and finally about where the use is mandatory or not an option, what can affect directly the user satisfaction.
- The cost, which must be directly related to system's users; this is the investment made by users at the same time they are using the system; the cost can be described through different views: for the vision of end-users can be considered the cost of opportunity for the total time spent by the them during the learning processes, added with the time spent using the system properly; in the point of view of system analysts, programmers or administrators it can be considered the amount invested in the implementation of the system, the cost of the hardware, software, human resources, maintenance, and so on.
- The system reliability that is directly related to data quality, which highlights some factors such as efficiency, user satisfaction, and others.
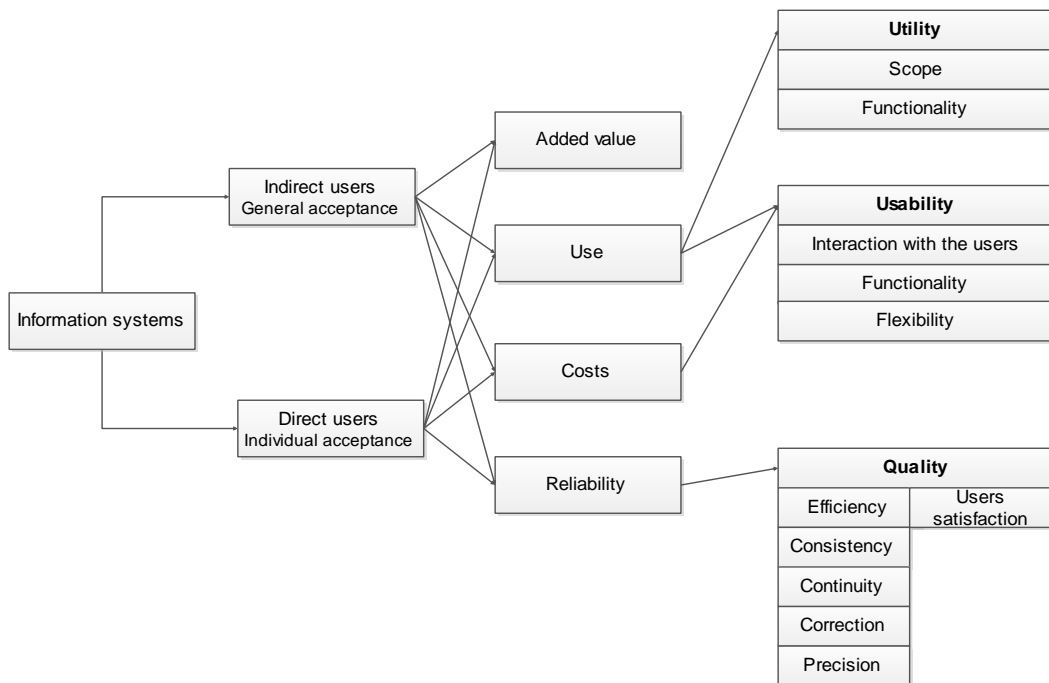

Figure 11 - Conceptual model for evaluating information systems – extracted from **(**Dias, 2001)

The concepts of system use, usability, and the information quality, are applied to evaluate the tools quality, and so the information quality (Dias, 2001). In that work, the author adds the needs of usage variables with high level of subjectivity and meeting the requirements of customer satisfaction. These factors are linearly related to the computing factors. Thus, the model is directed related to the behaviour of users, focusing evaluation on the following factors: system utility, its added value, the costs and the reliability that systems offer.

Resulting from such characteristics, it is possible to present others capable to measure and evaluate IS following a computational perspective, such as:

o **Coverage evaluation** - this confirms if the system is running all the routine procedures that are responsible for a safer operation; this factor should be evaluated and measured, between the number of times that the routines has been automated, which contribute to the user needs achievement, and the number of routine requested by users.

o **Evaluation of functionality** - this factor is characterized with metrics of functional quality; the use of these metrics aims to achieve a good accomplishment with the requirements of end-users; every change made in order to repair a particular functional deficiency or service can be faced as an evaluation metric, which can be quantified by the ratio between the number of requirements met, and the amount of requirements requested by the users, discrediting the service maintenance performed.

o **Evaluation of usability** - this factor is not limited exclusively to projects where the interface (man-machine) has a special purpose, but it should also be evaluated based on the following features: ease of use; ease of reuse, efficiency, errors thresholds, satisfaction, self-learning, and positive user satisfaction; the usability factor is about to ensure that the information system has available all the technologies that enable their use. Related to computational factors, Dias (2001) underlined the following particularities:

- Input a reduced amount of data with the values already defined;
- Criticize the data into the system before the processing step;
- Maintain data already introduced in the system;
- Simplify the selection of input devices and output data;
- Provide the output format setting for the data;
- Identify and standardize outputs;
- Supporting devices;
- Documentation about system perform;

- User manuals;

- o **Evaluation of users interface technology** – based on (Dias, 2001), Nielsen (1993) presented the following interface technologies:

  - In parts – low man-machine interaction;
  - Based on lines - interaction based on the command line;
  - Full screens - made by interaction of hierarchies;
  - Graphics - interaction made through visual and graphic representations used on multiple interfaces;
  - New technologies - interaction using multimedia applications and resources.

- o **Evaluation of the functionalities** - this factor evaluates the system from the performance point of view; it must present the following perspectives:

  - Timeless - how quickly the information is available, taking into account the urgent requirements of the users;
  - Efficiency - the resources and time available for the operations, and the information system must be conciliated at the performance level that users need.

- o **Evaluation of flexibility** - this factor has the goal to define the level of adaptation in the computing environment, and it's also used in others operating platforms; related to the computational factors, the following point must be underlined:

  - Open-solutions, and multi-platforms;
  - Compatibility and integration with the environment;
  - Easy aggregation, replacement and inactivation of information and functions;

Concerning the available data, the user level of independence associated to the possibility of issue queries to the system defines the follow:

- The number of languages provided by the system to the users;
- The number of fields to be concatenated in the optimization searches made on the system;
- The reuse of the existing research.
-

o **Utility evaluation –** that establishes the quality of the IS when compared with the software: it is a very important aspect to those who develop the databases (Dias, 2001). A very wide range of models that have intend to standardize the process of collecting and analysing data about the system attributes has been investigated by many researchers over the past years; in a set of attributes that were analysed we can included the following:

- Efficiency - this factor evaluate the systems performance accordingly the information access view; the efficiency is evaluated taking into account the following factors:
  - Time required for the user to access the data;
  - The number of menus, commands, and icons that a user must use before accessing the information;
  - The easiness to handle and update the system;
  - Time that an inexperienced user needs to understand system's functionality;
  - The level of the users requirements accomplished when compared to the contents of the information;
  - The adequacy of the information that is based on the end-user requirements.

  Efficiency can also be divided into the following (sub) factors:

  - *Consistency,* which is evaluated according to the system performance, and then compared with user requirements.
  - *Continuity,* which sets the time the system was available for use;
  - *Correction,* which defines the correctness of the available data and its accuracy;
  - *Precision,* which defines if the system is critical relatively to the input data; the data processing phase is done only after the validation and verification if it has self-protection.
- Timeliness – the information should be available when it is need, otherwise it cannot provide any utility to users.
- User satisfaction - the rules presented to evaluate the quality of an IS is only effective if users are indispensable; to evaluate a IS, it is essential to

know the opinions of users about services and products, and them transformed into indicators that will support system utility evaluation (Dias, 2001).

Arouck (2001) suggested that the identification and satisfaction of the dependent variables of a IS evaluation. Compared to the information quality indicators, and also the identification of methodologies for evaluating these indicators. According to this author, IS evaluation is a requirement for managers, either in terms of the improvement of internal systems, or to the justification of the high investments in this sector. The evaluation of the IS efficiency, has always been underlined in the research published in the journal *"MIS Quarterly"*, which research have been presented since the early 80's by the *Society Information Management (SIM)* and the *MIS Research Center (MISRC).* The objective of this publication was to answer the most critical questions in the field of management information systems. However, some research conducted during the 90's recognized a considerable decrease in the factor evaluation of IS efficiency. Some of the investigators of such research, such as Brancheau and Wetherbe in (Brancheau & Wetherbe, 1991), argued that this decline is due to the fact that the role of information technology on business performance is a delicate process, and an easy separation of the others factors, and whit that gain some research and identification of evaluation methodologies. For those authors, the efficacy variables of an IS needs to be linked to business performance, and these metrics should be credible and verified constantly. They also added that when determining how to evaluate the impact of investment in information technology inside of companies will be a challenge for the future.

3.5.1. The Essential Methods to evaluate the Utility of a IS

In the literature we can easily find a set of methodologies to evaluate the utility of an IS utility: those which was presented by Goodhue and Thonmpson (1995), and others authors that followed and analysed the reactions between an IS and the performance of the users; and those which was presented by Myers et al., (1997) that analyses the user value as a set of metrics, which makes the evaluation of the IS, and the impact on individual performance and in the working groups performance. The methodology presented in (Davis, 1989) and (Davis et al., 1989) has the main objective to evaluate the perceived utility and the ease of use. In addition to these methodologies, there are others authors like Ives and Olson (1084), Mignen and Conrath (1990), Galleta and Lederer (1989) Grover, Jeong and Segars (1996) or McLean (1993) presented very interesting

approaches how to evaluate the utility of an IS. All these reviews of models were the basis for the research process conducted by Arouck (2001).

3.5.2. The Model of Delone and MacLean

The model of Delone and MacLean follows a methodology very applied in IS evaluation studies. It provided the basis for a set of others proposed valuation methodologies. Its authors emphasize that the perspective "Quality of Information System" is a process that receives and executes data taking into account a specific set of rules. In this case, the key indicators for the evaluation process are:

- Access to information;
- Flexibility in the system use;
- Integrate tasks through information;
- Readiness in response time;
- Data credibility;
- Ease of use;
- Level of information utility.

Based on the work of Shannon and Weaver (1949) and also on the work of Mason (1978) and Delone and McLean, 1992], Arouk (2001) divided evaluation metrics into independent groups that were investigated in different studies involving specific areas of IS quality. According to two of them, the level of impact is one of the most problematic aspects to evaluate.

3.5.3. The methodology of Pitt, Watson and Kavan

Again, Arouck (2001) based on the work of Pitt, Watson and Kavan (1995) states that the perspective of quality of service was presented in (Delone and McLean, 1992) as methodology analysis, with the ability to measure the efficiency of the evaluation of a system – the author used a platform for the marketing area, called *serviqual*, that had the aim to evaluate the level of customer satisfaction.

3.5.4. The Methodology of Myers, Kappelman and Prybutock

Aroucka (2001) as shown Figure 12 that this methodology evaluates the interdependency between several perspectives, namely: system quality, information quality, and service quality. After, he analysed the methodology comparing metrics that can influence individually (or in a group) a IS, causing impact on system use and user satisfaction.
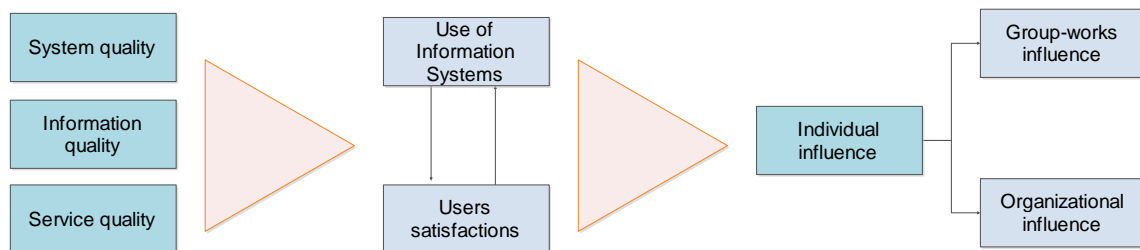
Figure 12 - The IS perspectives and their comparisons - adapted from (Myers et al., 1997).

Arouck (2001) also said that the frequent use of IS may influence positively or negatively the level of user satisfaction. The system utilization and user satisfaction are indicators that cause direct impact on individual influence, which in turn can influence the performance of working groups, and consequently the business environment. Built based on the work of others researchers in the quality area, ensuring that it is necessary to clearly define the levels, the prospects and indicators to be used in the evaluation of IS are quite diverse (Table 2) (Aurock, 2001). In that work, the author added that the upper level locate in the perspective of system quality, the semantic level in the perspective of service quality, and the level of efficiency in the perspective of the systems utility, user satisfactions, individual influence, influence in the working groups and business.

Author	Shannon and Weaver	Mason	Delone and McLean	Pitt, Watson and Kavan	Myers, and Kappelmn Prybutok
Year	1949	1978	1992	1995	1997
Perspectives	**Technical level**	-Production	-Quality System	-Quality System	-Quality System
	Semantic level	-Product	-Quality of information	-Quality of information; -Quality of Service.	-Quality of information; -Quality of Service.
	Level of effectiveness	-Reception; -Impact on the receiver; -Impact on the system;	-Utility; -User satisfactions; Influence individual; Influence business.	-Utility; -User satisfactions; Influence individual; Influence business.	-Utility; -User satisfactions; Influence individual; Influence in the working groups; Influence business.

3.5.5. The Task Technology Fit (TTF) Model

The *Task Technology Fit* (TTF) was presented by (Goodhue and Thompson, 1995), and aims to analyse and compare the relationship between IS users and their performance. The model considers that a technology only has a positive impact on the performance of the company, if when used it was done a good fit comparing to the process (tasks) that needs to be supported. According to such authors, the main purpose of the measurement of the IS utility is based on the ideas about users behaviour and informational procedures.

The TTF methodology is based in a successful methodology. The methodology, designed usually by *Information System Success (ISS)* it was presented by (DeLean & McLean, 1992). In a first phase, the ISS methodology makes the comparison between the IS quality and the IS utility, and the user satisfaction Figure 13. However, the utility metrics and the user satisfaction are compared in a second phase, based in the individual influence and business influence. The authors added that the use is an essential metric for measuring the success of an IS.
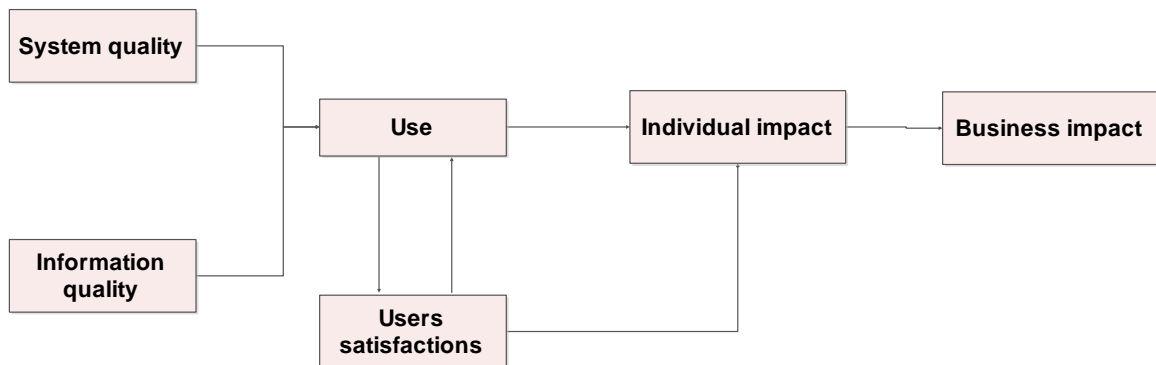
Figure 13 – The methodology for the measurement of an IS - extracted from (DeLome and McLean, 1992).

Goodhue and Thompson (1995) presented the main components of the TTF methodology and reorganized its model (Figure 14) as follows:

- Technology (T), that incorporates tools used by users in their functions execution; the methodology was presented in order to be generic enough allowing for the analysis of the impact of a specific system or set of systems.
- A task (T), which means functions performed by users in the process of transforming inputs into outputs; the methodology focuses on functions that users will depend on the technology to perform.
- Acquisition of technologies by tasks (TTF), that consists in answering the question how technology is essential for users in performing its functions.
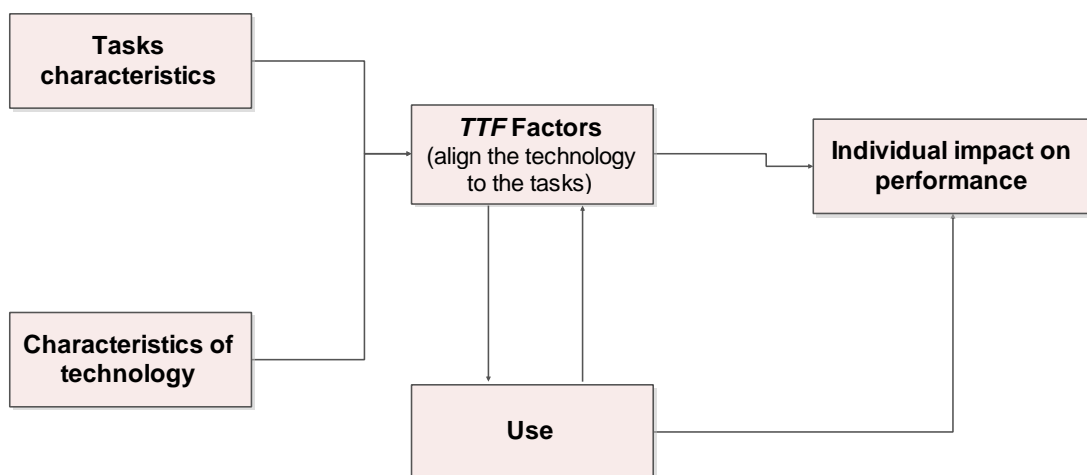
Figure 14 - The TTF model (Task Technology Fit) extracted from Goodhue e Thompson (1995).

In a second phase of the TTF evaluation methodology (Goodhue and Thompson) the 21 perspectives presented before in the first phase will be transformed into 16 perspectives, and grouped in a set of 8 factors that are more consistent for the IS analysis. Some of the resulting factors have more than one perspective (table 3).

Table 3 – Factors TTF perspective of the methodology - adapted from (Goodhue and Thompson, 1995)

| Factors *TTF*	Perspectives *TTF*
TTF1: Quality	Data timeliness. Data accuracy. Appropriate level of detail.
TTF2: Location	Easy location of data. Ease perception of data meaning.
TTF3: Authorization	Authorization to accessing data.
TTF4: Compatibility	Ease of grouping data from different sources.
TTF5: Timeliness of production	IT company ability to meet the deadlines established of data processing and reporting.
TTF6: System stability	Systems available to be accessed by users.
TTF7: Ease of use / experience	Easy to use hardware/software. Easy to get experience in using the system.
TTF8: Relationship of the IT sector with users	Perception of business activities of the organization by the business sector of the IT. Interest and dedication for IT sector. Agility to percept in the view of user by the IT sector. Availability and quality of technical assistance to users. Performance of the IT sector, in supporting the business needs.

3.5.6.   The Technology Acceptance Model Methodology

The *Technology Acceptance Model* (TAM) methodology, developed by Davis (1989), has the goal to understand the causal relationship between external variables of user acceptance and real uses of computers, trying to understand user behaviour through the knowledge of utility and ease of use, perceived for each user. This methodology is widely used in IS evaluation processes. The methodology was initially tested and compared with a set of users who participated in the study working on group - the first group consisted of 120 users on *International Business Machines* (IBM) in Canada; and the second group consisted in 40 students of *Master Admiration Business* (MBA) from Boston University in the United States.

The main objective of this study was to develop a new numbering scale for the perceived utility and the perceived ease of use, and then validate the new methodology. According to Davis, Bagozzi and Warshaw (1989), users tend to use the technology in order to improve individual performance in their work - perceived utility. However, even if a user note that a particular technology is useful, its application may be affected if its use or application is too difficult, once the difficulty does not compensate the use - easily perceived. The authors also added that users will use the technology only if they admitted that the use will bring positive results, focusing on perceived ease of use *(perceived ease of use)* and perceived use *(perceived utility).* Thus, the TAM methodology is generally used to understand why users accept or reject a particular information technology, and a possible improvement in the acceptance scale can be providing a support that predicts and explains the acceptance. Figure 15 presents us the TAM methodology that was developed by Davis.
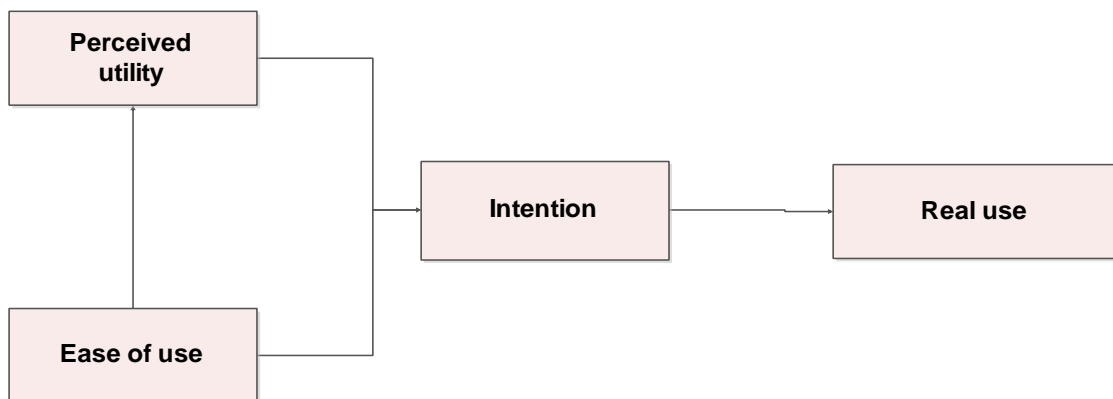
Figure 15 – The TAM Methodology - adapted from (Davis, 1989)

Davis (1989) in her studies suggested the use of two crucial variables that are particularly relevant in the TAM methodology. They are:

- The perceived Utility *(Perceived utility)* - users tend to use an IS or not, because they may believe or not that a particular methodology can improve the performance of their functions.
- The perceived ease of use *(Perceived ease of use)* - users admit that IS performances will be free of efforts.

According to Deltor (2004) the variables of perceived utility and perceived ease of use are based on the users' cognitive perceptions. However user perceptions are not considered to be synonymous of a reality. Carvalho (2006) in several studies based on TAM methodology concluded that the perceived utility variable is more important than the perceived ease of use variable, which mean that, if the IS was really useful, users tend to use them even when they have great difficulties in using it. A few years sooner, Dishau and Strong (1999) claimed that the combination of two methodologies allows a different perception about the factor user acceptance in technology, referring that:

The TAM methodology and other methodologies based on attitude/behaviour/position assumes that user values and beliefs are indispensable in the acceptance and use of the technology.

- The TTF adopts a very rational approach, aware that users choose a technology that gives them some benefit, such as improving performance of their work, independently of their attitude.

The authors added that the final result of the two methodologies TAM and TTF reverses in a better methodology, and more efficient, when compared with each one of these methods separately - figure 16.

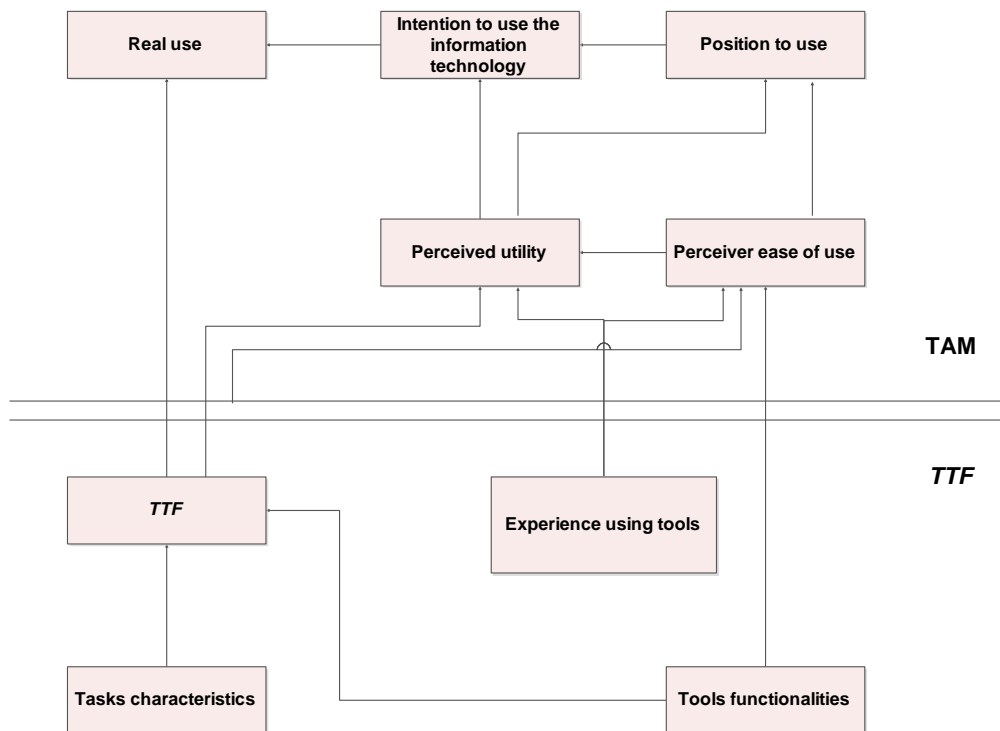**Figure 16 –** Methodology combined TAM and TTF - **Source:** Adapted from Dichaw and Strong (1999)

3.6. Use Cases of Balanced Scorecards

There are several documented experiences of using BSC. In the next section we will present and discuss some of them that we found as quite relevant and interesting to the present work.
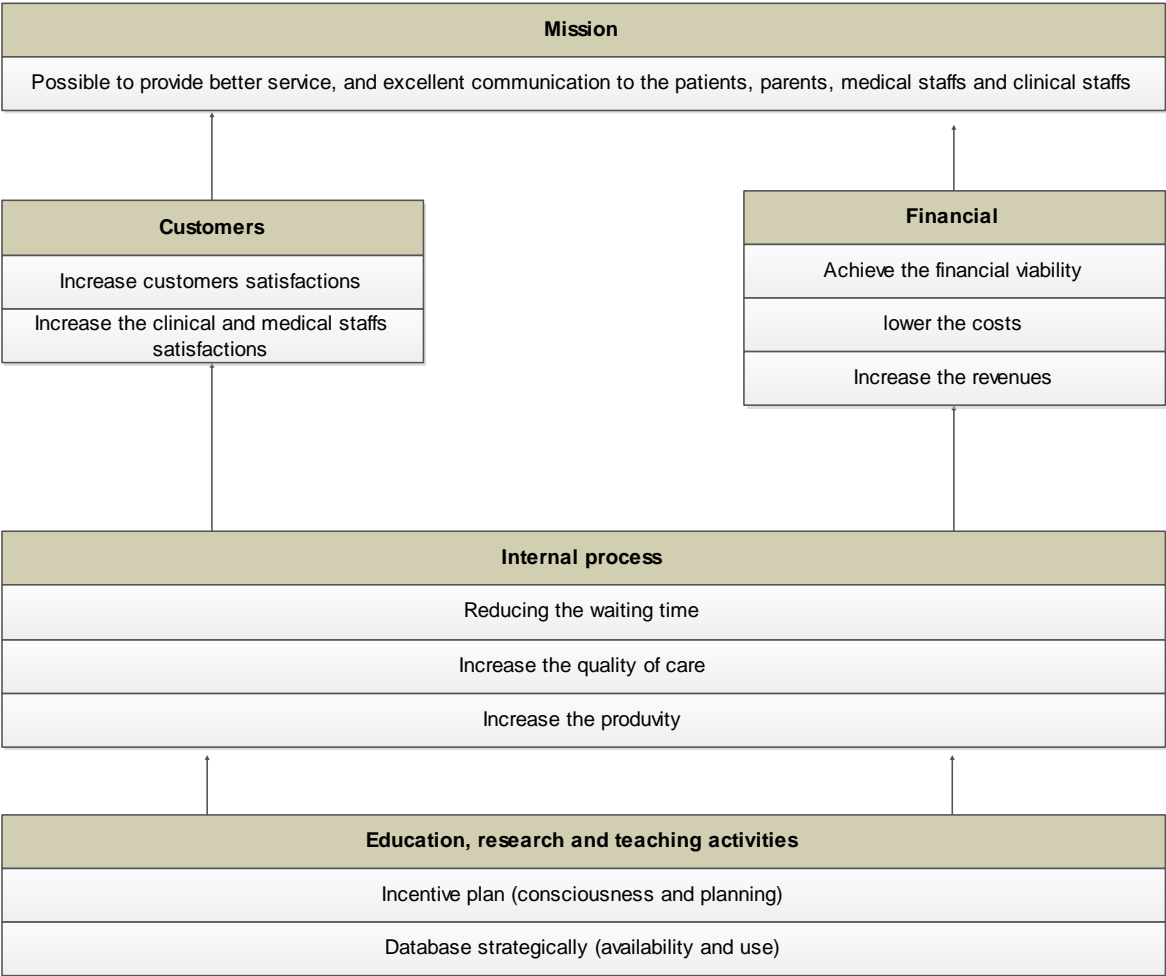
Figure 17 – The BSC implemented in the Duke Children Hospital – extracted from (Kaplan and Norton, 2001)

Duke Children Hospital

The Duke Children Hospital is an institution located in the State of North Carolina in the United States of America. This hospital implements Balanced Scorecards with a primary aim, which was to follow a strategy that allows for the principle of "... *practice of smarter medicine* ..." (Kaplan and Norton, 2001). For these authors, short-term results were remarkable for this BSC implementation. Its commission made the decision about the implementation of BSC, since the hospital had some deficiencies in its operational services, such as:

- At the hospital, there was some hesitation about what is the most essential services that should be provided.
- A deficiency of a common goal between all members, administration, staff and medical community.
- The relationship between paediatric staff and other hospital members, such as the administration staff, was very limited.
- The existence of high competition level.
- A deficiency in balancing factors, such as the quality and customer satisfaction, personnel and education, and some research and financial factors.

In this context, concepts were developed, as well as the definitions of the mission and the vision in order to present the objectives for all different perspectives. Then, a team was responsible for developing and implementing BSC (Figure 17). Implementing this methodology, the hospital showed serious improvements in clinical conditions, staff satisfaction, and also in patients and medical satisfactions (Kaplan & Norton, 2001).

The University of California

The University of California, also in the United States of America, planned to implement a system for monitoring internal activities. The implementation of the system should allowed added-value to the university administration in the following points (Hafner, 1998):

- Supporting analysis in the future.
- Planning the development of strategic objectives.
- Following the development/planning of the strategic objectives through the use of performance indicators.

However, the university managers believed that the systems available would not allow tracking the development of business model. In this sense, they decided to implement the BSC methodology that they believed would be able to keep track the overall strategic development process in the university. Based on that, they defined their strategic vision based on the BSC (Figure 18).

The use of *Balanced Scorecards* at the University of California allowed, among other advantages, brought the following that allows for (Hafner, 1998):

- Monitoring the implementation of strategic objectives.
- Listing daily the results with the objectives of long-term strategies.
- Contributing to increase the participation of employees.
- Increasing the potential of strategic culture at the University.

Administration and responsibilities Efficiency Value creation	Decision effectiveness Process effectiveness Anticipation of the future Responsibility
Financial perspective	**Internal process perspective**
Vision **(make for a better university)**	
Customers perspective	**Learn and growth perspective**
Customers' satisfaction Value for the stakeholders	Employee satisfaction Employee participation Effective use of technology Innovative culture Continuous improvement

Figure 18 – Vision and strategic objectives for the University of California Balanced Scorecards - adapted from (Hafner, 1998)

Charlotte City

The Charlotte city, in the United States of America, had as mission and ambition providing to its residents high quality of services. Such ambition provided a way to residents to choose in which city they intended to live. However, according to (Kaplan and Norton, 2001), the management structure had no confidence about the mission and the vision implementation strategy. Thus, trying to fix these problems the responsible of the city decided to implement the BSC methodology, defining the first steps trough the following strategic objectives:

- Security of cities.
- Transportation.
- Protection for older neighbourhoods.
- Renovation and management.
- Progress in the economy.

Then they developed and presented the strategic issues for the objectives, implementing the BSC in the city. In Figure 19 we can see its strategic map.
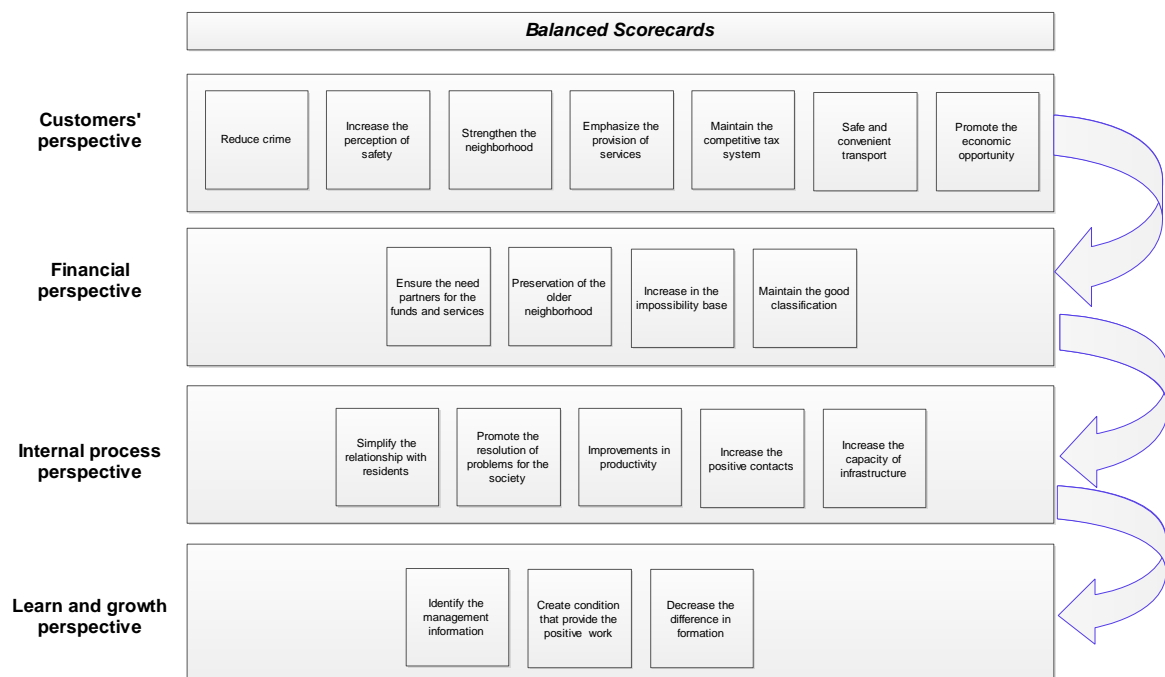
Figure 19 – The strategic map of the city of Charlotte – extracted from (Kaplan & Norton, 2001)

Pompeu Fabra University

The University of Pompeu Fabra, in Spain, implemented the BSC methodology in their libraries. The implementation process presented the following characteristics (Salas & Garcia, 1992):

- Definition of key success indicators, based on four perspectives (users, economic-financial, internal processes and human resources).
- The relationships between key success indicators were made through the use of cause-effect relationships.
- Some of the key success indicators are related to the main libraries objectives (*e.g.* user satisfaction) and others are related to lower levels in the library (*e.g.* employee motivation).

University's managers have implemented BSC using the four perspectives presented in Table 4 to Table 7, as well as the quantitative and qualitative indicators, monetary and non-financial, namely.

Rooms and Garcia (2002) had the opinion that it is essential to design a manual where the indicators are defined, as well as the objectives and the calculation formulas, and those responsible for the availability of data and calculations. BSC have already been implemented in other departments. However, (Salas & Garcia, 2002) argue that the major problem was related to the responsibilities of some departments to the accomplishment their own objectives.

Table 4 – Indicators of the user perspective - adapted from (Salas & García, 2002)

Perspectives	Users - Society in general	
Key indicators for the success	User satisfaction	Increasing the services' uses
Indicators	- Satisfaction of test results	- Number of students receiving user training / total number of students - No. of responses / information of the total students - Consultations *web* library / total number of students - Entries for users in the library / total number of students - No. of items supplied / total number of students

Table 5 – Indicators of the economic and financial perspective - adapted from (Salas & García, 2002)

Perspectives	Economic and financial	
Key indicators for the success	**Increase training resources**	**Cost control**
Indicators	- No. of papers sold / number of monographs acquired.	- Total cost of the library / number of response information. - Total cost of the library / number of students. - Cost of the library staff / total number of students.

Table 6 – Indicators of the internal process perspective - adapted from (Salas & García, 2002)

Perspectives	Internal Processes	
Key indicators for the success	**Increase the effectiveness and efficiency of services**	**Resources available to users**
Indicators	- Number of processes documents / total number of persons of library. - Number of documents assigned / total library staff. - Number of improvement actions taken / number of actions planned improvements.	- Number of square feet of library / students. - Total number of students / total number of read points. - Number of students / total number of people in the library.

3.7. The Use of Balanced Scorecards in Portugal

According to a study published by (Quesado & Rodrigues, 2007), in Portugal 47% of the companies know what is a BSC, but they never had contact with a methodology to put them in practice, 5.9% have already started the process of using it constructing and developing the methodology inside them, 18.8% have a BSC process implementation incomplete, 4.7% dropped out the BSC implementation in the middle of the process, and, finally, 12.9% plan to implement BSC in the future. However, 12% do not know what is a BSC. (Table 8)

Table 7 – Indicators of the human resources perspective - adapted from (Salas and García, 2002)

Perspectives	Human resources	
Key indicators for the success	**Specific training for administrative staff and services**	**Motivation of the administrative**
Indicators	- Number of specific training hours / total library staff	- Motivation for the test results - No. of library staff participating in working groups / total people in the library

Table 8 – Statistics for the Balanced Scorecards in Portugal - adapted from (Quesado & Rodrigues, 2007)

State of implementation of the BSC	*N*	*%*
Know the BSC, but never had contact with this methodology	38	44.7%
Do not know	11	12.9%
Already taken the first steps to implementation processes	5	5.9%
They have a BSC	16	18.8%
Already used, but abandoned it	4	4.7%
Expect to implement it in the future	11	12.9%
	85	100

By analysing the data collected in that study, we can see that the majority of the companies know the BSC methodology but never had contact with it. However, we can see also that a considerable level of companies have already implemented the methodology, or their managers intend to implement it in the future. The best-known case of using BSC in Portugal is the implementation made by the Technical University of Lisbon. In a process of development and innovation assets on the referred university, its managers used the *"action research"* methodology that provides a way to transform tacit knowledge into explicit knowledge. According to (Vaz, 2005), the BSC were used as a way of presenting results of actions and how they were achieved. The justification for using BSC was that they are considered an interpretive methodology for the evaluation of intellectual capital. The process of creation of assets has been developed over three years, between 1999 and 2002, being the results evaluated over a period of six years, between 1999 and 2004. In Figure 20 it is presented a strategic map used in the BSC implementation.
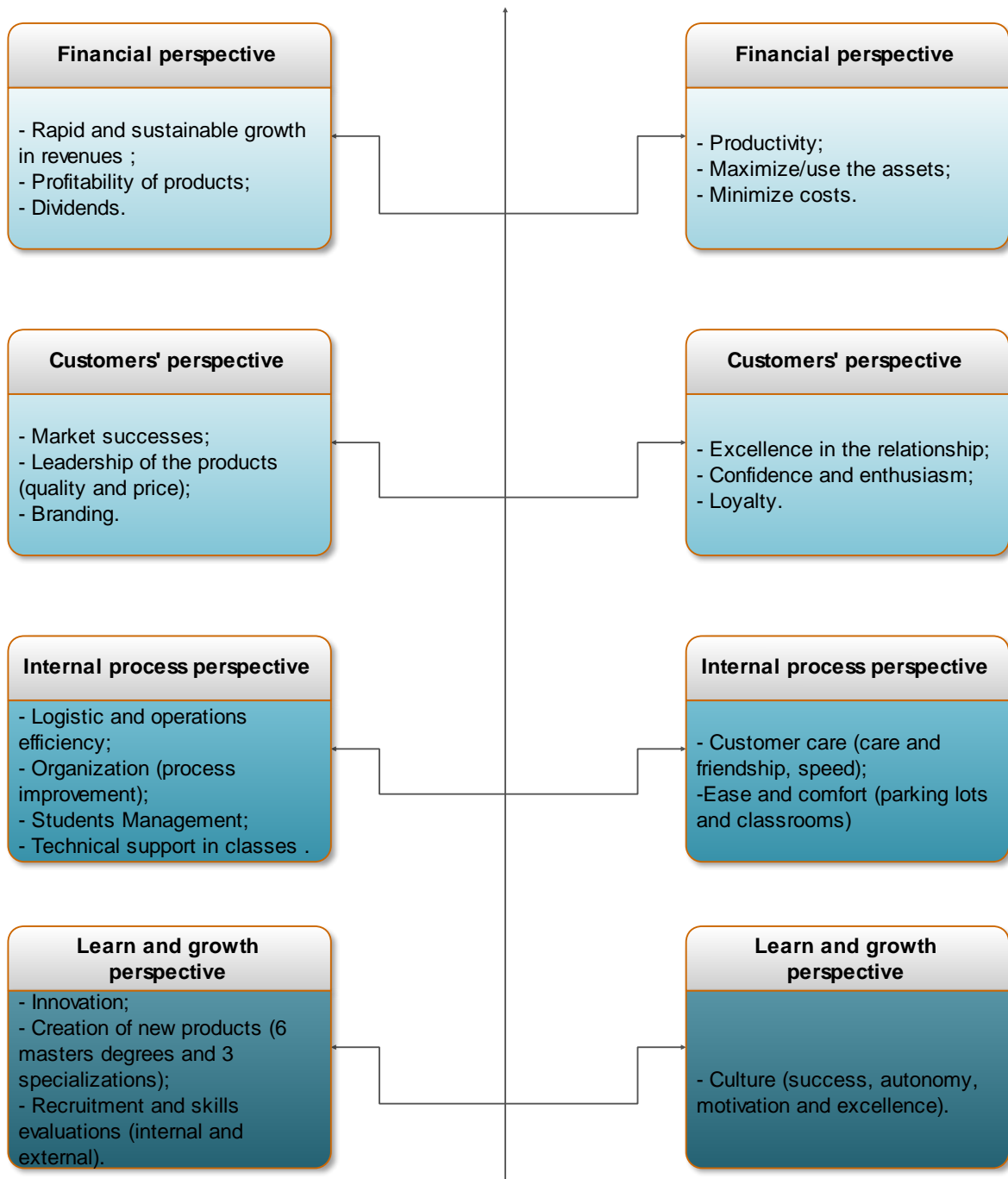
Figure 20 – The strategy map used in BSC implementation (1999-2004) – adapted from (Vaz 2005)

Chapter 4

Evaluating the Utility of a DWS

4.1. Building a Balanced Scorecard

The first steps to implement the BSC in a company (Kaplan & Norton, 1997a) must be based on methodological processes, and in a clear consensus about the process of translating the organizational mission and strategy into objectives and indicators. According to Giolli (Giolli, 2002) the process of implementing BSC must start with the creation of a vision and a strategy, in order to design the agreement on the objectives to be achieved. During the development process of a BSC there must be what we called as an "architect", which function is to facilitate the process and also be able to understand the information gained (Kaplan & Norton, 1997a). Based on the same work, we can say that the implementation of a BSC should have a full involvement of top managers of company, otherwise the all process can result in failure. Similarly, for Giolli (Giolli, 2002), in the early stages of building a BSC, you must have the agreement and participation of all the company's top managers about the reasons that led its implementation. Kaplan and Norton (Kaplan & Norton, 1997a) completed this idea saying that managers should also be in accordance with the main objectives of a BSC approach implementation, because they help to:

- Guide the definition of strategic objectives and indicators.
- Achieve understanding and involvement of all "actors" involved in the project.
- Present the structure that will lead the implementation and management processes.

Generally speaking, the implementation of a BSC in any business activity area aims to increase some of the most significant requirements of a company, such as the:

- Strategic vision definition and consensus;
- Work team definition;
- Strategy of communication;
- Incentives alignment;
- Resource allocation and strategic initiatives;
- Appeal for increased investment in intangible assets.

Following the ideas of Headley, in (Headley, 1998), after getting the agreement between the strategic objectives and the indicators, an "architect" must be selected in order to lead the entire BSC project implementation. However, others must also help him in the coordination and definition of the strategic indicators. The "architect" should lead all processes, as well as structuring the working program, and collect the necessary documentation for all project tasks. He should also be responsible for the cognitive and analytical processes, but specifically in what could be related to the translation of goals and objectives that will be evaluated, and about the interpersonal and emotional process in building teams or in the resolution of possible conflicts.

The construction of a BSC can be influenced by many factors as the complexity of its structure and formation. Things like these can influence strongly the way how the project should be implemented. Therefore, this process diverges from company to company. Kaplan and Norton (1997a), based on their experiences, presented a development plan based on four main steps and ten sub tasks. Let's see each one of them.

Step 1: Define the evaluation of the architecture

> **Task 1** - *Select the organization unit.* By achieving agreement among top managers, the "architect" should select what part of the organization will implement the BSC. In this sense, Kaplan and Norton (1997a) argued that this implementation would occur best in a company if is select a specific strategic area, carrying on business throughout the value chain, namely, cutting across the entire company. It should also be the area in which financial performance indicators could be reached easily, without complications in dealing with the allocation of costs to the centres established previously. The company area selected must not be too limited, once this will difficult the definition of a coherent

strategy, and that can be in fact, very not good. It is important to be noted that the selected area will set a strategy to meet its mission.

Task 2 - Identification of relationships between the organization and business unit. According to Giolli (2002), after selecting the area of an organization, the "architect" must understand all the relations it has with other areas in the company, and also with the organization as a whole. In this sense, a meeting between top managers and the "architect" must be promoted in order to analyse several aspects, namely:

- The financial targets for the selected area (profitability, growth, etc.);
- Some critical business issues, such as the environment, the quality, the competitiveness, etc.;
- The relationship between the selected area and the others areas of interest of the company.

The study of these factors is critical to the implementation of a BSC, since they can keep the business unit selected develop strategic objectives and indicators that optimize their own performance, and not harm others. These aspects also allow the "architect" to know business limitations and opportunities of the selected area, simplifying the way to identify them.

Step 2: Achieving a consensus on strategic objectives

Task 3 - Conducting interviews. For Giolli (2002), an "architect" must organize a retrospective set of elements on the BSC, and document the vision, the mission and the strategy of the company where the unit will use the methodology. The author adds that the "architect" should also collect information about the surroundings. The information should then be made available to departmental managers, conducting the "architect" the necessary interviews with all of them. From these interviews, the "architect" should collect information to support strategic objectives and about the indicators need to satisfy the four BSC perspectives. Just like Kaplan and Norton (1997a) said, the skills of the "architect" can also be performed by work groups, where "architect" is the leader.

According to Giolli (2002), the interviews have clear objectives, namely: introducing the concept of BSC to top management staff, and answering questions about the concept and

the acquisition of information in the initial phase of the company's strategy, as well as how these will be translated into strategic objectives and to indicators ready to be used in the BSC. Concerning the objectives, it is hoped that managers study the strategies and objectives so one can evaluate them according tangible indicators, and to confiscations that may have key elements regarding the development and implementation of BSC, and making the identification of potential sources of conflicts between persons (Kaplan & Norton, 1997a).

Task 4 - Summarizing conclusions**.** According to Giolli (2002), after these meetings, the "architect" and his working team should discuss and perform the analysis of the results of the interviews, highlighting all the points to be developed, and create a list of targets for the indicators to be presented at the first meeting with managers. For (Kaplan & Norton 1997a) the outcome of the synthesis phase, should lead to a list and classification of the targets for the four perspectives. The team who was part of the synthesis, must learn the list of objectives that the strategy that represents the organizational part area, and also verify the objectives that cam remain the cause-effect relationships between the perspectives.

Task 5 - Meetings with top management**.** For Giolli (2002) these meetings should allow managers to reach a consensus about the BSC. At this point, the "architect" shall provide a debate with the goal to establish a consensus about the mission and strategy of the organization. After that, the main objectives for each of the BSC perspectives should be studied. At this time, it should also be identified the possibility that some indicators have low priority and usefulness (Kaplan & Norton, 1997a). Then, the presentation of the objectives for each perspectives. Ate this point, must be select the best perspective. It might be three or four. Thus, for the selected perspectives should be selected the indicators for each objective, usually in a *brainstorming* section. Finally, a document should be prepared presenting a summary of the advantages and exposing the composition of the four subgroups and their leaders.

Step 3 - Select and draw indicators

Task 6 - Meetings of subgroups. According to (Kaplan & Norton, 1997a) several meetings between the "architect" and subgroups should be carried out in order to satisfy the referred objectives, namely:

- Improve the description of the strategic objectives presented in the meetings between the "architect" and subgroups.
- Identify the indicators that best fits the goals of each objective, for all purposes.
- Identify the sources of information for each indicator.
- Identify all the relationships between indicators of each of the perspectives and between these and other perspectives.

The process of selecting indicators should have the goal to know the way they reflect the strategy. In this sense, as there are unique in the strategy, indicators also make use of this feature. For Kaplan and Norton (1997a), each subgroup should be careful presenting the objectives for the perspective they represent, setting the indicators for each objective, and showing how they can be measured and evaluated, presenting a relationship graph representing the indicators and their own perspective in relation to others.

Task 7 - Second series of meetings with top managers

Based on (Kaplan & Norton, 1997a), these meetings should cover top managers and middle managers. The second series of meetings should approach several pertinent issues, such as the corporate vision, the strategy, the objectives and list of indicators that will constitute the BSC. The leaders of each group should then present the results, and commit its attainment. Then, the process of analysis for all key indicators and the beginning of preparation phase with the development of an implementation plan.

Step 4: Development of the implementation plan

Task 8 - Construction of the implementation plan

For Giolli (2002), a new team, which usually consists of the leaders of each group, should formalize the goals that must be met, and based on that create an implementation plan for the BSC. However, Kaplan & Norton (1997a) refer that it is important that the plan will aim how these indicators will be included in an IS, so that the BSC will be communicated to the entire structure.

Task 9 - Third series of meetings with top management. For Kaplan and Norton (1997a) this series of meetings should facilitate the agreement of the vision, objectives and evaluation measures developed in the first meetings, as a complementary way to validate

targets set by the teams that are responsible to implement the BSC. Concluding this task, top managers must agree on the program implementation, and then the BSC will be communicated to all the constituent parts of the company, including those who perform the most basic tasks in the organization.

Task 10 - Complete the implementation plan. The BSC will certainly add value to a company, if it is integrated into a management system. So, it is necessary to prepare an action plan, based on the best information available in order of the priorities being consistent with the BSC priorities. [Kaplan & Norton, 1997a] propose that the BSC implementation needs an environment analysis, and that can be formulated in a period of four months.

4.2. The Strategic Development

In the beginning of BSC, when the methodology was firstly introduced, it looked like every company wants to put a new group of measurements in place, with the development and following a strategic plan. However, is indispensable to say that the development and the strategic plan to follow are not implemented in a BSC. Strategizing is one of most critical and important step to build and implement a good Balanced Scorecard. In the development of a strategic plan process is important to focus on the strategic foundation structure, and finish it with a set of strategic targets or maps. The strategic targets, measurements, grids, and programming are the four indispensable key components that allow building a BSC. The adapted strategy is a mixed strategy (adaptive and offensive) where the principle focus is taking advantage of opportunities through leveraging the strength and overcoming the weaknesses.

Highlight

- Strengths – Using the DW's information in decision-making processes.
- Weakness – Technical staff and end-users' qualifications.
- Opportunity – New information obtained through the DW implementation.
- Threatens – Information overload.

Strategic areas

- Ensure the high utilization of information obtained through the DW implementation in decision-making processes.
- Improve the qualification of technical staff and end-users.
- Provide the DW guidance to new kinds of useful information.
- Compress information in order to reduce the high amount of data.

4.3. The Implementation Phase

4.3.1. The Strategic Map

The strategic map defined for the BSC must identify the cause-effect relationship existing in all perspectives, as well the strategic behaviour vectors defined (achieve the financial sustainability; increase the data warehouse utility and uses; and improve the concepts like innovation and technology), as well their objectives, and according to those, define the measures indicators necessary to evaluate the accomplishment of these goals.

4.3.2. Principles, Methodology and Perspectives

In the BSC building process we will not followed the original principles and methodologies of Kaplan and Norton (Kaplan & Norton, 1997a), setting four perspectives. Therefore, it will be use tree perspectives, namely:

- Perspective of Exploration (customers) ;
- Perspective of Internal Processes (internal processes) ;
- Perspective of Learning and Growth (learn and growth);

In this sense, it will be presented all these perspectives, as well their strategic objectives and mediation indicators, which allows to achieve them as we will see in the next tables.
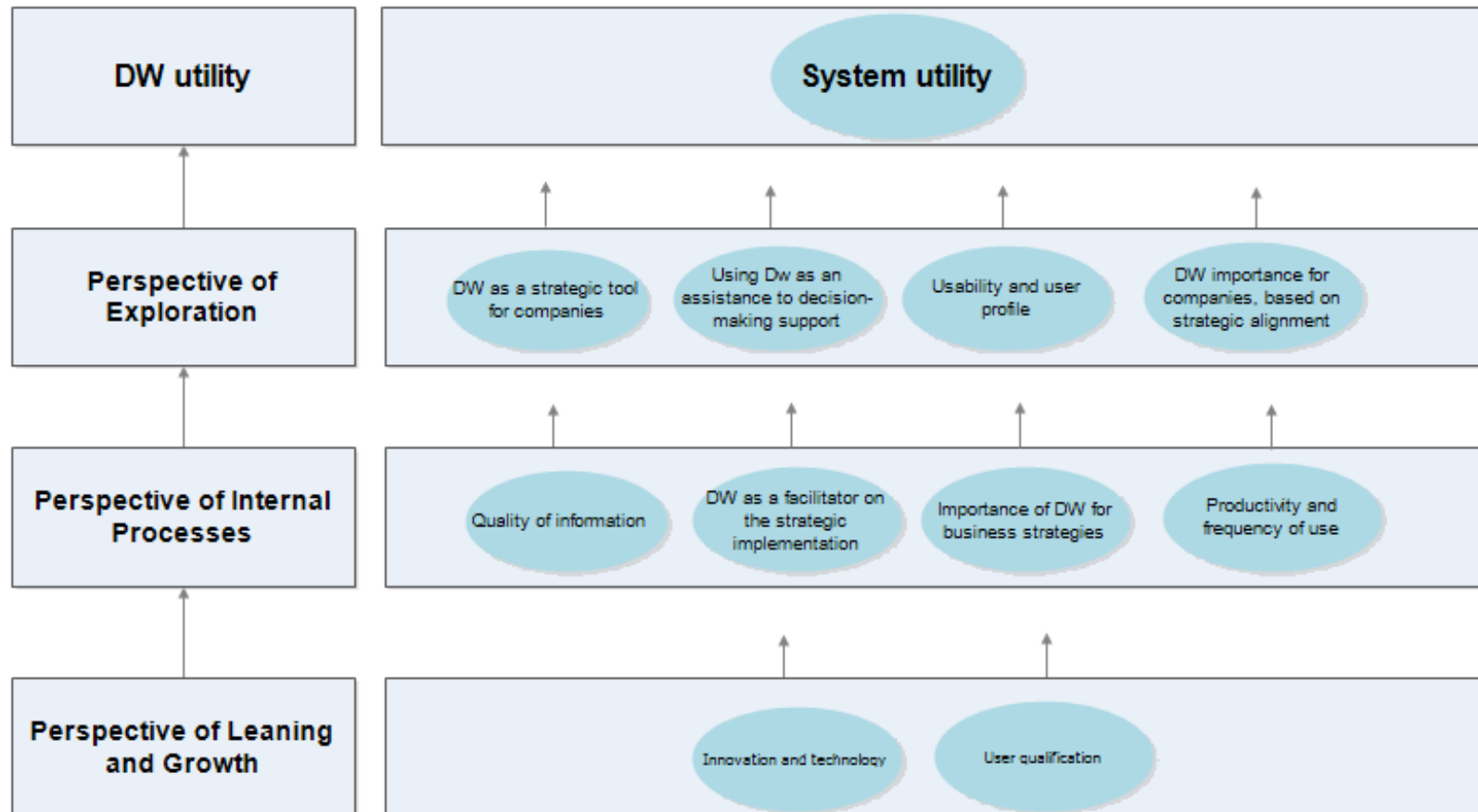
Figure 21 – The strategic map - compiled by the author

4.3.3. Perspective of Exploration

In the Perspective of Exploration, it was defined four strategic objectives, their own indicators and their final objectives (Table 9). The purpose of this perspective is to find out if each one of indicators have been met or not.

Table 9 – Description of the Perspective of Exploration

Strategic objectives	Indicators	Objectives
The DW as a strategic tool for companies.	Company impact.	Increase the importance of the DW to the company.
	Support for decision-making processes.	
	Information coverage.	
	Importance of information to decision-making processes.	
Using DW as an assistance to support decision-making.	DW flexibility.	Improve the DW flexibility, and its importance to support decision-making.
	DW modelling, based on company requirements.	
	The DW importance to company	
	DW efficiency, based on the company competitiveness.	
	DW impact on business performance.	
	Implementation costs justifications, and benefices obtained.	
	Existence of doubts about the DW implementation.	
Usability and user profile.	Ease of use.	Decrease the difficulties of utilization, and in the same time improve users' individual performance.
	Benefices relating to the speed of the execution tasks.	
	User performance compared to the proximity to the business sector.	
	Rate of DW use compared to the training received.	
	Sharing of experience among users.	
	General DW utility.	
DW importance for companies, based on a strategic alignment.	Company differentiation.	Increase the DW utility, compared to the accomplishment of strategic lines defined by the company.
	Improvement of working processes and reducing costs.	
	Increasing the market share.	
	Introduction of new products and services, and development of new manufacturing processes.	
	Improvements made on management processes.	
	Improvements made on information management.	

4.3.4. Perspective of Internal Processes

The Internal Processes Perspective was defined to evaluate the information quality, DW as a facilitator on the strategic implementation, importance of a DW for business strategies and productivity/frequency of use (Table 10). Through of this evaluation, was possible to find some conclusions, presented in the next topics.

Table 10 – Description of the Perspective of Internal Processes

Strategic objectives	*Indicators*	*Objectives*
Quality of information.	Reliability and accuracy of the information provided.	Increase the quality of the information stored on DW.
	Current and timely information.	
	Correct level of information detail.	
	Acquisition of information in exact time.	
	Perceptible and ambiguity free information.	
	Merge information from multiple sources without data inconsistency.	
	Data relevance.	
	Data localization.	
The DW as a facilitator on the strategic implementation.	Strategic plan based on the successfully implementation of the DW.	Increase the rate of the DW importance to the implementation of new business strategies.
	Improvements made with the strategic plan implementation.	
Importance of the DW for business strategies.	Decrease the lead time.	
	Definition of RRRRRRthe execution time for each task.	
Productivity and frequency of use.	Improvements made on the productivity sector.	
	Frequency of use.	

4.3.5. Perspective of Learning and Growth

Whit the definition of the Learning and Growth Perspective, it allows understanding the point of view of users, and through, evaluate the DWS utilities for companies.

Table 11 – Description of the Perspective of Learning and Growth

Strategic objectives	Indicators	Objectives
Innovation and technology.	Rate of new ideas used after the DW implementation.	Improve the factors in the innovation and technology sector.
	Level of new products and services developed after the DW implementation.	
User qualification.	Level of Experience of DW's users.	Increase user qualification.
	Level of acceptance by the DW's users.	
	Rate of days used in training for the initial exploration of the DW.	

4.4. Research Instruments Development, and Survey Implementation

The goal to applying the survey was to develop a simulation based on the questions defined for the research, where the main objectives is to obtain data that will be used in analyse. In order to adapt the scale of the points for each metric that was selected we defined the measures that will be used in the survey. The Likert scale (Babbie, 1999) was selected for this survey, which aims to transform the scale of order points into a linear scale. This scale represents a systematic and a refined way to develop the metrics, through independent answers, weighted and summed. The scale ranges from 5, 7 and 9 on the rating. In this case study, it will be used a Likert Scale of 5 points, based on the format suggested by Babbie (1999), starting with the alternative "Disagree", with three intervals, until the last alternative "Totally Agree", which will be, respectively, stored from 1 to 5.

Table 12 – Likert Scale – extracted from Babbie (1999)

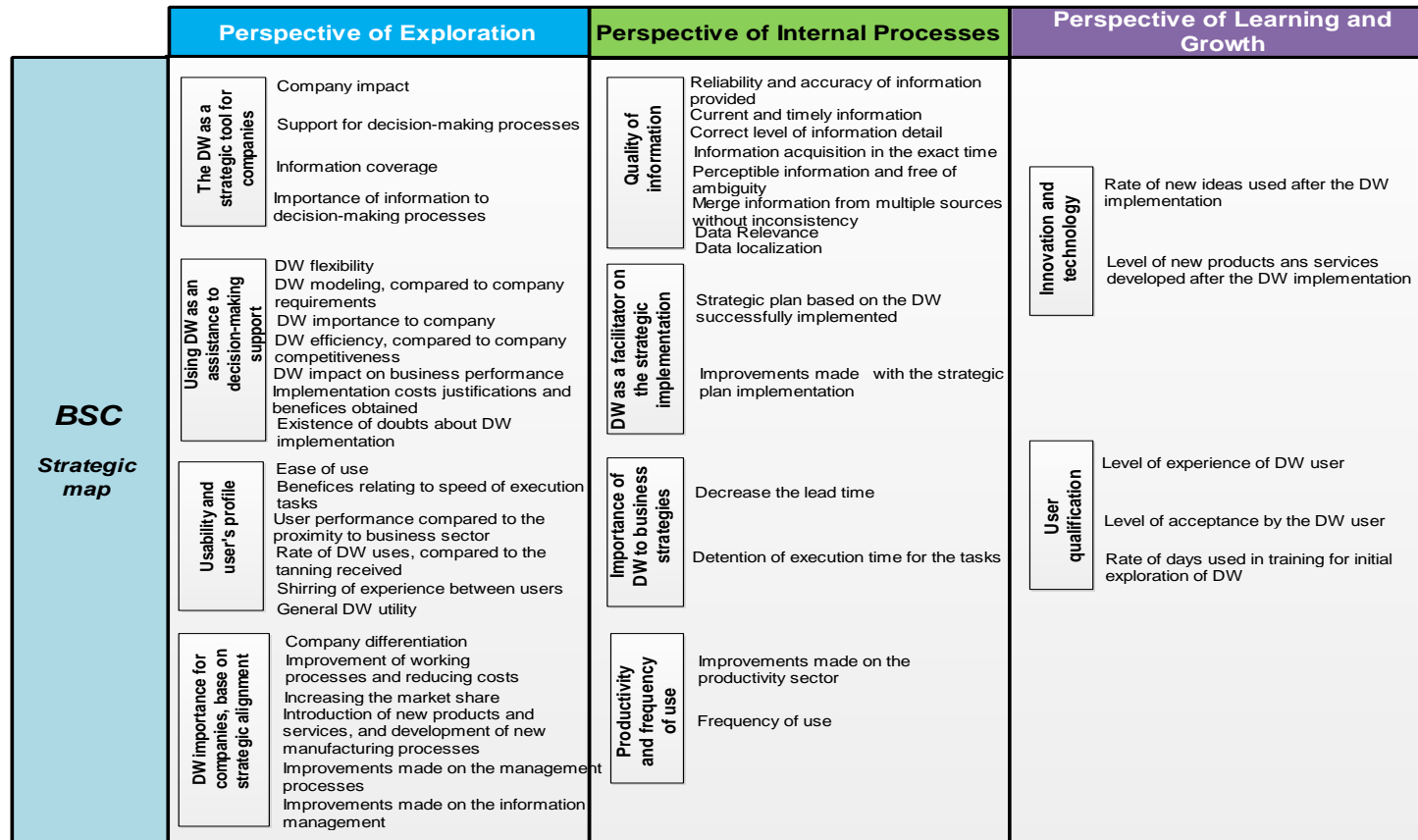| (1) I totally agree	(2) Disagree	(3) I do not agree or disagree	(4) I agree	(5) I totally agree
(Do not answer at all to the required)	(Serves with failed the minimum required)	(Meets partially the expectations)	(Meets completely the expectations)	(Above the expectations)

Figure 22 – The BSC strategic map

4.5. Evaluation of a DWS utility

4.5.1. Perspective of Exploration

The DWS as a Strategic Tool for Companies

Based on the users perception about a DW supports the strategy of the entire company (Table 13), it can be stated that, as a strategic tool, it meets completely the expectations of the company. It can be also affirmed that the DW implementation has generated positive impacts for the company (V1), allowing obtaining information quickly, being capable to support decision-making processes in time (V2). About its contribution to the integration of information from the many different strategic areas of the company (V3), it was said by its users that it exceed all the expectations planned. They also said that, the information generated by the DW is quite satisfactory for supporting company's decision-making processes (V4).

Table 13 – The DW as a strategic tool for companies

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V1	The DW implementation created positive impacts on company activities performance.	4	
V2	The obtaining of information from the DW is quick, and allows the decision-making support in a timely way.	4	
V3	The DW contributed decisively to the integration of information from the several different strategic areas of the company.	5	4
V4	The information generate from the DW is important for the decision-making processes.	4	

These characteristics were observed and evaluated by system users, and according to them, these characteristics are indispensable for the company regular operation. For the DW's users, information technology, and especially enterprise systems that use such kind of technology, allow for the execution of company's tasks with more intelligence and more efficiently. Users also added that these technologies change the way that managers structure and manage their business processes, the way they work, and how they do their own data integration.

Using the DW as Assistance to Decision-Making Support

Considering the information gathered on the users' questionnaires, the DW efficiency on the decision-making processes of the company meets partially the expectations anticipated. In Table 14, it can be seen that only two variables satisfy the expectations stated. Those variables are V6 and V8. Thus, it is possible to conclude that the DW model defined for the company meets its business needs, and also the DW efficiency promote business competitiveness in its own activity sector. The remaining variables satisfy partially in terms of DW efficiency during the decision-making processes.

Table14 – Using DW as assistance to decision-making support

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V5	The DW is dynamic and allows the quick changes to understand the needs of information in the decision-making processes.	3,5	
V6	The DW model defined for the company meets the business needs.	4	
V7	The use of DW brought improvements to the business processes of company?	3	3
V8	The DW efficiency promotes business competitiveness in its activity sector.	4	
V9	The DW implementation caused positive impacts on the company work processes.	3	
V10	The benefits gained from the DW implementation justify the implantation costs.	3	
V11	There is still some reservation about the company option to implement the DW.	3	

Usability and User Profile

In a general way, and according to users' perception about usability, the DW is easy to use (V12). Users consider that the fact of sharing best practices for use, make the dissemination of benefits of system partly ease (V16). In this case, the ease of system accesses is directly related to the system usability, to the experience, to the user profile, and to the motivation to use it. As it is presented in Table 15, the performance of users that answer the survey is related to the fact that they are closer to the business area where they act (V14). Another important factor to emphasize this, is that the users consider that the DW does not collaborate as a whole in daily activities, and as a way to improve user group tasks (V17). Finally, system's users consider that the DW helps a lot in the execution of its tasks.

Table15 – Usability and user profile

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V12	The DW is easy to use.	4	
V13	The DW helps to perform their tasks more quickly.	4	
V14	My good performance using DW comes from the proximity to the business area which I act?	4	4
V15	Your profile of use fits to the training received for the DW exploration.	4	
V16	Usually use to share your experience with others users of DW, simplifying the dissemination of the uses benefits.	3	
V17	Generally, the DW is useful for the daily activities and for the user group which they belongs	3,5	

DW Importance for Companies, based on Strategic Alignment

The main objective of the previous table was to present the results that users agree about who use a DW inside an organisation (Table 16). They said it enables users to introduce improvements in management and decision-making processes (V22), and hence obtain some kind of differentiation from other companies in the market (V18). The perception of users is consistent according to what was said by McGee and Prusak (2004), because according to these authors, "the competitive strategy of a company defines its business, how to operate their activity and, particularly, how to differentiate their producers and services from those offered by its competitors".

Table 16 – The DW importance for companies, based on strategic alignment

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V18	The company who use DW differs in relation to its competitor in the market where it operates.	4	
V19	By implementing DW, the company improve its working processes and consequently, reduced their operation costs	3	
V20	The use of DW allowed the company to increase its market share.	3	4
V21	The use of DW allowed the company to introduce new products and services on the market, or the development of new production processes.	4	
V22	The use of DW allowed the company to achieve significant improvements in their management processes.	4	
V23	The use of DW allowed the company to achieve continuous improvement in management their information.	4	

The users evaluated that a company with a DW have more possibilities to introduce new products and services in the market or develop new processes (V21). The responses in the inquiry say that the variable that evaluates reduction costs, which can be direct or indirect costs

(V19), does not promote a good improvement in the working processes. As consequence, the use of a DW promotes a partial "incensement" in the market share (V20), differentiating itself from the other competitors (V18). In the evaluation processes, users were unanimous stating that a DW allows the company to achieve continuous improvement in managing their information (V23).

4.5.2. The Perspective of Internal Processes

Quality of Information

Taking into account the survey's data, the users agree that a DW provides precise information (V24), up-to-date, opportune, and ready to be used in the company's decision-making processes (V25), providing information with sufficient level of detail, and ready to be used (V26). Users have timely access to data (V27), allowing the DW the consolidation of data from different sources without any incompatibility and inconsistency (V29). They also added that the data stored in the DW is relevant to the company. During the evaluation of the information quality metric (Table 17), it was found that two variable, the clarification of information provided by DW and an easily compression of information (V28), and the ease way to locating an identifying data (V31), presented results that satisfies partially the expectations of the company.

Table 17 – Quality of information

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V24	The DW provides precise information (correct and reliable).	4	
V25	The DW provides current information, opportune and timely for the company decision-making processes.	4	
V26	The information provides sufficiently detailed information for the company decision-making processes.	4	
V27	The DW allows you to access the data timely.	4	4
V28	The information provided by the DW is clear, easily understandable and free of ambiguities.	3	
V29	The DW covers information about different data sources, without generating any inconsistency.	4	
V30	The data stored in DW are relevant to the company decision-making processes.	4	
V31	It is easy to determine establish what information is available in DW, and how to find.	3	

DW as a Facilitator on Strategic Implementation

In this evaluation metric, users were unanimous in terms of results, since almost all their responses considered that strategic plans were implemented successful in the implementation

of the DW (V32), and the improvements made with it were relevant (V33). However, results only meet partially the expectations set by company (Table 18).

Table 18 – DW as a facilitator on the strategic implementation

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V32	The strategic plans implemented based on DW, have been successfully implemented?	3	3
V33	The improvements achieved with the strategic plans implementation were relevant.	3	

Importance of the DW for Business Strategies

The system's users found that the DW helps to decrease the business processes lead-time (V34). They also stated that during the process of setting deadlines for implementation, the DW satisfied partially the objectives expected (V35) (Table 19).

Table 19 – The importance of the DW for business strategies

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V34	The DW helps to reduce the lead time of business processes.	4	
V35	The DW helps in the process of setting deadlines.	3,5	3,75

Productivity and Frequency of Use

The V36 and V37 variables (Table 20), which evaluated respectively if the DW implementation improved the productivity, and if the frequency of the use of the DW in high most of working days, were evaluated by users with partial accomplishment of the company's expectations.

Table 20 – Productivity and Frequency of Use

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V36	The DW implementation allowed a better productivity.	3	
V37	The frequency of use of DW is high in most working days.	3	3

Generally speaking, in the perspective of Internal Processes, the user evaluated the metric with positive results. In this perspective we detected some disagreement between user answers, but then, after a deeper analysis, it can be said that the Internal Processes metric meets the business expectations.

4.5.3. Perspective of Learning and Growth

Innovation and Technology

Taking into consideration the innovation and technology evaluation metric (Table 21), we evaluated the two more variables, V38 and V39, which do not meet all the expectations intended.

Table 21 – Innovation and technology

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V38	The rate of new ideas is higher after the DW implementation.	3	
V39	The level of new products and services developed after the DW implementation is greater.	3	3

User Qualifications

The user qualifications metric was evaluated through the use of three other variables (Table 22): user level of experience (V40), DW acceptance by users (V41), and the scale of days used during the training days for initial DW exploration. As in the previous ones, these variables were evaluated to verify if they meet the expectations for the study carried out. Based on user responses they meet them with a positive evaluation.

Table 22 – User qualifications

Variables	Topics	Overall average of users information	Overall average for each evaluation measure
V40	The user experience level is high.	4	
V41	The level of DW acceptance by their users is high.	4	3,5
	The rate of days used during the training days for the initial exploration of DW was enough.	3,75	

Finally, the metric Learning and Growth that users also evaluate with positive results. In this metric it was also possible to verify the disagreement between the responses, but in the same manner as the anterior case, this is nothing that a deeper analysis could not resolve. We end saying that the Learning and Growth metric meet business expectations.

4.6.   Software for Balanced Scorecards

For the Balanced Scorecards implementation, it was used an informatics software *Balanced Scorecard Designer PRO*[1]. This is software that simplifies the process of creating and mugging balanced scorecards, helping to develop new scorecards with strategic maps, categories, indicators, etc. With this software it is also possible to generate a set of key performance indicators, define the association between groups, goals, and identify the importance of each indicator. This software also offers a flexibility way to calculate performance values depending on the indicator's settings, such as min/max values, target values, or measurements units. The resulted Scorecard can be exported into a MS Excel file for further processing.

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[1] http://www.bscdesigner.com/bsc-designer.htm

Chapter 5

Conclusions and Future Work

5.1 Some Final Remarks

In this final chapter it will be presented some general remarks and conclusions about the work done, as well as brief description of its limitations, and some proposals that can be useful for future work. This work intended to demonstrate the utility of BSC measurement methodology for evaluating the utility of a DWS. Based in this context the assessment was made founded on a strategic map created based on the principles and strategies for implementing a BSC inside a particular service sector in a company.

Nowadays, companies are increasingly looking for survive in a context of deep and permanent modifications, facing high levels of competitiveness in the markets where they are positioned. To follow those changes in its own favour, it is essential that companies have strong and viable management tools that can provide them a continues strategic management specific oriented to what they assume to be their vision. During the development of this work, it was possible to ensure that BSC is one of those essential tools, which has the ability to monitor business strategies.

BSC provides the definition and clarification of the visions and strategies of a company, establishing communication and connection between the perspectives, metrics and strategic objectives of a company, as well provide the means to verify the differences of the various perspectives used by an organizational model, depending on the particularities and strategic objectives of each sector. After some initial research, it was approached the problematic of the implementation of BSC in companies of the public. However, an empirical study (Pedro, 2004) about the use of BSC methodology showed that its implementation can fit into the new concept of public management, contributing in this way to a more dynamic strategy of these type of organizations.

5.2 Conclusions

A DWS utility evaluation process approaches a group of very specific factors that checks if a DW helps or not a company (and their managers) in the support of its decision-making processes. It's a process that takes into account factors such as the frequency of use, and the quality of information stored under the user's perspective, regarding tools and the information itself. Usually, companies need to make their decisions on a daily basis, supported by information that increasingly needs to be more grounded, in order to reduce uncertainty, minimize risks and create sustainable business conditions. Based on that, the investigation of relationships between the use of a DW and business performance requires recognition and study of how the information can be collected, stored, processed and, finally made it available, in order to achieve some competitive advantages. Therefore, information confirms the tendency for each day and establishes the basis for competition, becoming what sometimes is often referred as the companies' informational assets.

These new and essential achievements ascended when the companies started to see as an essential basis that information generates added value, rather than see as a set of a few technological innovations available and accessible to users. To achieve these objectives, from the beginning, it was done a bibliographic research, collected the necessary information to support theoretical work, and be a guideline to achieve that. In other words, it was gathered all the theoretical information available about the use of BSC methodology for evaluating the usefulness of a Data Warehousing Systems, its perspectives and the analysis of each one of them. Next, it was performed some searches related to a real data warehousing system, once it was intended to developed an evaluation process over a real world application scenario. At this stage, the research covered already all aspects about DW concepts, basic characteristics and functionalities, says of using, etc. It was also approached others similar evaluations methodologies that can be used not just to evaluate a DW, but others decisions support systems. In this alternative set, it can be found some other relevant methodologies for evaluation, such as Benchmarking (Watson, 1993), Six Sigma (Antony & Banuelos 2002) and (Mitra, 2004), Quantum Model (Hronec, 1994), Hoshin Kanri Model (Akao, 1997), and much more.

In the group of methodologies that can be used to evaluate the performance of a DW, and other types of enterprise decision support systems, it can be highlighted the Delone and McLean Model (Delone & McLean, 1992), the Pitt and Kavan methodology (Pitt, Watson & Kavan, 1995), the Myers, Kappelmen and Prybutock methodology (Aroucka, 2001), the Task Fit Techonology (TTF) (Goodhue & Thompson, 1995), and finally the Technology Acceptance

Model (TAM) (Davis, 1989). In this work it was also given crucial importance to others evaluations cases, which were made by many organizational entities that presented very interesting positive results.

5.3 Future Work

One future line to improve the presented work consist in perceiving the difficulties that emerge during the identification of the right evaluation keys, so that the evaluation process can be performed through appropriate indicators, if companies develop business intelligence applications based on the management of intangible assets, especially when using information generated by a decision support system. These systems can be used as effective tools to transform implicit knowledge in explicit and useful knowledge, as well to develop, built, and keep users (and their experiences) explicit or not.

According to (Niedermen, Barancheau & Wetherbe 1991), and (Arouck, 2001)], the metrics for evaluating the effectiveness of an IS must be associated with the organizational performance. These metrics should be reliable and verified continuously, because they are one of the main key factors that will determine how to measure and evaluate the investment impacts of Information Technology (IT), even though that the IT role is complicated and difficult to disassociate with others factors in business performance.

About IT investments in companies, taking into account that DW implementation costs can be obtained and measured, it is proposed that the benefits measurement and the added values of these systems into business performance should be studied more.

One other thing that can be explored in a near future is the fact that a DW is close to strategic levels, and, consequently, it complicates the effectiveness of the evaluation process and also its strategic potential, if we take into account the predictable subjectivity associated to the decision-making processes.

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