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MONIKA TSCHANZ BELLAGUARDA

PERFORMANCE ANALYSES OF PUBLIC HOSPITALS IN THE ESTATE OF BAHIA WITH DIFFERENT ORGANIZATION MODELS AN APPLICATION OF THE DATA ENVELOPMENT ANALYSIS (DEA) METHOD

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Orientador: Prof. Dr. Carlos Khoury

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ABSTRACT

This study analyzes the performance of 16 public hospitals in the Estate of Bahia which are either organized based on the traditional public organizational model or an outsourcing model. The performance was evaluated by applying data envelopment analysis where first an efficiency frontier for the group of analyzed entities is calculated based on linear programming and second, for every hospital, its respective distance from the efficiency frontier for each factor analyzed is calculated.

The data collection for this analysis was obtained through interviewing with a structured questionnaire. However, the quality of the collected data proved to be rather limited. Hence the results of the analysis should be seen as rather indicative how data envelopment analysis could be used to evaluate the performance of hospitals, than to drive conclusion on the performance of the respective hospital or organizational model.

By applying data envelopment analysis, we were able to identify best practice hospitals within the analyzed group and to identify the dimensions underperforming hospitals may improve.

A second intention was to analyze if one of the two organization models applied in the public hospitals in Bahia, the traditional public or outsourcing organization model differ in terms of efficiency. In concept, data envelopment may be helpful to identify such differences regarding performance, nevertheless, the analysis of the analyzed group of hospitals returned mixed results.

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LIST OF ABBREVIATIONS

DEA	Date Envelopment Analysis
DMU	Decision Making Unit
PI	Performance Indicator
FTE	Full Time Employee Equivalent
s	Outputs
m	Inputs
O	Output
I	Input
CCR	Charnes, Cooper, Rhodes
BCC	Banker, Charnes, Cooper
ADD	Additive
SBM	**Slacks-based measure of efficiency**
n	Number
(FAPESB)	Fundação de Amparo à Pesquisa do Estado da Bahia
NPGA	Nucléo de Pós Graduação
UFBA	Universidade Federal da Bahia

SUMMARY

1 INTRODUCTION

1.1 1.1 CONTEXT

Huge differences exist between the performances of the different hospital and models in Brazil. The access to the services of public hospitals and the quality of the services there provided are especially important for the large part of the population that can not afford the access to private hospitals. As public hospitals is the only affordable option for a large part of the population, an improvement of the performance of these hospitals is substantial for the improvement of life quality and conditions for this country.

Actually, in Bahia there are two different organizational models for public hospitals: the traditional public organizational model which was adopted by the secretary for health of the state of Bahia (Secretaria da Saúde do Estado da Bahia - Sesab) to administer hospitals and the outsourcing model passing the responsibility of the management of a given hospital, including hiring of staff and purchasing of goods of consumption to a given company through a management contract.

1.2 1.2 INITIAL QUESTION

- ⇨ What is the relative performance of a selection of public hospitals located in Bahia with different organization models?

- ⇨ In which dimension does the performance of the hospitals differ and where would less performing entities have to improve?
- ⇨ Do hospitals with a traditional public organization model and those operated by third parties have a significantly different performance?

1.3 1.3 TOPIC

Main topic is the evaluation of the performance of public hospitals in the State of Bahia and the comparison between the traditional public organization and the outsourcing model.

1.4 1.4 OBJECTIVES OF THE STUDY

Objectives include to compare the relative performance of a selection of public hospitals in Bahia with different organization models and to identify the best performing hospitals (best practice) by establishing a ranking among the hospitals as well as to discover in which dimensions less performing hospitals have to improve.

To compare the relative performance of a group of hospitals, the Data Envelopment Analysis (DEA) method is applied. With the DEA method the performance can be compared based on inputs and outputs.

The study appears to be relevant as it seeks to identify the best practice entities and areas for improvement for underperforming hospitals.

Furthermore, a methodology for performance evaluation widely used abroad and in other estates of Brazil is applied to the public hospitals in Bahia contributing to its distribution in Brazil to potentially be further applied in Brazil in the future.

1.5 1.5 PROBLEMATIZATION

Public hospitals are non-profit organizations and hence have other objectives than profit or shareholder value maximization. Therefore the evaluation of their performance should consider other than financial measures. The traditional financial measures for performance evaluation, based on indicators like unit cost or profitability and traditional measures known as “Performance Indicators” (PI) a single relation between one input and one output factor, are not sufficient to express synthetic results about productive efficiency of hospitals due to the incompatibility between observed results and partial indicators (MARINHO, 1998). Performance evaluation of hospitals may include financial measures, but essentially, operational measures calculated based on operational data are more appropriate.

Furthermore, definition of business targets for public organizations is more difficult. Output of the productive process of hospitals is an improvement of the health status which is difficult to measure. An alternative is therefore to model the production of the intermediate good health services by involving a multi-output and multi-input production function (GROSSKOPF, VALDMANIS, 1987). With this approach, relative performance of a group of hospitals can be compared based on their real input and output usage, rather than based on cost and profit.

Based on Motta (1986) the organizational models adopted by public hospital can be differentiated either in traditional public or non-traditional public organizations, whereas the traditional public model is more often found. At present, in the estate of Bahia out of the 41 public hospitals of the estate, 30 are classified by the secretary of health of the estate of Bahia (Secretaria de Saúde do Estado Bahia-(Sesab), as traditional public organizations and 11 as outsourcing models. The traditional public is the incumbent model, whereas the outsourcing is the more recent model which gained importance mostly during the last three years.

The outsourcing model was adopted without primer analysis of its impact on the care model for health surveillance (Modelo Assistencial de Vigilância à Saúde). However Mendes (2005) showed that the understanding of the hospital directors about the care model is not influenced by which organizational models is actually adopted: an analysis made after the implementation of the outsourcing model did not reveal changes in the directors' understanding of the care model. As the involved agents do not understand the importance of the care model for health surveillance and consequently how to include the model for health surveillance in the health service provided, the implementation of the model is difficult. As a consequence of the lacking implementation of the care model, the hospitals become isolated organizations.

The care model includes a selection of cross-sector instruments which are directed towards the identified problems related to the health status which can be differentiated into defects, the respective determinants and resulting risks. This model was adopted by the Brazilian Government and seeks to refer continuously to the identified problems through operational measures which are dedicated to the different groups within the population of the State.

Therefore, this study should assess the benefits of the outsourcing model and their relationship through the comparison of the two models and the analysis if there is a significant difference between the performances between them.

1.6 1.6 HYPOTHESES

- ⇨ By the comparison of the differences between the performances of public hospitals in Bahia with different organization models best practice performers can be identified
- ⇨ Based on the analysis of the identified differences it is possible to identify the dimensions in which less performing entities can improve
- ⇨ As it is the more recent and modern model, the outsourcing model has a significant higher performance than the traditional public model

1.7 1.7 JUSTIFICATION

A sufficient and equal access to health services for the whole population is one of the principal objectives of a country and an important differentiator between developed and emerging countries. In this context, improved services of the public hospitals is one important factor to achieve above objective. As investments and financial resources allocated to public hospitals are limited, a perspective of output maximization of dedicated resources is the most appropriate approach. Therefore, identification of the best practice business models among public hospitals in order to

adjust less performing entities according to the principles of the best practice model is a key factor to improve performance of the sector.

Whereas hospitals in other estates of Brazil have been subject to a performance analysis in the past, for example the analysis made by Marinho on private, public and university hospitals in Rio de Janeiro (2001a, 2001b as well as Marinho and Façanha (1998), (2001), the group of public hospitals in Bahia has not been subject to similar studies before. This was evident by the fact, that data necessary for such an evaluation was not available and often, the understanding of the hospital's management about the importance of such information was often not available. Therefore, the obtained results may bring a new perspective towards performance and new instruments to face future challenges as for example the growing importance of outsourcing models in the public health services of the Estate of Bahia.

1.8 1.8 OBJECTIVES

1.8.1 1.8.1 General objectives

By the application of an evaluation method based on the efficiency frontier method, the Data Envelopment Analysis (DEA), this study applies an additional concept how management of public hospitals and the regulating authorities could analyze operational performance. DEA compares the relative performance of the analyzed hospitals by establishing a performance measure for each of the hospitals

which is composed by the relation between the delivered services (outputs) compared with the applied inputs.

The analysis if performance differs significantly depending on the organizational model should increase the scientific background for future choices between the two models and help to understand the contribution of the outsourcing model to overall management strategy adopted by the Brazilian government.

1.8.2 1.8.2 Specific objectives

This research should give a picture about the general performance of a selection of public hospitals in Bahia with different organization models. For the single hospitals this project should specify how the hospital is performing relative to the performance of the totality leading to a ranking between the analyzed hospitals. As far as the hospitals which are underperforming in the system, the dimensions in which they are underperforming should be identified in order to help the management to develop improvement measures for the specified areas.

The comparison of the performance of the traditional public organizational model and the outsourcing model shall identify the model which is more effective within the perspective of the overall strategy chosen by the secretary of health services of the State of Bahia.

1.9 1.9 Structure of this study

This study is structured in four main parts: a) review of literature, b) presentation of the methodology of this study c) data analysis and d) elaboration of conclusions.

The review of literature starts with the discussion of performance concepts and performance evaluation methods. Then a fundamental part of the review of literature gives a brief overview about organizational theory applied to the hospitals and discusses the two organizational models that are mainly used by the public hospitals in Bahia, the traditional public model and the outsourcing model and how those models are embedded in the public health concept of the Estate of Bahia. Furthermore a brief discussion is made on non-profit organizations. The review of literature closes with the presentation of the model of analysis where the theoretical background of the Data Envelopment Analysis (DEA) is discussed.

The methodology part gives an idea of the concept of this study such as methodologies used for research and data analysis, instrument for data collection and the local and temporal framework.

The data analysis is the key part of this study. The performance of a group of public hospitals of Bahia with two different organization models is analysed, both as a group and separate per organization model.

The data analysis is followed by the conclusions.

2. REVIEW OF LITERATURE

1.10 2.1 DEFINITION OF PERFORMANCE

In managerial accounting, *"performance"* is understood as a measurement of the level to which the objectives set are achieved. In this context, performance is the relationship between the actual output compared to a standard output in relation to the amount of input, it measures the output and the input compared to appropriate objectives, standards and references.

Performance is an efficiency measures, whereas *"efficiency"* compares the relationship between the achieved output in relation to the necessary input necessary. Efficiency means that the input necessary to achieve the desired output is minimized. This distinguishes from *"effectiveness"* which measures only if the desired output or result is achieved, without measuring the necessary input.

2.2 WHAT IS PERFORMANCE MANAGEMENT

The breadth of the subject area and lack of a concise definition make it difficult to identify the boundaries of what is and isn't performance management. The area which is most indicative of the evolution of performance management, and the area perhaps has the most identifiable stream of literature is that of performance measurement, and in particular that of the Balanced Scorecard, with which in many

people's eyes it has become synonymous. The Balanced Scorecard began life as an operational tool designed to measure and help improve operational performance in a manufacturing organisation. Once discovered by an accounting Professor, Bob Kaplan, its scope broadened to the measurement of organisational performance. It has now developed from a measurement tool into a strategic performance management approach of which measurement is but a small part. Balanced Scorecard is a much used, and abused term, in the field but it is the most identifiable concept. However in order to study performance management the comprehensiveness of the subject must be reflected, recognising its vertical and horizontal spread throughout organisations.

With its origins in different management disciplines, performance management includes a variety of activities including the planning and execution of actions required to ensure performance objectives are achieved. Literature is drawn from various disciplines to reflect this.

The area in which the multidisciplinary nature of performance management has been most extensively and effectively investigated is that of performance measurement. Themes from the fields of strategy, accounting and operations management have converged to form a field that is developing a momentum of its own. For example, the most widely known approach to performance measurement, the Balanced Scorecard is now widely used as a strategy development and execution tool but was developed in an operational environment and developed by Bob Kaplan, a professor of Accounting.

Following their review of the performance measurement literature Neely et al. (1995) defined performance measurement its strictest sense as the process of quantifying the efficiency and effectiveness of action. Neely (1998) went on to identify

the activities required to measure performance by defining a performance measurement system as consisting of three inter-related elements: a) individual measures that quantify the efficiency and effectiveness of actions; b) a set of measures that combine to assess the performance of an organisation as a whole; c) a supporting infrastructure that enables data to be acquired, collated, sorted, analysed, interpreted and disseminated.

Importantly this identifies that performance is multidimensional (requiring a number of measures to assess) and an infrastructure to measure and manage.

This is one of the most precise and often quoted definitions of performance measurement, other notable definitions such as those Ittner, Larcker and Randall (2003), Gates (1999) and Otley (1999) broaden the scope of performance measurement to include strategy development and the taking of action. Given the often quoted adage that “what gets measured gets done”, implicit in the growing literature on performance measurement is that performance measurement includes development of strategies or objectives, and the taking of actions to improve performance based on the insight provided by the performance measures. This blurs the distinction between performance measurement and performance management. However the definitions discussed show that performance management is a collection of activities including the setting of objectives or strategies; identification of action plans / decision making; execution of action plans and the assessment of achievement of objectives / strategies.

2.3 WHAT SHOULD BE MANAGED?

The problem of how organisations should assess their performance has been challenging management commentators and practitioners for many years. Financial measures have long been used to evaluate performance of commercial organisations. By the early 1980's however there was a growing realisation that, given the increased complexity of organisations and the markets in which they compete, it was no longer appropriate to use financial measures as the sole criteria for assessing success.

Following their review of the evolution of management accounting systems, Thomas Johnson (1983), (1987) and Robert Kaplan (1984) highlighted many of the deficiencies in the way in which management accounting information is used to manage organisations. They highlighted the failure of financial performance measures to reflect changes in the competitive circumstances and strategies of modern organisations.

Whilst profit remains the overriding goal, it is considered an insufficient performance measure, as measures should reflect what organisations have to manage in order to profit (Bruns, 1998). Cost focused measurement systems provide a historical view, giving little indication of future performance and encouraging short termism (Bruns, 1998).

1.11 2.4 HOW TO MEASURE PERFORMANCE

A range of authors discussed the traditional approaches to measure performance based on Performance Indicators, whereas Thanassoulis, Boussofiane, Dison (1996) are defending the traditional approaches basically due to the ease of use. Barrow and Wagstaff (1989), Chilingerian (1994), Bates (1997) brought several critics to the traditional approach like the incapacity of performance indicators to express synthetic results of productive efficiency, due to incompatibility between obtained results and partial indicators or due to the not precise separation between production process, production inputs and outputs or the inherent limitations due to the incorporation of factors which are out of range to be manipulate. Bittar (1994) conducted a study involving performance indicator measures on public and private hospitals in São Paulo.

Other authors suggest alternative approaches, for example Farrell (1957) suggested to measure technical efficiency by comparison of total factor productivity of an individual entity to the best practice frontier, whereas best practice is constructed by enveloping the input and output data from the analyzed samples by linear programming. Barrow and Wagstaff (1989) adapted Farrell's efficiency frontier methodology for the evaluation of performance of public sector companies. Two main research streams exist analyzing the efficiency frontier: parametrical stochastic frontiers, with a previous established production function (AIGNER, LOVELL and SCHMIDT, 1977) and not-stochastic frontiers calculated by mathematical programming as Data Envelopment Analysis (DEA) developed by Charnes, Cooper and Rhodes (1978) and refined by Andersen and Petersen (1993).

Façanha and Marinho (2001) analyzed Brazilian university hospitals from an economical point of view. The authors started their analysis with an inventory of the inputs and outputs of the hospitals and applied also the DEA methodology. 43

hospitals where analyzed, whereas 19 hospitals achieved a technical efficiency score of 100%. In the final comments, these authors see the advantages of the DEA methodology by providing the management of the respective public hospitals an illustration of the positive proprieties of mechanics of coordination by emphasizing the comparative evaluation instead of a prescribed efficiency to identify and consequently remove inefficiencies.

1.11.1 2.4.1 Introduction of efficiency concept

Beetham (1987) noted the difficulties in measuring the efficiency of the services provided by government agencies. It is difficult to exactly define their products, the determinants for effective delivery, elements of which constitutes an index of their efficiency can potentially be derived. He follows that the demand for quantitative index of output and hence of effectiveness from separate agencies of government will itself skew their efforts towards cure rather than prevention, because it is something measurable and under their own control. A health service can more readily measure the effectiveness of its contribution to curing lung cancer than to preventing it. Decisions about how to define or measure “effectiveness” are thus itself qualitative or political judgments. The same goes for judgments about what level of service is sufficient of constitute an effective provision. In the non-market sector, where supply is related to need rather than to effective demand, such judgments are irreducibly qualitative. One can question whose need is to be met: that of society or the individual? How are such needs to be defined? Up to what cost should they be satisfied? These are political judgments and since in practice judgments about the

cost-efficiency of a given service cannot be divorced from questions about the level of its provision, those too become political. The general conclusion is that any discussion of efficiency cannot be divorced from an understanding of the distinctive activity or practice of the institution under examination and the criteria for assessing the effectiveness of its administration are correspondingly varied. This leads Beetham to mention the importance of comparative analysis to the study of public administration, since it is only through comparison that the distinctiveness of an organization's culture can be identified and that it can be seen as a social product rather than the result of a human nature.

1.11.2 2.4.2 Comparison between performance indicators and DEA

Marinho (2001a) compared the efficiency analysis of public and private hospitals based on performance indicators as well as the Data Envelopment Analysis. He points out the limitations of the performance indicator where two different performance indicators can result in two completely different outcomes.

Thanassoulis et al. (1996) compare Data Envelopment Analysis (DEA) and ratio analysis as alternative tools for assessing the performance of organizational units that use one or more resources to secure one or more outputs, whereas the inputs and/or outputs are possibly incommensurate. The comparison focuses on how well the two methods agree on the performance of a unit relative to that of other units, and on the estimates of targets each method provides for improving the performance of units. It is found that provided the performance indicators capture all variables used in the DEA assessment the two methods agree reasonably closely on

the performance of the units as a whole, thought this depends on the way the performance indicators are combined into a summary figure of performance. The two methods can disagree substantially on the relative performance of individual units. Ratio analysis, unlike DEA, is not found to be suitable for setting targets so that units can become more efficient. This is mainly due to the fact that DEA takes simultaneous account of all resources and outputs in assessing performance while ratio analysis relates only one resource to one output at time. However, the two methods can support each other if used jointly. Whereas DEA rests on the economic notion of a production technology transforming inputs to outputs and is a non-parametric approach for estimating maximum output levels for given input levers or vice versa. These estimated levels are feasible under efficient operation within the transformation technology of the Decision Making Units (DMU) being assess. The estimates lead not only to a measure of relative efficiency but also to other information, notably input and output levels which would render a DMU relatively efficient. Each Performance Indicator (PI) measures performance in relation to one input and one output only, therefore Thanassoulis et al. (1996) combined therefore several performance indicators to gain some view of the overall performance of a unit.

1.11.3 2.4.3 Discussion of possible efficiency indicators for analysis

Marinho (2001a) in his analysis of hospitals in Rio de Janeiro used the indicators number of beds, number of not-physician employees, number of physicians as input factors and the number of treated patients (both ambulant and

interned) as output indicators. In another study, the same author used as input factors the total constructed area, number of active rooms available for consultation, emergency treatment and surgeries, total financial resources received, total number of nurses, total number of physicians, total number of active beds for general care and intensive care, total number of teaching people and as output factors the total number of surgeries, total number of consultations, total number of interned patients, total number of exams, the inverse ratio of total number of hospital infections, the inverse ratio of total number of deaths, total number of releases and total number of residents (MARINHO, 2001b).

Grosskopf and Valdmanis (1987) used as input factors the number of physicians, number of full time employees of non-physician labor, number of admissions and total net plan assets and as output factors the total number of patients days in acute care and intensive care, and total number of interned patients and ambulant patients surgeries, number of consultations for ambulatory and emergency treatments.

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1.13 2.5 ORGANIZATIONAL THEORY APPLICATED TO HOSPITAL ORGANIZATIONS

Mintzberg (1996) mentions the development from a “one best way” approach which has dominated our thinking about organizational structure since the beginning of the twentieth century. Based on Mintzberg (1996) there is a right way and a wrong way to design an organization. A variety of failures, however, has made it clear that organizations differ, that, for example, long-range planning systems or

organizational development programs are good for some but not others. So, recent management theory has moved away from the “one best way” approach towards an “it all depends” approach which is formally known as “contingency theory”. Based on this theory, the structure should reflect the organization’s situation, for example its age, size, type of production system and the extent to which its environment is complex and dynamic. Based on the various attributes of organizations such as parts, coordinating mechanisms, design parameters and situational factors Mintzberg differentiates seven configurations of organizations.

According to Mintzberg, hospitals are of the Professional organization type,

> […]a public configuration which relies on the standardization of skills. The pull to professionalize dominates and having to rely on trained specialized professionals but with considerable control over their work to do its operating tasks, the organization surrenders a good deal of its power not only to the professionals themselves but also the associations and institutions that select and train them in the first place. So the structure emerges as highly decentralized horizontally; where power over many decisions, both operating and strategic, flows all the way down the hierarchy, to the professionals of the operating core. Above the operating core we find a rather unique structure. There is little need for a techno structure, since the main standardization occurs as a result of training that takes place outside the organization. Because the professionals work so independently, the size of operating units can be very large and a few first line managers are needed. The support staff is typically very large too, in order to back up the high-priced professionals. The professional organization is called for whenever an organization finds itself in an environment that is stable yet complex. Complexity requires decentralization to highly trained individuals, and stability enables them to apply standardized skills and so to work with a good deal of autonomy. To ensure that autonomy the production system must be neither highly regulating and complex nor automated.

The basic structure of the professional organization is built by the work of the professionals operators. The professional organization relies for coordination on the standardization of skills, which is achieved primarily through formal training.

Duly trained specialists are hired for the operating core that is given considerable control over their own work. Control over their work means that

professionals work relatively independently of their colleagues but closely with the clients the serve as for example the doctors treating their own patients.

Most of the necessary coordination among the operating professionals is then handled automatically by their set skills and knowledge, in effect, by what they have learned to expect from each other. No matter how standardized the knowledge and skills, their complexity ensures that considerable discretion remains in their application.

Training, reinforced by indoctrination is a complicated affair in the professional organization. Whereas the initial training typically takes place over a period of years in a university or special institution, there follows typically a long period of on-the-job training such as internship in medicine. All that training is geared to one goal, the internalization of the set procedures which is what makes the structure technically public a structure that relies on standardization for coordination.

At an operating level, the professional organization works similar to a set of standard programs or a repertoire of skills the professionals stand ready to use, that are applied to known situations, called contingencies, also standardized. In Mintzberg et al (1996) this process is named pigeonholing. In this connection, the professional has the following basic task:

> to categorize or diagnose the client's need in term of one of the contingencies, which indicates which standard program to apply and to apply or execute that program. In the administrative structure of the professional organization the operation core is the key part. The only other part that is fully elaborated is the support staff although very much focused on serving the activities of the operating core. Given the high cost of the professionals, it makes sense to back them up with as much support as possible. On the other side, the techno structure and middle-line management are not highly elaborated in the professional organization. They can do little to coordinate the professional work. Moreover with so little need for direct supervision of, or mutual adjustment among, the professionals, the operating units can be very large.

Coordination within the administrative structure is another matter, however. Because these configurations are so decentralized, the professionals not only control their own work but they also gain much collective control over the administrative decisions that affect them. This is partly done as part of the administrative work is done by the operating professionals and partly as they ensure that important administrative posts are staffed by professionals or at least sympathetic people appointed with the professionals blessing. What emerges therefore is a rather democratic administrative structure.

1.13.1 2.5.1 Organizational models of public hospitals in Bahia

1.13.1.1 2.5.1.1 Traditional public organization model

2.5.1.1.1 Genesis of the term public and the principals of the public organization theory

The traditional public organizational model represents a bureaucratic form. The origin of the term bureaucratic can be traced back to Jean Claude Marie Vincente in France and the seventeenth century where the increasing importance of the administrative office of this era resulted in the term bureaucratic consisting of the French term “bureau” (agency) and the Greek term “kratia” (power) (MIGOTT; GRZYBOVSKI; SILVA, 2001).

Beetham (1987) summarized the following different uses of the concept of bureaucracy: First, the standard usage of the term “bureaucracy” in the nineteenth century was to indicate a type of political system, literally “rule by the bureau”. It

denoted a system in which ministerial positions were occupied by career officials, usually answerable to a hereditary monarch. Bureaucracy was contrasted with a system of representative government, i.e. the rule of elected politicians accountable to a representative assembly or Parliament. A second usage belongs to the sociology of organization and derives originally from the work of Max Weber. For Weber (BEETHAM, 1987) bureaucracy did not meant a type of government, but a system of administration carried out on a continuous basis by trained professionals according to prescribed rules. This very general concept of bureaucracy as professional administration embodies a double contrast:

first between administration and policy making, which is the responsibility of the association that employs the bureaucracy, and to which it is legally subordinate;

secondly between modern and traditional methods of administration, which are arranged on non-professionalized lines. This general concept belongs to the sociology of organization, with its concern to understand the most general characteristics and types of organization in modern societies.

A third usage derives from the discipline of public administration. As the term implies, bureaucracy here means public administration as opposed to administration within a private organization. The point of the contrast is to identify the differences between the two and to emphasize the qualitatively different character that a system of administration possesses by virtue of its situation within the field of government, such as it compulsory character, its particular relation to the law, its concern with a general rather than a private interest, the public accountability of its operations and so on. In the outsourcing model, a former public administration is turned into a private administration by rendering an outsourcing contract. This

creates a situation where the administration is private, but the services provided continue to be public and importantly, the public administration has the responsibility to choose and to supervise the private administration. Under this point of view the outsourcing model can be seen as private administration opposed to traditional public organizational model where the administration is public. Therefore, this third concept shall be applied to this paper.

A fourth usage derives from political economy. It is concerned with distinguishing organization in economic terms, according to the source of their revenue and this is actually the concept under which we see the traditional public or bureaucratic organizational model for the purpose of this analysis. Based on this, a bureaucracy is defined as a non-market organization, which is financed by means of a general grant form its parent association, in contrast to one that is financed by the sale of its product on the market. The purpose of defining bureaucracy in this way is to emphasize that the character and mode of operation of an organization varies systematically according to the method of its financing, and the economic environment it operates. The financing source for both organization models, the traditional public organization model and the outsourcing organization model, are public resources. The economic function of the public resources are to create workplaces and to maintain a sustainable workforce. In this context, the hospital can be seen as economic organization, however the origin of the financial resources is not relevant for this analysis.

Further, the purpose of constructing an organization model should be discussed.

According to Beetham (1987) there are three different purposes which the construction of a model can serve: first, to provide a definitional test which specifies

the criteria which determine what is to count as a bureaucracy and what is not, secondly, to set a normative standard which seeks to prescribe what are the necessary conditions for organizational efficiency or effectiveness and to explore how far bureaucracy is able to satisfy these conditions; thirdly to develop an explanatory framework which aims to provide a framework for explaining the way bureaucracies function and why they have the respective consequences for the formation and execution of policy. Thus Weber (1919 apud FREUND, 1987) defined bureaucracy as an expression of the rationality of the modern capitalism imposing general rules how to control the operation of organizations of the society (public or private entities). For Weber, bureaucracy is a simple way to establish justice as independent from the single person; equality is created by providing everybody with the respective talent with a chance to fulfill a task or role. Based on Freund (1987), Weber understands bureaucracy as an administrative system which praises hierarchy, authority and the discipline which aims to fulfill the organizational objectives as the implementation of the bureaucracy removes the personal nomination which in earlier societies resulted in arbitrary decisions of sovereign over its inferiors and of powerful people in general.

Weber distinguished ten or eleven basic features common to modern systems of large-scale administration which Beetham (1987) reduced for convenience to the following four main features: Firstly, hierarchy meaning that each official has a clearly defined competence within a hierarchical division of labor and is answerable for its performance to a superior; secondly, continuity in a sense that the office constitutes a full-time salaried occupation with a career structure that offers the prospect of regular advancement; thirdly impersonality meaning that the work is conducted according to prescribed rules, without arbitrariness or favoritism and a written record is kept of each transaction; fourthly expertise as officials are selected

according to merit and are trained for their function and control access to the knowledge stored in the files. These summaries the criteria a system of administration must meet if it is to count public. But Weber also claimed that the closer an organization approximated to his model, the more efficient it was likely to be and that it was the superior efficiency of public association that accounted for its general expansion within modern society. Hence Weber believed that the defining characteristics of bureaucracy were also necessary conditions for administrative or organization efficiency; in effect that his definitional model served as a normative model as well. In Beethem (1987) Weber was cited as follows: “Experience tends to show that the purely public type of administrative organization is from a purely technical point of view capable of achieving the highest degree of efficiency … it is superior to any other form in precision, in stability, in the stringency of its discipline and in its reliability.” It is important to note that Weber’s standard of comparison was not some absolute ideal, but the forms of administration known to past history by unpaid volunteers, local notables, collegial bodies or kinship networks. Furthermore, by efficiency Weber meant not one single characteristic, but a complexity of values which included quality of performance (e.g.; speed, predictability), expansion of scope and cost-effectiveness of operation, which in his view were the characteristics required of an administrative system which had to meet the complex and large-scale administrative needs of a mass industrial society, rather than those of a localized economy geared to the rhythms of nature and the political requirement of a narrow elite.

One of the most important critics on Weber’s model is that the model failed to recognize the ambivalent character of bureaucracy partly because studies of organization were in their infancy in the early decades of the century, but it was also

because his ideas were unduly influenced by the examples of the Prussian army and the Taylorian system of scientific management where the model of machine-like discipline obscured key dimensions of organizations. Such dimensions can be found in alternatives such as the idea of an organization as a social system or network of interpersonal relations: whereas Weber's model of organizational efficiency assumes that all aspects of the individual personality which are not relevant to the strict performance of his or her duties will be cast off as they enter the organization, or suppressed through effective socialization. In practice, people's personalities are never so totally subsumed into their roles.

A different perspective on organization is to see them as communication systems in which the efficient transmission and processing of information is necessary to ensure effective decision-taking. Arguably, Weber's concept of administration puts too much emphasis on the execution of policy, to the exclusion of policy formation and review, both which require effective mechanism for collecting and processing information within the organization. There are good reasons for believing that a strictly hierarchical structure is not the most appropriate for these tasks, for example as its direction of emphasis from the top downwards, whereas the transmission of information also requires effective channels of communication upwards. Further according to Beetham (1987) there is no best way and no universally applicable principles of organizational efficiency and the criteria for effective operation will vary systematically with the purposes, technology and environment of the organization. On this view, it is the task of theory, not to produce a list of abstract generalization that are true everywhere, but to discover which types of organization are most appropriate to which particular kinds of context. Beetham (1987) draw to following two conclusions based on this: First, a structure which works

effectively in one context may not in another and hence it is less a matter of exaggerated hierarchy or rule following as such, but its inappropriateness to the goals of a particular organization in a given environment. Secondly, efficiency is itself a many-layered concept, whose different elements are not necessarily mutually consistent.

Case (1996) points out that Weber developed bureaucracy as administrative system which is based on hierarchy, discipline and submission under authority, defending the fulfillment of the organizational objectives and submitting the employees to a lower level and with limited qualification resulting in a fragmentation between the blue collar and the white collar work which does not allow changes in moments of broad changes which would require the organizations to take decisions quickly and require transparent management.

Freidson (1994) understands that out of the different models available to organize and regulate the services and labor industry as well as the services delivered by the health services the traditional bureaucratic model (either public or private ownership) is appropriate as the professionals are hierarchically controlled and management by their management and/or by the public bureaucracy and their leadership.

2.5.1.1.2 Influence of the bureaucratic theory on the organizations in Brazil

The first bureaucratic administration model implemented in Brazil was nominated as patriarchic as the state and the monarch became one and the most

common practices where corruption and nepotism where servants and supporters received benefits and aristocracy, finally a system that became unsustainable with democracy and capitalism (FREUND, 1987).

As answer to above describe model, the public theory of organization understood as ideology of the power (MOTTA 1986) spread in Brazil which during the nineteenth century influenced the organization of the work in the industries, the public bureaucracy and the administration of educational institutions; however there was limited discussion and criticism in the area of the public management of health services in Brazil.

The Weberian Model or Bureaucratic model was developed with the objectives to come over the institutionalized practices of the Patriotism in an epoch of corruption and nepotism.

The bureaucratic ideas continue strong worldwide including in Brazil where organizations in generally assume the bureaucratic theory as management instrument although it creates some difficulties regarding the administrative transparency.

As some of the organizational structures in Brazil can be considered as obsolete, heavy, hierarchic and centralistic which feeds the inefficiencies of the information system and a mere inexistence of indicators for the evaluation of the services which bears the consequence of increasing costs of the administrative machine as well as the reduction of the delivered services, the non-existence of social control and a reluctance against every form of changes.

According Motta (1986) there are two hypotheses how to explain the delay of certain sectors in organizing their bureaucracies in the most rational and legal

ways: the sectors which are structured most public correspond to those that need to be more efficient given their importance for the state; the social sector by its nature, consist of preferred area for customer based biased practices, which were always strongly present in the political activities in Brazil.

In the decade of 1980, the crisis of the public structure of the public management peaked mainly due to the influences of the following factors: the preceding decades reveled that the estate of social well-being in Brazil may found its end; the internationalization of the financial system resulting from the deregulation of the investments in the European stock exchanges which was basically a tentative to acquire foreign resources to maintain the estate of social well-being in Europe; the global recession as a consequence of the increased interest rates in North America; and the shock of the increased oil prices:

This political outlook set the stage for increasing waves of reformation at the beginning of the eighties, resulting in a second model of public management developed in the United Kingdom and which was defined as New Public Management or Third Way (MACHADO; PINHO, SOUZA et al, 2001).

This new administration model operates under a participative vision enabling the motivation and interaction of all persons involved in the activities of the organization and enhances the acceptance, understanding and implementation of the necessary changes.

During the last 15 years, the technological changes resulted in a colloquial situation of the public structures by increasing the political awareness of the civil society which required a higher control over the public actions and with the globalization decreased the regulation capacity and leadership of the government by requiring profound reforms.

Based on this, all new models upcoming start with a fundamental preamble: the government has to adopt the management principles of private entities and has to transfer the economic control to the market, together with certain services which are considered as public such as health, social assistance, education, research, leaving the government with the responsibility to establish contractual partnerships with the market in order to provide this services.

Starting in the nineties the traditional public organization model is questioned leaving space for other models that are considered as more modern, decentralized and claim to save the citizenship and reorient versus the control mechanism over the results with administrative flexibility, autonomy in management and social control (BRASIL, 2002).

1.13.2 2.5.2 Outsourcing organization model

Under the current context of management, the transformations established based on a new economic order of the world imposed the organizations under a new rhythm in a way that the continuity of the organization depends increasingly from its management autonomy.

The need for a modernization of the public management developed when the public model came towards its end and resulted in a need for new models: According to Franco (1990) in order to understand these models it is important to consider the scenario and political forces preceding those.

During the decade 1970, in light of the globalization, technological changes and unbalanced growth of the government, government itself entered into a crisis, facing a fiscal deficit and seeing its different forms of intervention loosing their power. As the government faced difficulties to maintain itself, the creation of conditions that allow competitiveness in a globalized world, to minimize conflicts and fight against undesired effects became necessary

In accordance with Pereira (2000), the management of public administration in theory increases the efficiency of the social services delivered to the society and requires investments in areas where its direct intervention is required under all circumstances, such as health services.

Under this perspective, a range of countries implement agendas for the reformation of the government and the respective national health services which are characterized by changes in the pattern of their activities as well as of the relationships between private and public in the area of health service. (BRASIL, 2002a).

In 1995, the master plan for the reformation of the public apparatus of the Brazilian government stressed the need to increase the power of the government, or its administrative and management capacities in order to implement the necessary decisions, and also by limiting its activities to its inherent functions such as the definition of public politics, regulation, coordination and implementation of the decentralization which is one of the principles of the organizations of the unique health system – (Sistema Único de Saúde - SUS).

According to Bresser-Pereira (2000), in Brazil, a reformation of the government faces four problems that, although interdependent, can be distinguished: a) delimitation of the size of the government, b) redefinition of its regulative functions,

c) recuperation of the financial regime, and d) the increase of its political capacity to intermediate interests and to guarantee the legitimization and to govern.

Based on this, the proposal to reform the government had to overcome the fiscal crisis, had to pass from a public administration to a managerial administration, more flexibility, privatization, and outsourcing. However, what means outsourcing?

The term “outsourcing” consists of “sourcing” and “out”, meaning that defined resources and competencies are originated from a third party outside the company. According to Cherchglia (1999) the third party

> […] represents an intermediate characterized by an administrative technique where a third party enters, normally a company in a work based relationship. Based on this, outsourcing implies the existence of a partnership with the main objective to optimize the productive output, quality, profitability and competitiveness through a horizontal process where the organizational structure of an entity is simplified in order to focus the efforts on a better methodology to generate the product/service of its purpose activities. Due to the reduction of the salary payments, this allows also a reduction of the product or service price.

It is however questionable, if lower costs resulting from outsourcing would result in lower prices for the customers. Depending on the respective industry and competitive environment, it is likely, the reduced costs will result in higher profits.

McIvor (2005) introduced outsourcing as follows: “Outsourcing involves the sourcing of goods and services previously produced internally within the sourcing organization from external suppliers. The term outsourcing can cover many areas, including the outsourcing of manufacturing as well as services. … Outsourcing can involve the transfer of an entire business function to a supplier. Alternatively, outsourcing may lead to the transfer of some activities associated with the function whilst some are kept in-house. … In many cases, outsourcing is a major strategic decision that has implications for the entire organization.” McIvor (2005) also refers to

the similarity of the outsourcing concept with vertical integration as both are concerned with the decision on whether to perform an activity internally or source it from an external supplier.

Based on the objectives underlying the outsourcing, McIvor (2005) distinguishes two different objectives to outsource: outsourcing to maintain the competitive position of the organization or outsourcing as a source of competitive advantage. The most common reason for outsourcing is to reduce costs and improve performance of a particular activity. Whereas outsourcing to reduce costs can deliver benefits for the organization and impact on the bottom line results at this stage it is only likely to maintain the competitive position of the organization as in many cases, the company is accessing the capabilities of a supplier that are also accessible to its competitor and with that is not a basis for creating competitive advantage. However, organizations can employ outsourcing as a vehicle to achieve competitive advantages. PWC (1999) have found that outsourcing has moved from searching for efficiencies and improvements in a single process or activity, to reconfiguring entire processes in order to obtain greater value across the organization.

Girardi; Carvalho; Girardi Júnior (2003) provided the following definition for outsourcing: third party suppliers organizationally dedicated to the supply of the work forces and services. In a generic way, outsourcing can be defined as contracting third party employees instead of contracting paid work forces directly, or, alternatively, by contracting or accrediting independent suppliers for the delivering professional services within the organization. Every outsourcing relationship establishes a contractual relationship between a principal (contractor) and its agent (contracted party) in which the agent acts on behalf and after determination of the principal. Therefore for the management one of the consequences from outsourcing is the

existence of conflicting interests between the contractors and the contracted parties which creates the necessity to establish norms and rules to define the contractual rules and to monitor the fulfillment of these rules and to whenever necessary to re-negotiate the terms of the relationship and contract.

From a legal point of view, outsourcing is foreseen by article 197 of the federal constitution which permits that heath related services are executed either directly by the government or by contracting third parties (BRASIL, 1988, p. 202).

In view of the government's crisis alternative management models gained importance, especially those, which according to the ministry of health, are know by most of the professionals in the hospital health sector as management innovation, outsourcing, cooperatives, supporting functions, social organizations, management contracts, among others. (BRASIl, 2002, p. 78).

Outsourcing as management model in the health area is recent and therefore the analysis of the outsourcing model is too. In Brazil, the outsourcing model is more frequently seen in larger hospitals where physicians and other professionals suspend their relationship with the public administration in order to organize themselves in cooperatives which become responsible not only for the outsourced delivery of the services but also for the management of the entities itself by a management contract with the government (GESTÃO DE PESSOAL E PROCESSOS DE TERCEIRIZAÇÃO NO SUS, 2003, p. 1).

Based on Santos et alt. (2003) the following characteristics can be observed for the outsourcing modalities in the hospital area:

a) Horizontal organization structure;

b) Increased flexibility and agility;

c) Simplified decision processes;

d) Higher level of shared objectives between professionals and management;

e) Shared control and decentralization;

f) Dedication towards the market and satisfaction of customer needs;

g) Focus towards the essential aspects of the business;

h) Allocation of functions based on competences;

i) Authority based on knowledge, which is valid for professional organizations in general;

j) Distribution of the activities based on competences, which is valid for professional organizations in general;

k) Increased flexibility regarding hiring people and the definition of compensation levels

m) Compensation is based on the team and equality

n) Performance orientation

o) Dedication versus quality

In the Estate of Bahia the outsourcing model in the Health Services is encouraged by the estate law no. 7,027 from January 29th 1997 following the raising debates regarding social organizations with the objective to transfer the management of an health service entity or group of entities after public auction or establishment of

contract not allocated based on auction; fixed assets and public instruments to private entities providing the management the autonomy for purchases and staffing (GONÇALVES, 1998).

In 2003, law numbered 8,647 provided a revision of the terms and conditions for social organization. A special emphasis was made on the adaptation of criteria to ensure a certain quality standard of the services provided to the citizen. Furthermore, a reduction of bureaucratic formalities for the provision of the services was intended, besides the implementation of mechanics to facilitate an integration between the public sectors of the estate, the society and the private sector. Important is also that law number 8,647 emphasis the maintenance of a planning and control system of the activities that allow the evaluation of the effectiveness and the results. The management board of the social organization which is presided by the Administration department of the Estate and counts with the participation of the representatives of the departments of the corresponding areas of activities of the transfered services and represantatives of the civil society which are nominated by the president of the estate receives the expressed responsibility to supervise and monitor the social organizations:

> […] to comment the terms of the management contract to be signed between the department of the Estate of the area corresponding to the activities and services to be transferred and the selected entity, and the operational objectives and defined performance indicators. To evaluate and to accompany the management capacity of the social organization regarding the optimization of the quality standard in providing the services to the citizen. To comment the performance of the social organization in case the objectives defined in the management contracts are not fulfilled.

With that the public sector is submitted to an administrative approach established based on the reforms of the governmental apparatus, in a way that intends the separation between the management functions and the delivery of the

services, with the aim to increase the efficiency of the public expenses. Based on this, the separation of the functions, in the case of the outsourcing of the health services (SUS) is not accompanied by regulatory mechanism which is and important object for critics from the leadership and governing parties active in this area, especially the national advisory board for health (Conselho Nacional de Saúde) (Gestão..., 2003, p. 1). Under this perspective Gonçalves (1998, p.5) confirms that the federal law no. 9,637, article 15 from May 15th, 1998 ratifies the necessity to monitor that the principles of public administration such as legality, impersonality, morality, public service and economics, are fulfilled in management contracts; as well as to establish programs, objectives, terms and limits to compensations and advantages.

1.13.2.1 2.5.2.1 Changes in business environment driving outsourcing

McIvor (2005) lists a range of trends as driver for the increased use of outsourcing. Besides the globalization, developments in information and communication technologies, more demanding consumers, and public sector reforms are another driver which we want to look at more closely. Successive governments have pursued radical public sector reforms which have placed the use of competitive market mechanisms at the heart of these reforms. Proponents of this philosophy argue that assets and activities should be transferred from the public sector to the private sector in order to improve performance. They also argue that the public sector should aspire to levels of performance attained in the private sector. Much of the

force behind this trend has been the prevailing belief that best value is achieved through the use of competitive market solutions for service provisions. The constant drive for cost reduction and the efficient use of resources forced many public sector organizations to consider reducing the scale of government departments and public services. This trend towards radically changing the large hierarchical nature of public sector organizations with more responsive customer-oriented network structures is in common with the changes occurring in many commercial organizations. However, these developments in the public sector have been very controversial. For example, the high level of unionization in the public sector has hindered the freedom with which governments can pursue such reforms.

1.13.2.2 2.5.2.2 The potential benefits of outsourcing

McIvor (2005) cites the following benefits of outsourcing. From the list below, especially cost reductions and performance improvement appear to be the benefits sought by applying outsourcing in the public health care, whereas flexibility, specialization and access to innovation appear to be less relevant.

Cost reductions: In a study carried out by PriceWaterhouseCoopers (1999) it was found that most Western organizations primarily employed outsourcing to save on overheads through short-term cost reductions. For example, Chrysler estimated

that in 1997, through increasing outsourcing of processes to suppliers, it would add $325 million to its annual profits and eventually generate over $1.2 billion in savings (CHALOS and SUNG, 1998) cited in McIvor (2005). Outsourcing enables the customer to benefit from suppliers cost advantages such as economies of scale, experience and locations. Suppliers may take on investment and development costs while sharing these risks among many customers.

Performance improvement: many specialist suppliers can achieve much higher levels of performance in certain activities than can be achieved internally by the outsourcing company. This performance advantage is based not only in the form of reduced costs. Specialist suppliers can also provide the outsourcing company with a higher level of service quality.

Flexibility: due to issues such as rapid changes in technology, reduced time-to-market and increasingly sophisticated consumers it is very difficult for organizations to control and excel at all the activities that create competitive advantages. Outsourcing can provide and organization with greater flexibility. Specialist suppliers can provide greater responsiveness through new technologies than large vertically integrated organizations.

Specialization: outsourcing can allow an organization to concentrate on areas of the business that drive competitive advantage and outsource more peripheral activities enabling it to leverage the specialist skills of the supplier. Through extensive outsourcing organizations have created networks of product and service providers specializing in their distinct area of expertise.

Access to innovation: many organizations are reluctant to outsource because they fear they may lose the capability for innovation in the future. However, in many supply markets there exists significant opportunities to leverage the

capabilities of suppliers into the product and services of the customer organization. Rather than attempt to replicate the capabilities of a supplier network it can be much more prudent to use outsourcing to fully exploit the suppliers' investments, innovations and specialist capabilities.

1.13.2.3 2.5.2.3 The risks associated with outsourcing

In McIvor (2005) the following risks associated with outsourcing are cited. Thereof especially cost increases and organizational change implications appear to be relevant, whereas the supply market risk, and loss of skills appear to be less relevant for the specific case of public hospitals.

Cost increases: there are cases where organizations outsource to achieve cost reductions where costs do not decrease as expected and in some cases can increase. When organizations outsource to achieve cost reductions, there is normally an early anticipation of cash benefits and long-term savings. However, many organizations fail to account for future costs and in particular that of managing the outsourcing process. For example, there is a tendency to under-estimate the management resources and time that have to be invested in outsourcing.

Supply market risk: organizations can encounter significant risks when they use supply markets for activities that they have performed internally in the past. Over dependency on a particular supplier can lead to significant risks in terms of cost, quality and supplier failure.

Loss of skills: outsourcing can lead to the loss of critical skills and the potential for innovation in the future. In the long-term an organization needs to maintain innovative capacity in a number of key activities in order to exploit new opportunities in its respective markets. If an organization has outsourced a number of critical activities, its ability to innovate may be severely diminished.

Organizational change implications: outsourcing has significant social implications for an organization. For example, outsourcing can lead to the redeployment of staff within the customer organization or the transfer of staff to the supplier organization. The demands associated with an outsourcing transcend organizational boundaries, and therefore the approach to managing the change process must ensure that complementary activities and behaviors are exhibited within and between organizations

A common risk of outsourcing could be to loose the functional unity through the existence of multitude and variety of third parties. Another risk is a purely cost-reduction motivated outsourcing, mainly by the reduction of the rights of its work fore. A further often cited argument is the often coexistence of employees under different working conditions and payment policies. Naturally this can be a source of tension between different hospital teams.

1.13.3 2.5.3 Evolution of outsourcing organizational model and comparison to the traditional public model

An effective evaluation of the results of outsourcing is necessary and the monitoring of provided services, essentially regarding the fulfillment of the contractual terms and regarding the quality of contracted services which Duarte (1998) summarizes as “management of the outsourcing contract”. As a further instrument the analysis of level of satisfaction of internal and external customers can be considered.

A range of authors discussed the impact of the ownership on the performance of hospitals: although without profit targets, behavior of public hospital need to maintain relationship with some maximization criteria of operational measures however without harming its main mission which is generally the recuperation, preservation and improvement of the standards of the human health status (MARINHO, 2001).

Grosskopf and Valdmanis (1987) provide a summary of the effects of ownership on efficiency divided in the property rights literature where the attenuation of property rights as the owner’s right to profits reduces the incentives to monitor performances reducing the efficiency and the public choice literature where decision makers in hierarchic not-for-profit organization rather pursue budget maximization than cost minimization. Both streams suggest that public and not-for-profit entities are likely to be inefficient relative to the proprietary hospitals.

In the same article above authors discuss the impact of the ownership on quality whereas conflicting results where obtained: on the one hand public hospital decision makers may maximize their utilities which is a function of quantity and quality or prestige of the services leading to greater capital intensity like undue duplication, over-equipment, over-training of staff. On the other hand, public hospitals

may minimize quality because quality is difficult to quantify when appealing for budget increases to legislatures.

Referring the comparison of the performance of the traditional public organizational model and the third party model, Brasil cited in Bittar (1994) defines outsourcing as a process of transfer of certain function within a company that can be executed by other companies. The transfer happens in different ways and extensions, starting from the outsourcing of certain functions and services like housekeeping or maintenance of equipments and can include the whole management of a hospital. In the same text, Bittar cites Taylor to list possible reasons for choosing outsourcing: specialization of contracted company, cost reduction, difficulties to attract necessary professional in the market, to avoid cost of equipments, buying power of the contracted company, low number of employees per bed, profit increase, increase of hospital's reputation, establishment of new services, improvement of conditions for patient, hiring and retention of physicians.

Duarte (1998) introduced outsourcing in his article on aspects of outsourcing in hospital as a recently highly used term that became synonym of modern management, although it is not really something new in the hospital area, it gets treated as development and solution for the chronic problems existing in the management of medical-hospital services provision.

In most cases outsourcing has a sudden reduction of costs as objectives, however, often only the social cost related to salary payments were reduced. Many hospitals consider as outsourced services a transfer of the functions of a group of employees to a new regime of salary payment and executing exactly the same jobs and functions in the same way as before, with the difference of reduced payments of social tributes and costs and guarantees.

Outsourcing is defined as a transfer of non-core activities not directly linked with the mission of an organization to others with the main objective to remain concentrated on the core activities. A study of Bittar (1994) in eight hospitals in São Paulo showed that basically every hospital has distinctive services that are outsourced, ranging from the sole outsourcing of the cleaning services or the maintenance of high-complexity equipments, whereas in the one with the most outsourced functions only the nursery and medical team, accounting and finance and the management consisted of hospital-own employees. In this case, for every outsourced area a hospital-own resource was responsible to accompany and evaluate the outsourced services and supervise the execution of the contract. According to Taylor (1993) cited by Bittar (1994) and Duarte (1998) in a study in the US 55% of 1.185 analyzed hospitals employ at least one outsourcing company to execute or manage a specific service. The most frequent services outsourced are: laundry, janitor, nutrition, security, IT services, collection, physiotherapy, emergency, anesthesia, audiology and biometrics. According to Duarte (1998) in Brazil the most common outsourced services are: security, janitor, cleaning, maintenance of equipment, removal and outpatient clinics, whereas recently increasingly also laundry, kitchen and sterilization were outsourced. Furthermore it has been observed that tasks whose frequency and volume did no justify the own provision of that service were included in the outsourced services.

Accordingly Duarte (1998) comes to the conclusion that the decision about what should be outsourced in each hospital should be analyzed carefully, considering the specific situations and indications, discussed and analyzed critically by its top management. Such analysis should include among others clear answers to the following questions according to Duarte (1998):

What is our mission?
What is our business?
What is essential (activity and purpose) in our business?
What are the core activities related to our business
Which of these core activities, third parties could potentially execute better than us?
How much do these activities cost under our execution and how much does it cost to acquire them from third parties?
What is the impact of outsourcing a specific sector or services for the satisfaction of our clients?

It is recommended that outsourcing is always aligned with the strategic decision and direction of the hospital, as it defines how an organization operates in its environment and what are its restrictions in competing and looking for opportunities? Looking at a hospital as a highly complex organization, the relation with third party providers can be considered as partnership between companies with distinctive and complementary activities and purposes. Duarte (1998) lists following advantages of a well-implemented outsourcing model:

Concentration of core activities
Productivity improvement
Quality improvement
Increased customer satisfaction
Prevent immobilization of capital for equipment
Cost reduction
Improved competitiveness

1.13.4 2.5.4 Care models in the perspective of an approximation of the care model for health surveillance (modelo assistencial de vigilância da saúde)

1.13.4.1 2.5.4.1 Care models: conceptual aspects

Based on Teixeira (2002), the care model consisted originally of a set-up or organization of processes to provide health services.

In the meantime, according to Paim (2002), the care model is no longer an instrument to organize health services processes and neither an instrument how to administer the system of health services and developed into a more problem oriented approach and was defined by Paim (2002) as a "given set-up how to combine techniques and technologies to solve health related problems and to fulfill the individual and collective health related needs" (PAIM, 2002, p. 374). Although this is has been an issue for long time, the discussion on health politics in Brazil did not favor this topic but instead elements as financing or management of the unique health system (SUS) (Teixeira, 2002). In Brazil, there is a dispute between the different care models, however, mainly two models occupy a dominating role: in the health area, the private assistance medical model and the sanitary care model that both co-exist in a contra dictionary way.

The most important feature of the private assistance medical model is the specialist physician, preferring the utilization of technology for diagnostics and treatment of diseases. And, although mainly curative, they are mainly dedicated to the attendance of spontaneous demand implying a valorization of the hospital as preferred placed to respond to these needs.

Secondly, the sanitary care model constitutes mainly of campaign activities, special programs and initiatives dedicated to the epidemic and sanitary surveillance. Their main subjects are of sanitary nature and their work's main objectives are the ways of transmission and risks of a range of diseases.

In this discussion, the different forms of activities within the health area, and with that the dominating health care models, are contradicting with the doctrine

of the preventive medicine, which came up after the Second World War and is centered within the principles of an integrated attention. Since the seventies, the critics regarding the organization of the health services and especially regarding the sanitary reformation in Brazil, facilitates the development of a broader health concept which received legal bases with the Constitution in 1988 (PAIM, 2002) mainly due to the incentives for the construction of new care models.

There can be found some beliefs that the care models existing in Brazil proved themselves inappropriate to attend the challenges resulting from the health situation of the Brazilian population and from the results of the analyses of the politics and service systems. On an international basis, the discussion regarding a reformation of the health sector gave birth to the development of alternative models as organized supply or programs, health surveillance, health programs, family health and others (PAIM, 1999).

Based on Teixeira (2002), the alternative models started to be operating within the process of organizing the health services per districts which started with the unique and decentralized health system (Sistema Unificado e Descentralizado de Saúde - Suds) in the second part of the eighties. This process brought together a range of attempts to articulate initiative to promote, prevent and rehabilitation in individual and collective dimensions, opening ways for construction of the unique health system and facilitating the protection of health in its most recent conception, which means the reduction or elimination of risks, public politics between different sectors which are all dedicated to life quality, peace and citizenship (PAIM, 2002).

1.13.4.2 2.5.4.2 Care model for health surveillance (Modelo Assistencial de Vigilância da Saúde-MAVS)

The common axis of the ongoing discussions on health surveillance can be found in the epidemiology, both in respect of its contribution for the analyses of health related problems which includes the classification of the general indicators as well as the planning and organization of systems and services or the implementation of new practices and new care models.

These different concepts are not contradicting, but stress distinct dimensions: according to Vilabôas (1998) by providing a definition of the idea of health surveillance, whereas Paim (1994) stresses distinct aspects of the sanitary practices. Paim sees health surveillance as a set of sanitary practices dedicated to control risks, damages and their determinants, considering the problems and needs related to health, whereas the technical dimension is stressed. Mendes (1995) defines the idea of heath surveillance as a sanitary practice organizing the work processes in an integrated way and sees itself in a management function.

In the view of Teixeira (2002) health surveillance includes the following seven basic characteristics:

a) Intervention in case of health problems (damages, risk and/or respective determinants);

b) Focus on problems that need attention and continuous attendance;

c) Operationalization of a risk concept;

d) Articulation between promotional activities, preventive and curative;

e) Cross-sector activities;

f) Activities within its territory

g) Intervention by operations

Independently of what the focus is, the care model of health surveillance is understood as axis of the reorientation process to reorient the care models in a way coherent to the unique health system, given that it is based in its directive and doctrines as well as organization on article 196 of the Brazilian Federal Constitution which defines health as follows (BRASIl, 1988, p.133):

> […] common good and responsibility of the government, guaranteed through social politic instruments and economies that aim the reduction of the risk of a disease and other negative factors and universal and equal access to the activities and services dedicated to its promotion, safeguard and recuperation.

This article grants the citizen the right to access to all public health services, equality regarding his attendance in line with his needs and acknowledgement that every person is an inseparable and integer part of a community. Based on this broader health concept the doctrinal and organizational principles of the unique health systems were developed. These principles are: universality, equality and integrity. The universality implies the guarantee of access to health services to all citizens. With the universality, the individuals receive the right to an access to all public services as well as those which are contracted by the public force. The principles of the equality assures actions and services to al levels in line with the complexity of each case, given that every citizen is equal in front of the unique health system. The third principle the integrity represents that every person is an inseparable part of the community (PAIM, 2002).

The organizational principles include the regionalization, the control hierarchy, decentralization with a unique direction in every sphere of the government, participation of the citizen and the complementary character of the public sector.

The regionalization and control hierarchy corresponds to the service organization in increasing technological levels which can be found in a defined geographic area with a defined population that is served.

The access to the services should occur based on the lowest service level which qualifies to attend and resolve the most important health problems. The other levels have to be used for services that require a higher technological complexity.

The principle of decentralization is understood as a redistribution of the responsibilities for health related activities and services between the different levels of the government. Furthermore, by constitution, the participation of the citizen for the formulation of the health politics and the control of their execution at all levels is guaranteed through representative entities (BRASIL, 1990).

By accepting the principles of the unique service system, the health surveillance model includes to strengthen de activities regarding the epidemiologic and sanitary surveillance, the implementation of the nutritional surveillance dedicated to higher risk groups, the surveillance in the area of the workman's health, taking into account the work environment and the occupational risk; the environmental surveillance in specific epidemic risk areas, without loosing their focus on the necessity to reorient the preventive actions regarding risk and health recuperation, this is the proper medical-ambulatory, laboratory and hospital-based assistance (TEIXEIRA, 2001).

The care model of health surveillance surpasses the current models, by presenting alternatives to overcome the division between collective and individual practices by suggesting a formulation and incorporation of new subjects and extrapolating a set of professionals and health related workforce and by involving the organized population. It represents a proposal that broadens the object for intervention by taking into account not only the clinical and epidemiological determinants in an individual or collective sector, but also, the social determinants impacting the different segments of the population with their impact on the general conditions of living (TEIXEIRA, 2001).

The broader concept of the health surveillance requires the progress in the process of breaking the management of the system down at municipal level as well as the management of local health units within the municipal territory. This requires basic strategies for the consolidation of the unique health system such as the investment in the articulation between sectors, in the reorganization of the primary attendance and in strengthening the social control over the management of the health system (TEIXEIRA, 2002).

1.14 2.6 NON-PROFIT ORGANISATIONS

The review on non-profit organizations shall be made as this author considers the non-profit organizations a) in terms of efficiency measures comparable to public sector organizations in a sense that the organizations aims not primarily to

maximize their profits and b) as non-profit organizations may shall be considered as viable alternative to public organizations.

Non-profit organizations or the so called “third sector” is defined by Seibel and Anheier (1990) “to designate all organizations which are neither profit-oriented business nor governmental agencies or bureaucracies”. Based on Seibel and Anheier (1990) the term was first used by several U.S. scholars (ETZIONI 1973, LEVITT 1973; NIELSEN 1979) and the influential Filer Commission (1975) and was later increasingly applied by European researchers (DOUGLAS 1983, REESE 1987, REESE et al. 1989, REICHARD 1998, RONGE 1988). The term has both normative and strategic roots. For Etzioni (1973) referred to by Seibel and Anheier (1990), the term “third sector” suggested elements of the then widely discussed convergence thesis. Third sector was intended to express an alternative to the disadvantages associated with both profit maximization and bureaucracy by combining the flexibility and efficiency of markets which the equity and predictability of public bureaucracy.

The discovery of a third sector occurred at a time when politicians and policy makers in most Western societies began to reconsider the division of labor between the public and the private sectors, and to examine ways of reducing state responsibilities. This intensified interest in the third sector was supported not only by conservative political forces but also by others from across the political spectrum. The reason for this new, or in some countries rediscovered, interest in the third sector are complex and can be only partially conveyed by catchwords such as “new solidarity”, “sociabilité”, “private initiative”, “self-reliance”, “alternative to both market and state” and “reduction of big government”. The broad range of economic and social attributes which exist under the term “third sector” allow politicians to support those parts of aspects of the third sector which seem to support their own critique

and interpretation of the “welfare state in crisis” This ideological shift of the mid-1970s coincided with growing national and international economic difficulties. The public sector and expectations of what it could or should achieve moved to a more central place in the political agenda.

1.14.1 2.6.1 Characteristics and classifications

Anheier and Seibel (1990) refer to the difficulties in classifying organizations by applying institutional characteristics such as “nonprofit” versus “for-profit” or “private” versus “public”, mainly as result of a continuous shift in what societies define as private and public, for-profit and nonprofit. Political scientists have conceptualized the third sector as an intermediary zone between market and state and have analyzed the way in which third sector organizations act as mediators between the organized economic interest of market firms, labor, and the political interests of state agencies and their constituencies on the other. Whereas most no political science research on the third sector is in the tradition of either micro-economics or organizational analysis, political science research tends to describe the third sector’s macro-political functions. However, political science research in general deals with the third sector’s mediating role and gives little attention to analysis of the sector’s service-providing organizations.

The third sector mediates also between special and general interest. The central characteristic of mediating organizations in this sector is their ability to combine aspects of social and political integration with economic objectives.

Looking at the organizational rationales of non-profit organizations Seibel and Anheier (1990) start from the assumption that any organization located between the market and the state must operate efficiently in allocating goods and services, and obey the same rational dictum as for-profit enterprises and state bureaucracies. But then, in which dimensions are they different from state and market organizations and does this distinction justify their special status? Reichard apud Seibel and Anheier (1990) suggest four variables as underlying rationales which form the basis of the third sector: rationality, formality, solidarity and type of exchange. Thus, third sector organizations tend to be characterized by lower degrees of means rationality and formality and higher degrees of solidarity and direct exchange. Moreover, third sector organizations are defined by a higher degree of autonomy in relation to these aspects than either state agencies of for-profit firms. Therefore, third sector organizations are different in relative, not in absolute terms: they may be less means-rational and less formal, and they may put more emphasis on solidarity and direct exchanges than do organizations in other sectors.

Lastly, the theory discusses not also the underlying organizational rationale of third sector organizations, but examines their functions and contributions to resource allocation and social welfare – such as the question, which third sector organizations achieve results and supply goods and services that cannot be provided by other sectors, including households. There are two broad orientations emerging from this approach. The first is represented by the American micro-economic school which views the third sector either as a combination of market and state failure within the framework of institutional choice, or as an institutional option to reduce transaction costs. In this case, the third sector compensates for the state's failure to meet minority demand for public or semi-public goods. For example Hansmann apud

Seibel and Anheier (1990) argues that nonprofit organizations arise as a response to market failure, such as information asymmetries between producer and consumer and argues that in these cases, nonprofit organizations appear more trustworthy since they have fewer incentives to downgrade quality in order to increase profits. The second approach is represented by neo-corporatist theories: Under this perspective, the third sector offers a buffer zone between state and society and mitigates social tensions and political conflicts. Third sector organizations take on functions which the state, for various reasons, cannot fulfill or delegate to for-profit firms and hence an essential function of the third sector is the institutionalization of organizational responses to “unsolvable” problems.

1.14.2 2.6.2 Economic theories of the nonprofit sector

James (1990) introduces quasi-public goods as goods that yield both social and private benefits and can be funded from either private or social sources. Health care is a common example such as education, cultural activities and social services. Nonprofit organizations are also the major private providers of these services. The questions economists ask are: what factors determine the size of the nonprofit sector? How do nonprofits behave when they bear key responsibility for providing public services? If we shift some of the responsibility for these services from the government to the private nonprofit sector, would this make matters better or worse in terms of variables such as quantity, quality, cost, efficiency and distributional equity? An important question furthermore is why nonprofit organization are preferred in certain cases instead of the government as in many countries, non-profit

organizations are rather in competition with government than with for-profit firms. Secondly, government may be a substitute for non-profit organizations in production, but is usually a complement in financing as from a worldwide point of view private philanthropy is insignificant, which government subsidies are a crucial source of funds to nonprofit organizations, particularly in countries where the nonprofit sector is large.

Weisbrod apud James (1990) views nonprofit organizations, particularly those financed by donations as providers of goods with external benefits, quasi-public goods, in situations where government does not produce as much service or the precise kind of service that people demand. In this sense, nonprofit provision has emerged as market response to excess demand or differentiated demand. Furthermore, specific reasons for the government delegate production of public goods rather than producing itself while he keeps the financing responsibility can be: First, if policy-makers prefer to provide services differentiated by language, religion delegation of production responsibilities to NPO is one way to achieve this objectives. Second, private organizations can more easily charge fees for services, to the government's share of total cost is reduced when production responsibility is delegated to them and more people can be served for the same public expenditure. Third, private organizations may also generate lower costs than government institutions, especially for labor which is partly because such organizations do not face civil service wages and other constraints and partly because historically they have benefited from voluntary donations of time as well money. However, it is not clear whether these lower costs imply lower quality or greater efficiency. This is what we would very much like to know but find it hard to determine because it requires to measure the value added by the organization which is difficult as for example public

and private hospital often deal with different kinds of patients, so if they obtain differential results, we don't know whether this is due to consumer differences ex ante or to the differential value added by the institution.

1.14.3 2.6.3 Examples of efficiency equity dilemmas in the nonprofit sector

Simon (1990) provides a series of examples for efficiency equity dilemmas. He refers to efficiency not only to the economists' notions of productive or Pareto efficiency, but also, more generally, to effective ways of achieving various social purposes. Equity refers not only to horizontally or vertically equal treatment, but also to fairness in the way an institution relates to other individuals and groups. Simon refers to three overarching questions that arise when the modern welfare state considers legal policies affecting the nonprofit sector:

What roles are appropriate for the nonprofit sector to perform?
What methods should the state use to encourage the nonprofit sector to perform such roles?
What regulatory controls should be placed on nonprofit sector relations with the governmental and business sectors and with charitable donors?

These issues overlap a great deal. For example, the question of whether a certain mission is appropriate for nonprofit organizations may be difficult to answer without evaluating the pro's and con's of the methods that may induce nonprofits to undertake such a mission. Similarly, issues of subsidies and issues of regulation are not easily separated.

1.14.4 2.6.4 Appropriate roles for the nonprofit sector

Simon (1990) states that there is evidence suggesting that, controlling for quality, some services may be more cheaply provided by nonprofits than by governmental or for-profit organizations. Sometimes this is the result of the superior ability of nonprofits to attract contributions or volunteer labor of workers accepting lower wages. Sometimes it results from the ability of nonprofits to enforce internal cross-subsidization of one class of users at the expense of another class of users. And sometimes the cheaper nonprofit performance may result from the avoidance of public constraint that attaches to much governmental activity.

There are of counter-arguments concerning inefficiencies attributable to the nonprofit form, as compared to for-profit and sometimes governmental bodies as well. The point is that they beget countervailing equity objections. Finally the public constraints imposed on governmental programs may derive from an insistence on policing these programs to ensure that they serve all elements of the population in the service of equity.

Research has revealed several inherent deficiencies of third sector organizations such as goal diversion, lack of accountability, rent seeking or philanthropic amateurism. Together, these failures and deficiencies account for a more realistic view of organizational behavior in the third sector.

1.14.5 2.6.5 Performance in non profit organizations

Drucker (1990) starts the chapter on performance with the remark “nonprofit institutions tend not to give priority to performance and results. Yet performance and results are far more important and far more difficult to measure and control in the nonprofit institution than in a business. This is explained by the fact that in a business, there is a financial bottom line. Profit and loss are not enough by themselves to judge performance, but at least they are something concrete. When non profit executives face a risk-taking decision, they must first think through the desired results, before the means of measuring performance and results can be determined. Performance means also concentrating available resources where the results are. It does not mean making promise you can not live up to. But equally dangerous is the opposite – to go for the easy results rather than for results that further the mission. Avoid overemphasis on the things the institution can easily get money for, the popular issues, and the easy things.

Drucker (1990) points out that nonprofit organizations are human-change agents and their results are therefore always a change in people, in their behavior, in their circumstances, in their vision, in their health in their hopes, above all, in their competence and capacity. The non profit institution therefore needs to set specific goals in the terms of its service to people and it needs constantly to raise these goals, or its performance will go down. Further important is that organizations are built around information and communication instead of around hierarchy and all people in the information-based organization need to take responsibility for upward communication.

Regarding standard setting, Drucker (1990) stresses the importance to a) set standards and b) set high standards. Especially in developing countries, many people make the same mistake by thinking that as there are untrained, unskilled people, we have to start low. Drucker explains this as if you start low, you can never go higher. More difficult, such organizations also need control of standards.

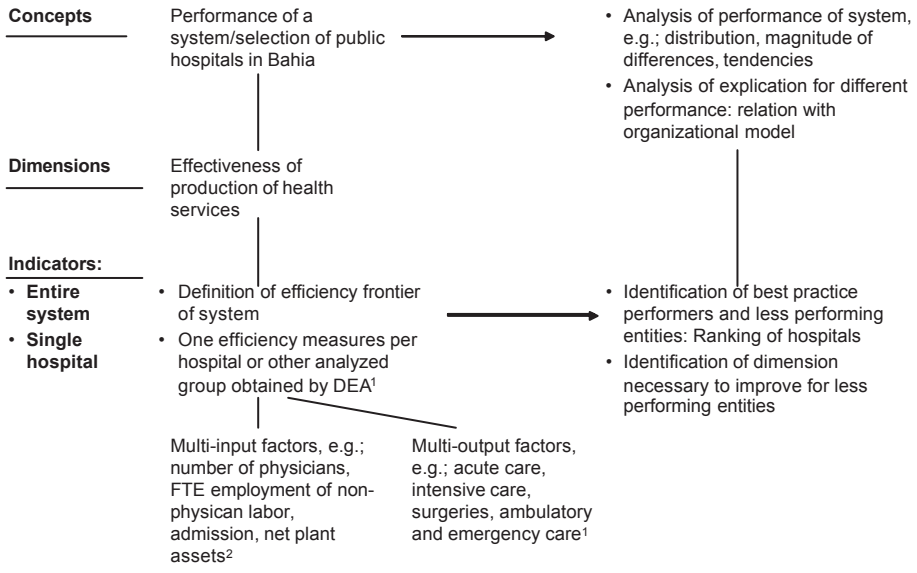
In a summary, Drucker (1990) points out that the performance area is the most important difference between business and non-profit institutions. Businesses usually define performance too narrowly as the financial bottom line. However, as this is too narrow as a performance measurement and performance goal, the company is unlikely to do well or survive very long, although it is very specific and concrete. Different to this, in a nonprofit organization, there is no such bottom line, but instead a temptation to downplay results by arguing that before all, a good cause is been served. However this is not enough, Service organizations are accountable for putting the money where the results are and for performance. Although nonprofit organizations find it hard to quantify the results of their work, this can be done. One needs to define performance for each of the nonprofit's key areas.

1.15 2.7 MODEL OF ANALYSIS

Main concept of the analysis is the performance of the selected hospitals, whereas main performance dimension is the efficiency of the production of health services. A hospital is judged technically efficient if it is operating on the best practice frontier in its industry (GROSSKOPF and VALDMANIS, 1987). The same authors

mention the Farell framework that measures the efficiency of any entity relative to the efficiency frontier by calculating how much the input could be reduced and still produce the same output. This assumes that all entity have access to the same technology. In absence of this condition, an efficiency frontier can be calculated per group with access to the same technology and resources.

The empirical analysis starts with the definition of the input and output factors to be analyzed, possible factors are mentioned earlier (GROSSKOPF and VALDMANIS, 1987) and (MARINHO 2001a, b). Then, with the defined input and output factors one efficiency measure per hospital or analyzed group is calculated by the application by a linear programming method called Data Envelopment Analysis - DEA (CHARNES, COOPER and RHODES, 1978) which also calculates efficiency frontier of the group which is built by the best performing entities (best practice).



1 Data Envelopment Analysis
2 Example from Grosskopf, S.; Valdmanis, V.: Measuring hospital performance. Journal of Health Economics 6 (1987), p. 89-107, 1987, North Holland.

Figure 1 - Model of analysis

1.15.1 2.7.1 Theoretical background of DEA

DEA has opened up possibilities for use in cases which have been resistant to other approaches because of the complex (often unknown) nature of the relations between the multiple inputs and multiple outputs involved in many of activities. The commonly used measure of efficiency is “output divided by input”. Examples are “output per worker hour” or “output per worker employed”. Such measures are referred to as “partial productivity measures” to distinguish them from “total factor productivity measures” because the latter attempt to obtain an output-to-input ratio value which takes account of all outputs and all inputs. In comparison to partial productivity measures total productivity measures helps to avoid imputing gains to one factor that are really attributable to some other input. For example, an increase of output resulting form an increase in capital management might be mistakenly attributed to labor. However, total factor productivity measures bear difficulties such as choosing the inputs and output to be considered and the weights to be used in order to obtain a single-output-to single-input ratio that reduces to a form like expression. The usage of the Data Envelopment Analysis (DEA) does not require the user to prescribe weights to be attached to each input and output as in the usual index number approaches and it also does not require prescribing the functional forms that are needed in statistical regression approaches to these topics as DEA utilizes techniques such as mathematical programming which can handle large numbers of variables and relations. This relaxes the requirements that are often encountered when one is limited to choosing only a few inputs and outputs because the techniques employed will otherwise encounter difficulties. A specialty of DEA is

also that it uses variables weights for the single factors. In particular the weights are derived directly from the data with the result that the numerous a priori assumptions and computations involved in fixed weight choices are avoided. Moreover, the weights are chosen in a manner that assigns a best set of weights to each hospital, in a way that resulting input-to-output ratio for each hospital is maximized relative to all other hospitals when these weights are assigned to these inputs and outputs for every hospital.

DEA is a non-parametrical methodology for a comparative measurement of efficiency of defined Decision Making Units (DMU), whereas the comparative standard efficiency for a defined DMU is given by measuring the development of the performance of the totality of analyzed DMU. As an advantage, resulting references are not theoretically prescribed indicators, but a factor resulting from the analysis of the system and observation of best practice.

Main objective of the model is to explain the relative efficiency of one DMU applying fractional programming: A number *n* of analyzed DMUs are using a number of different inputs "*m"* to produce a number of different outputs "*s".* By fractional programming the maximal relationship between the weighted sum of outputs and inputs are calculated, whereas the model determinates used weights by calculation the input vector $x_j=(x_{1j}, x_{2j}, \ldots, x_{mj})T$ and the output vector $y_j=(y_{1j}, y_{2j}, \ldots, y_{sj})T$ for each DMU j with j=1, 2, …n. The model calculates following variables:

The relative weights for each of the *m* inputs and *s* outputs by a multiple (u_j and v_i)
The maximum extension h_o of the efficiency of a DMU_o, calculated incorporating all inputs and outputs according to following equation:

$$\max h0 = \frac{\sum_{j=1}^{s} u_j y_{jo}}{\sum_{i=1}^{m} v_i x_{io}} \quad \text{subject to} \quad \frac{\sum_{j=1}^{s} u_j y_{jk}}{\sum_{i=1}^{m} v_i x_{ik}}$$

y_{jk} =1

and x_{ik}, positive numbers are output and input of the k^{th} DMU

u_j and v_i = 0 are the weights determined by the solution of above equation

1.15.1.1

1.15.1.2

1.15.1.3 2.7.2 Example areas of application

A variety of applications of DEA (Data Envelopment Analysis) for use in evaluating the performances of many different kinds of entities engaged in many different activities in many different contexts in many different countries. One reason is that DEA has opened up possibilities for use in cases which have been resistant to other approaches because of the complex (often unknown) nature of the relations between the multiple inputs and multiple outputs involved in many of these activities (which are often reported in non-commeasurable units) (COOPER, SEIFORD, TONE, 1999).

A common measure for efficiency for the evaluations of performance of organizations such as hospitals is a ratio like Output divided by Input. Two types of ratios can be differentiated: “Partial productivity measures” and “Total factor productivity measures”, the latter attempts to obtain an output-to-input ratio value that takes account of all outputs and all inputs, whereas “Partial productivity measures” accounts of a single or only some of the inputs and outputs. The advantages of “Total factor productivity measures” are that by combining all inputs and all outputs to obtain

a single ratio helps to avoid imputing gains to one factor (or one output) that are really attributable to some other input (or output). However, the attempt to move from partial to total factor productivity measures encounters difficulties such as choosing the inputs and outputs to be considered and the weights to be used in order to obtain a single-output-to single-input ratio that reduced to a form like expression. With the DEA methodology the user is not required to prescribe weights to be attached to each input and output, nor to prescribe the functional forms that are needed in statistical regression approaches to these topics. DEA utilizes techniques such as mathematical programming which can handle large numbers of variables and relations and this relaxes the requirements that are often encountered when one is limited to choosing only a few inputs and outputs because the techniques employed will otherwise encounter difficulties (COOPER, SEIFORD, TONE, 1999).

To provide an introduction to DEA a single input and output correlation is analyzed in accordance of the example in Cooper et al. 1999:

Table 1 - Example - Single Input and Single Output Case (COOPER et al. 1999)

Store	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Employee	2	3	3	4	5	5	6	8
Sales	1	3	2	3	4	2	3	5
Sales/Employee	0.5	1	0.667	0.75	0.8	0.4	0.5	0.625

The number of employees and sales are as recorded above in each column. Sales per employee are a productivity ratio often used in management and investment analysis. This may also be treated in the more general context of efficiency and we may identify B as the most efficient branch and F as the least efficient. A slope connecting each point to the origin corresponds to the sales per

employee and the highest such slope is attained by the line from the origin through B. This line is called the “efficient frontier”. The efficient frontier touches at least one point and all points are therefore on or below this line. The name Data Envelopment Analysis, in short DEA comes from this property because in mathematical parlance, such a frontier is said to “envelop” these points. Compared to the statistical analysis represented by the regression line which goes through the middle of the data set and distinguishes between the points above the regression line as excellent ant the points below as inferior. One can measure the degree of excellence or inferiority of these points by the magnitude of the deviation of the regression. On the other hand, the frontier line designates the performance of the best store and measures the efficiency of other stores by deviations from it. There thus exists a fundamental difference between statistical approaches via regression analysis and DEA. The former reflects “average” or “central tendency” behavior of the observation while the latter deals with best performance and evaluates all performances by deviations from the frontier line. These two points of view can result in major differences when used as methods of evaluation. They can also result in different approaches to improvement. DEA identifies a point like B for future examination or to serve as a benchmark to use in seeking improvements. The statistical approach, on the other hand, averages B along with the other observations, including F as a basis for suggesting where improvements might be sought (COOPER, SEIFORD and TONE, 1999).

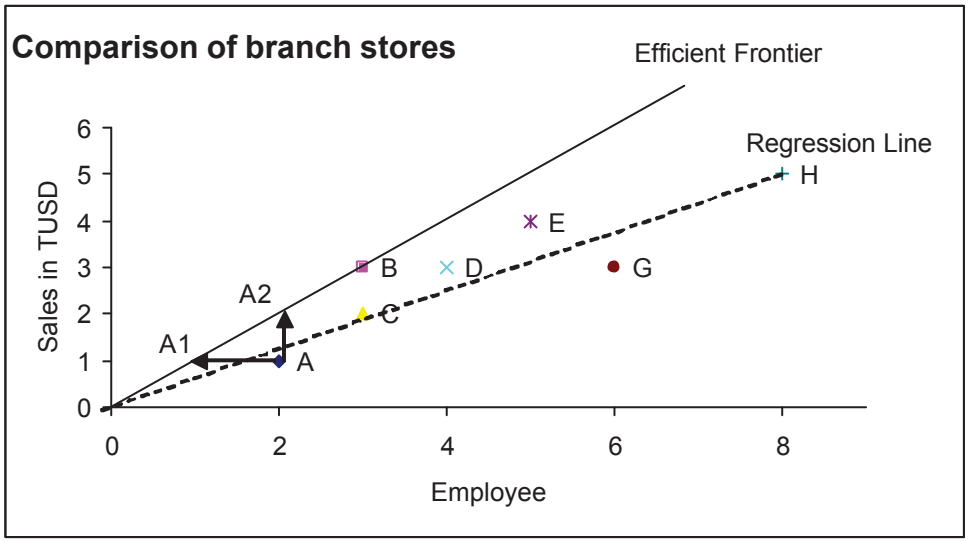


Figure 2 - Example – Efficient Frontier (COOPER et al 1999)

There are two options to move an inefficient dataset up to the efficient frontier: either by reducing the input (number of employees) to reach the point A1 or raising the output (sales) to reach the point A2. Any point on the line segment A1A2 offers a chance to effect the improvements in a manner that assumes that the input should not be increased and the output should not be decreased in making the store efficient. This property, sometimes referred to as “units invariance” has long been recognized as important in engineering and science. The examples used to this point have been very limited in the number of inputs and outputs used. However, the approach is similar for a multiple inputs and multiple outputs data set. One way to simplify a data set that consists of multiple inputs and outputs (as shown in Table 2 would be to weight the various inputs and outputs by pre-selected (fixed) weights.

Table 2- Example Hospital case – Inputs and Outputs (COOPER et al 1999)

Hospital	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Doctors	20	19	25	27	22	55	33	31	30

Nurses	151	131	160	168	158	255	235	206	244
Outpatients	100	150	160	180	94	230	220	152	190
Inpatients	90	50	55	72	66	90	88	80	100

The resulting normalized ratio would then yield an index for evaluating efficiencies as shown in Table 3 below in the raw “fixed”, using the following weights for the values in above set:

V1 (weight for doctor) : v2 (weight for nurse) = 5:1

U1 (weight for outpatient) : u2 (weight for inpatient) = 1:3

Table 3 - Example weights (COOPER et al 1999)

Hospital	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Fixed	1	0.9	0.77	89	0.74	0.64	0.82	0.74	0.84
CCR	1	1	0.88	1	0.76	0.84	0.9	0.8	0.96

This simplifies matters but raises other questions such as justifying the defined weights. Finally there arise also problems with the results shown since it is not clear how much of the efficiency ratings are due to the weights and how much inefficiency is associated with the observation. DEA by contrast uses variable weights and the weights are derived directly from the data with the results that a priori assumptions and computations involved in fixed weight choices are avoided. Moreover, the weights are chosen in a manner that assigns a best set of weights to each hospital, so that the resulting input-to-output ratio for each hospital is maximized relative to all other hospitals when these weights are assigned to these inputs and outputs for every hospital. The row labeled CCR in table 3 above shows the results

obtained from DEA using what is called the “CCR model” in DEA, which was developed by Charnes, Cooper, Rhodes (1978). These efficiency values are always at least as great as the ratio values obtained from the previous fixed value weights. Moreover, this “best ratio” results in general, under the following conditions:

a) all data and all weights are positive (or at least nonnegative);

b) the resulting ratio must lie between zero and unity and;

c) the same weights for the target entity are applied to all entities. Consequently the entity being evaluated cannot choose a better set of weights for its evaluation (relative to the other entities). This means that the evaluation is effected from a point on the efficient frontier so that a value like 0.88 means that it is 12% inefficient.

1.15.2 2.7.3 DEA Models

Different types of DEA models exist; Table 4 summarizes the most important topics for consideration in choosing between the basic DEA models:

Table 4 Comparison of DEA models (COOPER et al 1999)

Model		**CCR**	**CCR-Output**	**BCC**	**BCC-Output**	**Additive (ADD)**	**Slacks-based measure of efficiency (SBM)**
Data	X	Semi-Positive	Semi-Positive	Semi-Positive	Free	Free	Semi-Positive
	Y	Free	Free	Free	Semi-Positive	Free	Free
Translation Invariance	X	No	No	No	Yes	Yes	No
	Y	No	No	Yes	No	Yes	No
Units invariance		Yes	Yes	Yes	Yes	No	Yes
Efficiency measure range "?*"		[0,1]	[0,1]	[0,1]	[0,1]	No	[0,1]
Technical or Mix efficiency measured		Technical	Technical	Technical	Technical	Mix	Mix
Returns to Scale		Constant	Constant	Variable	Variable	Both	Both

"Semi-positive" means nonnegative with at least one positive element in the data for each DMU and "free" permits negative, zero or positive data. The CCR model is based on the assumption that constant returns to scale prevails at the efficient frontiers, whereas the BCC model developed by Banker, Charnes and Cooper (1984) and the Additive models assume variable returns to scale frontiers, i.e.; increasing, constant and decreasing returns to scale. One of the main purposes of DEA study is to project the inefficient DMUs onto the production frontiers, e.g.; the CCR projection and the BCC projection, among others. There are three directions, one called input-oriented that aims at reducing the input amounts by as much as possible while keeping at least the present output levels, and the other, called output-oriented, maximizes output levels under at most the present input consumption. There is a third choice, represented by the Additive and the Slacks-based measure of efficiency model (SBM), both deal with the input excesses and output shortfalls simultaneously in a way that maximizes both. If achievement of efficiency or failure to

do so, is the only topic of interest, then these different models will all yield the same result insofar as technical and mix inefficiency is concerned. The models can also be classified according to whether or not they use the efficiency measure ?*. It is to be noted that ?* is measured in a manner that depends on the coordinate system of the data set. On the other hand the ?* free models, as the additive model are essentially coordinate-free and translation invariant. They evaluate the efficiency of a DMU by the metric distance from the efficient frontiers and are invariant with respect to the translation of the coordinate system. Although they supply information on the projection of the inefficient DMUs onto the production frontiers, they lack a one-dimensional efficiency measure like ?*.

For the purpose of this work The output oriented CCR model was used. The CCR model was selected due to its relatively ease of use and as the constant returns to scale assumptions is believed to be valid for hospitals. As public hospitals operate normally with limited input, the output oriented model, seeking the maximization of the output, given the level of input appeared most suitable.

1.15.3 2.7.4 The number of Input and Output items

If the number of DMUs (n) is less than the combined number of inputs and outputs (m + s), a large portion of the DMUs will be identified as efficient and efficiency discrimination among DMUs is lost. Hence, it is desirable that n exceed m+s by several times. The selection of input and output items is crucial for successful application of DEA, therefore a process of selecting a small set of input and output

items at the beginning and gradually enlarging the set to observe the effects of the added items is generally recommended.

1.15.4 2.7.5 Main differences between the BCC and CRR models

The CCR model generally involves fewer constraints and hence is likely to be slightly more efficient computationally. Second the solutions from this model directly provide more of the pertinent information in forms for use. Based on Ball (1999) most authors to measure hospital efficiency have used the CCR model, probably because it is the simplest form of the DEA methodology, being easier to understand and interpret.

1.15.5 2.7.6 Types of efficiency

Two types of efficiency or inefficiencies can be differentiated: The first is that given a certain output, inputs are being employed in the wrong proportions. This inefficiency is called by Barrow (1989) as allocative inefficiency and by Cooper et al. (1999) as mix inefficiency. The second is that too much input is used, compared to the level of output that is being produced, this is known as technical inefficiency. Barrow (1989) provides as an example of allocative inefficiency the employment of expensive and highly trained personnel such as physicians to perform tasks that

could be performed equally or more effectively by cheaper less specialized personnel such as nursing staff.

Figure 3 below illustrates the allocative and technical efficiency. The isocost line labeled C_1 indicates the combinations of x_1 and x_2 that all generate the same level of expenditure. The allocatively efficient input mix at any level of output will be the mix that minimizes the cost of producing the level of output in question, or equivalently, the mix that maximizes the level of output obtained from a fixed money outlay. This occurs at point C or any other point where the slope of the isoproduction function (isoquant) equals the slope of the isocost function.

The technical efficiency can be illustrated by the isoquant diagram. Whereas in above illustration of the mix efficiency, it was assumed that there was one isoquant associated with each level of output, whereas the further away from the origin the isoquant, the higher the level of output. The location of isoquant is determined only by technology.

Now, to understand the technical efficiency, the allowance is made that some entities may be more efficient at transforming inputs into output than others. Based on this, the isoquants y^0_A and y^0_B are both associated with the same level of output. Under this assumption, A is less efficient, as the isoquant y^0_A implies that more of both inputs are used to produce the same level of output as the more efficient entity y^0_B.

The mix or allocative efficiency analyses the necessary improvement to move a production point such as D on the isoquant by reducing the inputs by determined amounts. The technical efficiency projects a data point that is efficient based on the mix and hence is located on the isoquant, to a more efficient isoquant.

Hence it analyses by how much all inputs can be reduced, whereas the output level is maintained equal.

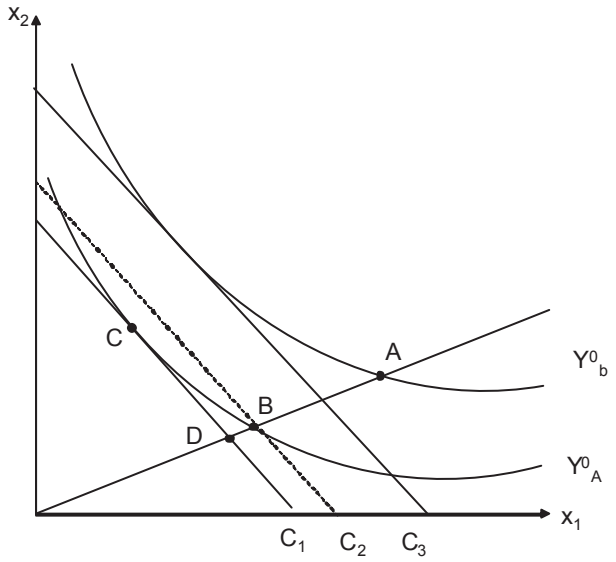


Figure 3 - Allocative and technical inefficiency (BARROW 1989)

1.15.5.1 2.7.6.1 Decomposition of technical efficiency

It is an interesting subject to investigate the sources of inefficiency that a DMU might have. Is the inefficiency caused by the inefficient operation of the DMU itself or by the disadvantageous conditions under which the DMU is operating? For this purpose, comparisons of the (input-oriented) CCR and BCC scores deserve considerations. The CCR model assumes the constant returns-to-scale productions possibility set and hence the CCR score is called global technical efficiency. On the

other hand, the BCC model assumes the convex combinations of the observed DMUs as the production possibility set and the BCC score is called local pure technical efficiency. If a DMU is 100% efficient in both the CCR and BCC scores, it is operating in the most productive scale size. If a DMU has the full BCC efficiency but a lower CCR score, then it is operating locally efficiently due to the scale size of the DMU. Thus, it is reasonable to characterize the scale efficiency of a DMU by the ratio of the two scores.

1.15.5.2 2.7.6.2 Scale efficiency

Scale efficiency is defined as follows. The efficiency scores obtained under the CCR and BCC model for a specific DMU is expressed as T*CCR and T*BCC respectively. The scale efficiency (SE) is defined by SE= T*CCR divided by T*BCC, whereas the scale efficiency is not greater than one. For a BCC-efficient DMU with constant returns of scale characteristics and in the most productive scale size, its scale efficiency is one. The CCR score is called the (global) technical efficiency is one. The CCR score is called the (global) technical efficiency (TE), since it takes no account of scale effect. On the other hand, the BCC expresses the (local) pure technical efficiency (PTE) under variable returns-to-scale circumstances. Using these concepts, relationship demonstrates a decomposition of efficiency as:

[Technical Efficiency (TE)]=[Pure Technical Eff. (PTE)] x [Scale Eff. (SE)]. This decomposition, which is unique, depicts the source of inefficiency, i.e., whether it is caused by inefficient operation (PTE) or by disadvantageous conditions displayed

by the scale efficiency (SE) or by both. The Figure 4 illustrates the different efficiencies existing in a single input and single output case. DMU A is operating locally efficient (PTE=1) and its overall inefficiency (TE) is caused by the scale inefficiency (SE) expressed by LM/LA. For DMUs B and C, their scale efficiency is one, i.e., they are operating at the most productive scale size. For the DMU E we can observe a scale inefficiency PQ/PR and a technical inefficiency of PR/PE. Thus E's overall inefficiency is caused by the inefficient operation of E and at the same time by the disadvantageous conditions of E.

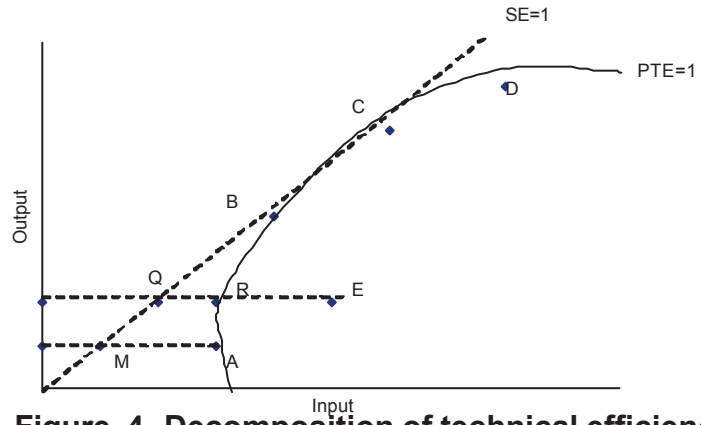


Figure 4- Decomposition of technical efficiency

1.15.6

1.15.7 2.7.7 The reference set and improvement of efficiency

We introduced above the two types of inefficiencies, being the technical and mix efficiency. Applying this concept, to improve efficiency, there are two approaches:

To reduce the input values radially by the technical efficiency ratio (to achieve technical efficiency), whereas the respective proportion of the input values are maintained.

To eliminate the excess input factors or to augment the output values by the output shortfalls (to achieve mix efficiency). This analysis is called the "Slack analyses" and refers to the max slack solution to the maximization problem.

The movements above together are called as CCR projection.

Two types of efficiencies are differentiated: technical efficiency requiring that the technical efficiency score equals to one and the max-slack solution where the number of excess inputs or shortage outputs equals to zero. Consequently, a unit is called CCR efficient only when both of these conditions are satisfied, being the efficiency score of one and all slacks equal to zero. These two conditions do equally fulfill the Pareto-Koopmans efficiency, referring to the economist Vilfredo Pareto and Tjaalling Koopmans cited in Cooper et al (1999): "A DMU is fully efficient if and only if it is not possible to improve any input or output without worsening some other input or output."

1.15.8 2.7.8 Limitations of the DEA model

Among the critics raised by Ball et al. (1999) are the weights. According to Wilkinson (1991) cited in Ball et al. (1999) "the widely varying weighting patterns and the fact that some of the selected factors are completely excluded from the efficiency calculations are likely to produce results of limited value." Therefore, the application

of weight restrictions became a potential area for improvement and respective methods such as the introduction of factor inequalities to the development of closed cones within which the factor weights may vary to a proscribed degree. Ball et al. (1997) cited in Ball et al. (1999) summaries the reasons for the introduction of weight restrictions in a health service context as follows:

> **"A DMU that has specialized in a particular area to the neglect of others currently has more chance of being classified as efficient than the good all-rounder:**
> **The lack of discrimination, given a reasonable number of inputs and outputs, is unsatisfactory, as most DMUs will be 100% efficient. Eliminating factors is conceptually unsound and a very crude form of weight limitation – a variable gets a weight of either zero or one;**
> **In many problems, not all inputs contribute to the production of every output. This raises the possibility of reaching 100% efficiency on the basis of a meaningless ratio:**
> **Allowing some inputs and outputs to be more highly weighted than others may be appropriate, where specialist knowledge or policy suggests this to be sensible."**

Ball et al (1999) mentions the following dimensions that are critical for the outcome of the DEA analysis. The outcome obtained by applying DEA depends heavily on an appropriate selection of the variables. Selected variables should be relevant and contribute to the efficiency calculations. Furthermore, the definition of an appropriate sample is key: the DMUs should be chosen for their inherent similarity rather than according to externally given definitions. Lastly, the presentation of the results is key, instead of discussing average efficiency scores, the results should focus on the performance of each individual DMU with particular reference to target setting for improving efficiency.

3 METHODOLOGY

1.16 3.1 METHODOLOGICAL RESEARCH STRATEGY

The original idea of this research follows a hypothetic-deductive process which started from the Data Envelopment Analysis (DEA) as a possible methodology for the performance analysis, which will be applied to a selection of public hospital in Bahia, Brazil. The project is guided by the hypothesis that a selected group of hospital shows different performances allowing the identification of less performing entities within the system and the assumption that identification of underperforming dimensions is an important instrument for the development of improvement measures.

1.17 3.2 INSTRUMENT FOR DATA COLLECTION

This project is part of a larger research project related to public health services in Bahia Brazil which was proposed to Fundação de Amparo à Pesquisa do Estado da Bahia (FAPESB) in August 2003 involving a comprehensive data request to a range of public hospitals in the State of Bahia through semi-structured interviews which where conducted by trained medical professionals, and documental analysis. Data necessary for the analysis presented in this project should be obtained within this request where data will be collected through forms and questionnaires.

1.18 3.3 METHODOLOGY OF DATA ANALYSIS

Health service includes a multi-input, multi-output production function possible to be modeled with DEA. Furthermore, to compare a series of entities, DEA does not estimate an explicit cost, production or profit function, but instead programming techniques are used to bound or envelop the data with a non-parametrical production function without presupposing the functional form or the technology which could confound the performance-ownership relationship and lead to incorrect interferences.

DEA is a non-parametrical methodology for a comparative measurement of efficiency of defined decision making units (DMU), whereas the comparative standard efficiency for a defined DMU is given by measuring the development of the performance of the totality of analyzed DMU. As an advantage, resulting references are not theoretically prescribed indicators, but a factor resulting from the analysis of the system and observation of best practice.

Main objective of the model is to explain the relative efficiency of one DMU applying fractional programming: A number *n* of analyzed DMUs are using a number of different inputs *m* to produce a number of different outputs *s.* By linear programming the maximal relationship between the weighted sum of outputs and inputs are calculated, whereas the model determinates used weights by calculation the input vector $x_j=(x_{1j}, x_{2j}, \ldots, x_{mj})T$ and the output vector $y_j=(y_{1j}, y_{2j}, \ldots, y_{sj})T$ for each DMU j with j=1, 2, …n. The model calculates following variables:

The relative weights for each of the *m* inputs and *s* outputs by a multiple (u_j and v_i)

The maximum extension h_o of the efficiency of a DMU_o, calculated incorporating all inputs and outputs according to following equation:

$$\max h0 = \frac{\sum_{j=1}^{s} u_j y_{jo}}{\sum_{i=1}^{m} v_i x_{io}} \quad \text{subject to:} \quad \frac{\sum_{j=1}^{s} u_j y_{jk}}{\sum_{i=1}^{m} v_i x_{ik}} = 1$$

and x_{ik}, positive numbers are output and input of the k^{th} DMU

u_j and v_i = 0 are the weights determined by the solution of above equation

1.19 3.4 OBJECTIVE OF ANALYSIS

A selection of the public hospitals of the Estate of Bahia

1.19.1 3.4.1 Local framework

This research is limited to a selection of public hospitals in the State of Bahia.

1.19.2 3.4.2 Temporal framework

The timeframe we intended to analyze originally were the last three to four years (1999-2003). However, as data were only available for 2003, the limits in the availability of data allowed only the analysis of one year.

4 DATA ANALYSIS

1.20 4.1 SELECTION OF THE DEA MODEL

Marinho and Façanha (2001) discussed the choice between the CCR and BCC model considering the fact the hospital have to absorb peeks in demand and therefore operate with excess capacities and consequently short-term balances between demand and offer are not very frequent in such organization. The CCR model makes references to Charnes, Cooper and Rhodes (1978), whereas the BCC model references to Banker, Charnes and Cooper (1984). The basic idea of both models is the comparison of product given by the aggregation of outputs and inputs, whereas the respective weights are allocated in a way that each decision making unit (DMU) is represented in the most efficient and consistent way, based on the available data and the restriction that no DMU can be located beyond the efficiency frontier. The differences between the models are the following:

The BCC model accepts variable returns of scale which results to that a specific DMU is transposed to the efficiency frontier and would correspond to the definition of the composed unit whose references would have similar scales.

The CCR model assumes constant returns of scale, as discussed earlier, which in accordance of the microeconomics theory is more usual in a long-term perspective.

As hospitals have to attend positive peaks of demand, we can assume that hospitals are generally operating with an excess of capacity and therefore short-term balances do hardly exist. Hence, the CCR model represents better the disbalances in the long-term. All DMUs identified as efficient under the CCR model are also efficient under the BCC model, but this relation is not true vice-versa.

The selection of an output oriented model is appropriate, given the public service character of hospitals. The quantity of certain basic inputs can not be reduced as the number of doctors and staffs who are governmental employees are constant and property and equipment can not be sold. Under this hypotheses, a maximization of output with given inputs seems to be more adequate. Nevertheless, the CCR is not sensitive towards if an input- or output orientation is chosen.

1.21 4.2 DATA COLLECTION AND QUALITY OF DATA

The hospitals to be analyzed were identified based on a random selection. The data was collected in a joint effort of a research project of the Núcleo de Pós-Graduação em Administração - NPGA of the Universidade Federal da Bahia (UFBA).

In total 13 researchers, all university trained health professionals, conducted the interviews with the 19 hospitals that finally provided data for this project. The questionnaire was prepared jointly by the researchers and covered the broad scope of the overall research project. The most basic problem of the data gathering was that all hospitals had major difficulties in providing consistent data. Various feedbacks received in the interview indicated, that the information is not actually collected meaning that the requested data does not exist at the moment and it did not appear to be the case instead that the hospitals' management was not willing to provide an external entity with this information. Sometimes several visits and follow-ups were necessary to generate a decent data basis. Although the data requested was quite voluminous, the requested information can be considered as basic management information that should be available to efficiently manage an organization.

The set of data that was finally obtained for our research purpose did reveal serious considerations about the quality of the data gathered. Simple reasonability checks of the data indicated that the data provided is not sound.

Secondly, not all hospital provided data for all dimensions requested, which is a problem for the analysis with DEA as for the selected DEA model, the data point must be different from zero. As a solution, we decided to reduce our analysis to those dimensions where we have sufficient data points that are different from zero for all hospitals.

The issues regarding data quality is not assumed to have limited the empirical analysis per se, however, the results of the analysis may be limited or distorted and should be interpreted with the respective care.

1.22 4.3 HOSPITAL DATA ANALYZED

Originally, it was planned to obtain from the interviews a comprehensive set of data for each hospital covering both productivity and quality aspects. In especial, productivity numbers per medical department i.e. number of inpatients and average length of stays where requested, besides several quality indicators such as mortality and morbidity rates, number of hospital infections, number of passes away, and number of releases. However, due to the limited availability of comparable information for a large number of hospitals lead to the decision to only a small number of indicators. These are as input factors: a) the number of authorization for hospital internalization (AIH); b) number of hospital beds; c) number of physicians; d) number of non physician personnel; and as output factors: a) number of inpatients; b) average length of stay; c) number of patient days. In especial, it has to be considered, that the number of inpatients was calculated based on the number of patients per treatment day and the average length of stay per medical specialty. Furthermore, three hospitals were eliminated, as the basic information regarding the number of inpatients was not available. Remaining were sixteen hospitals, whereas eight are managed through the traditional/public model and eight operate an outsourcing model. Regarding the employee numbers (number of physicians and number of non-physician personnel) it is important to note, that the data obtained was not parameterized to full time employee equivalent due to the availability of this information. Table 5 provides an overview of the hospital and the respective data analyzed.

Table 5 - Overview of hospitals and respective data analyzed

Hospital	(I)# of AIHs	(I)# of beds	(I)# of physicians	(I)# of non-physician personnel	(O)# of Inpatients	(O)Average length of stay	(O)# of patients days
HB 1	1'462.0	45.0	14.0	118.0	1'522.1	2.7	4'161.0
HB 2	1'544.0	35.0	7.0	81.0	1'551.1	4.0	6'278.0
HB 3	3'360.0	75.0	30.0	134.0	479.4	2.6	1'241.0
HB 4	1'920.0	30.0	3.0	74.0	2'155.2	3.0	6'570.0
HB 5	2'161.0	40.0	18.0	45.0	724.0	3.0	2'190.0
HB 6	2'256.0	37.0	7.0	31.0	799.7	3.8	3'029.5
HB 7	15,603.0	462.0	242.0	1'042.0	61'168.4	2.0	121'442.8
HB 8	4'800.0	62.0	80.0	191.0	4'608.5	1.1	5'256.0
HT1	1'344.0	24.0	27.0	134.0	843.2	2.3	1'934.5
HT2	406.0	64.0	11.0	152.0	312.0	17.8	5'564.0
HT3	2'304.0	40.0	59.0	72.0	448.3	4.2	1'898.0
HT4	545.0	110.0	40.0	240.0	8'921.5	2.5	22'411.0
HT5	2'400.0	50.0	15.0	140.0	1'277.5	3.1	4'015.0
HT6	2'640.0	50.0	13.0	119.0	3'732.1	1.8	6'825.5
HT7	1'658.0	22.0	49.0	90.0	541.4	4.7	2'555.0
HT8	331.0	76.0	38.0	126.0	1'153.3	3.4	3'869.0

Source: Field research

1.22.1 4.3.1 Assessment of quality of data analyzed

First plausibility checks of the underlying data indicate that the quality of data is fairly limited: the number of authorization for internalization differs strongly from the number of inpatients. The reason for this could not be investigated further due to the limited access to the hospitals. Based on this and the experience that was

made during the effective data collection, we draw the conclusion, that data quality is limited and conclusion from our analysis should be treated with the respective caution.

1.22.2 4.3.2 Model chosen for analysis

For the purpose of this analysis, the output oriented CCR model was chosen. We assume that the constant returns to scale assumptions should still be valid, as all analyzed entities are delivering health services. For the simulation, the DEA analyzer developed by Cooper, Seiford and Tone (1999) was utilized.

Table 6 - Weights

DMU	Score	V(1) # of AlHs	V(2) # of beds	V(3) # of physicians	1.22.3 V(4) #of non-physician personnel	U(1))# of Inpatients	U(2) Average length of stay	U(3))# of patients days
HB 1	0.4856	0.0001	0.0432	-	-	-	0.1028	0.0002
HB 2	0.9467	0.0001	-	0.0101	0.0105	-	0.0602	0.0001
HB 3	0.2035	-	0.0195	-	0.0258	0.0006	0.2794	-
HB 4	1.0000	-	0.0333	-	-	-	0.0567	0.0001
HB 5	0.6513	-	0.0154	-	0.0204	0.0005	0.2212	-
HB 6	1.0000	-	-	-	0.0323	0.0005	0.1490	-
HB 7	1.0000	0.0000	0.0012	-	-	0.0000	-	-
HB 8	0.6167	-	0.0262	-	-	0.0002	0.0905	-
HT1	0.5920	-	0.0704	-	-	0.0005	0.2434	-
HT2	1.0000	0.0025	-	-	-	0.0001	0.0537	-
HT3	0.5472	-	0.0135	-	0.0179	0.0004	0.1938	-
HT4	1.0000	0.0018	-	-	-	0.0001	-	-
HT5	0.4364	-	0.0458	-	-	0.0001	0.1288	0.0001
HT6	0.7895	-	-	0.0413	0.0061	0.0003	-	-
HT7	0.9437	-	0.0482	-	-	0.0001	0.1354	0.0001
HT8	0.4522	0.0003	-	-	0.0169	-	0.0947	0.0002

In the simulation, as discussed earlier, the model allocated the weights shown in the table above to each input and output factor. The DEA model allocates

weights in order to obtain a single-output-to single-input ratio that is reduced to a form like expression. For this, DEA utilizes techniques such as mathematical programming which can handle large numbers of variables and relations and this relaxes the requirements that are often encountered when one is limited to choosing only a few inputs and outputs because the techniques employed will otherwise encounter difficulties (Cooper, Seiford, Tone, 1999). Furthermore the weights are defined for each DMU and input and output factor and are resulting from the underlying dataset.

In table 6, among the input factors, the highest weight was allocated to the number of beds, whereas the number of authorization for internalization received the lowest weight. Among the output factors, the highest weight was allocated to the output factor average length of stay and the lowest weight was allocated to the number of patient days. For input and output factors, the lowest weight was allocated to the factor that returned the highest number of excess and inputs. Hence it appears that the model softens the largest deviations by allocating lower weights.

On average in the analyzed group two of the input and output factor were allocated zero weight, this means that on average, the efficiency score was calculated using only five of the seven factors. For five hospitals the efficiency score was calculated using all seven factors.

1.23 4.4 ANALYSIS OF EFFICIENCY

The following will discuss both the level of technical efficiency and the necessary reduction in every input factor to move an inefficient unit to the efficiency frontier as well the necessary reductions in inputs in order to achieve mix efficiency.

1.23.1 4.4.1 Analysis of technical efficiency

Table 7 shows the technical efficiency scores obtained by each of the 16 hospitals analyzed. Five out of the sixteen analyzed hospitals were identified as technically efficient compared to their peers. Overall the set of data analyzed returned an average technical efficiency of 72.9%, resulting to an inefficiency of 27.1%. In Marinho (2001a) the following average inefficiencies that were obtained in analysis of hospitals, mainly in the United States in other research. However, apparently, this work involved a larger number of hospitals analyzed, which could lead to smoothen-out extreme values more than in analysis involving a smaller number of hospitals. Marinho, Facanha (2001) in their analysis of 43 University Hospitals in Brazil obtained an efficiency ratio of 17.54%

Table 7 - Average technical efficiency ratio obtained by other authors for the analysis of hospitals

Author	Year	Country	Technical inefficiency
Fare, Grosskopf & Valdamis (1989)	**1989**	**USA**	**7%**
Banker, Conrad & Strauss (1986)	**1986**	**USA**	**12.7%**
Byrnes & Valdamis (1994)	**1994**	**USA**	**16%**
Marinho, Façanha, (2001)	**2001**	**Brazil**	**17.5%**
Ferrier & Valdamis (1996)	**1996**	**USA**	**48%**

Out of the 16 hospitals analyzed with the DEA model, 5 units were identified with a score of 100% technical efficiency. However, those should not be seen as not having any potential for efficiency improvement as the obtained score is an indicator for the consistence and balance between inputs and outputs compared to the analyzed group. A maximal efficiency does not mean a complete absence of inefficiencies, but the frequency, size and type of problems found in inefficient units recommend investigations for the whole system.

Table 8 - Technical efficiency ranks – All hospitals

DMU	Score	Rank
HB 4	1	1
HB 6	1	1
HB 7	1	1
HT2	1	1
HT4	1	1
HB 2	0.94672	6
HT7	0.943658	7
HT6	0.789488	8
HB 5	0.651345	9
HB 8	0.616691	10
HT1	0.592039	11
HT3	0.547199	12
HB 1	0.485625	13
HT8	0.452162	14
HT5	0.436383	15
HB 3	0.203497	16
Average	**0.729050**	

1.23.2 4.4.2 Composition of the efficiency frontier

The reference set/efficiency frontier is defined for each unit analyzed to analyze the unit's projections to the efficiency frontier. For this, the model, identifies

for each hospital, those hospital that are the closest in terms of the analyzed factors and obtained efficiency rate and can therefore be used as reference set.

Based on the identified reference sets, for each hospital is quantified in how much all outputs have to be increased to improve the efficiency, whereas the level of input is maintained. The reference set is defined for each unit and is composed by one or more of the units that were identified as technically efficient, hence have a technical efficiency score of 1.

The reference set for the units with efficiency score 1 are the units itself as they build the efficiency frontier. For the units with an efficiency score lower than 1, two to four hospitals were used as reference set, whereof hospital HB 7 was used eleven times, followed by hospital HT2 which was used ten times, hospital HB4 five times, four times hospital HB6 and once hospital HT4. The reference set for the analysis of all hospitals can be found in the Appendix 10.4.

1.23.3 4.4.3 Mix efficiency

As previously discussed, the slack analysis seeks to satisfy the Pareto-Koopmans efficiency and calculates by how much each input and output factor can be decreased (input) respectively increased (output) without reducing the achieved productivity level. It is important to note that the analysis below analyzes the mix efficiency only and does not take into account the shortage outputs that have to be eliminated in order to reach technical efficiency.

Table 9 – Slack analysis

DMU	Score	Excess # of AIHs S-(1)	Excess # of beds S-(2)	Excess # of physicians S-(3)	Excess # of non-physician personnel S-(4)	Shortage # of Inpatients S+(1)	Shortage Average length of stay S+(2)	Shortage # of patients days S+(3)
HB 4	1.0000	-	-	-	-	-	-	-
HB 6	1.0000	-	-	-	-	-	-	-
HB 7	1.0000	-	-	-	-	-	-	-
HT2	1.0000	-	-	-	-	-	-	-
HT4	1.0000	-	-	-	-	-	-	-
HB 2	0.9467	-	0.43	-	-	651.64	-	-
HT7	0.9437	1'253.09	-	44.91	37.60	-	-	-
HT6	0.7895	20.35	0.14	-	-	-	0.91	3'103.85
HB 5	0.6513	61.99	-	9.53	-	-	-	470.30
HB 8	0.6167	2'864.35	-	49.55	50.47	-	-	6'759.55
HT1	0.5920	910.60	-	19.27	78.23	-	-	622.25
HT3	0.5472	1'164.20	-	50.83	-	-	-	455.49
HB 1	0.4856	-	-	1.04	12.08	110.64	-	-
HT8	0.4522	-	20.41	22.28	-	160.51	-	-
HT5	0.4364	250.45	-	6.45	19.28	-	-	-
HB 3	0.2035	1'038.86	-	12.42	-	-	-	2'385.35

1.23.3.1 4.4.3.1 Input factors

The largest excess input was identified for the number of authorization for hospital internalization, especially for hospitals HT7, HB8, HT3 and HB3 where the excess number identified was larger than 1,000. However, as this input factor was allocated a lower weight, the excess of respective factor did not proportionally result in lower efficiency and hospital 15 ranked still seventh with a score of 94%.

The operational reason for the identified excess in number of authorizations can not be clarified at this stage and should be discussed with the administration of the respective hospital. The other input factors such as the number of physicians and number of non-physician as well as the number of beds with an showed considerable lower excesses in absolute terms, however all of them were

allocated considerably higher weights and therefore these excesses resulted in a relative higher deviation from the efficiency frontier.

1.23.3.2 4.4.3.2 Output factors

The shortage of patient days showed the highest deviation of all factors analyzed, especially hospital HB8, HT6 and HB3 who returned shortages of 6,760, 3,104 and 2,385 days respectively. Three hospitals, HB2, HB1 and HT8, returned a shortage in number of patient admissions and only for HT6 a shortage in average length of stay was identified.

1.23.4 4.4.4 Projection

The projection per Decision Making Unit (DMU) returns the shortage output and excess input to reach technical efficiency and the mix efficiency. For DMUs that were identified as inefficient in the output oriented model, the projection to the efficiency frontier is made in two steps: First by increasing all output factors by the identified technical efficiency. This is obtained by dividing the value of the output factors by the technical efficiency score. Secondly, based on the results of the slack analysis, either the number of inputs has to be reduced by the identified excesses or the number of the respective output factors has to be increased by the differences

obtained in the slack analyses. As an example this is showed below for one hospital. The projection for the other hospitals can be found in the Appendix.

Table 10 - Example projection – HB1

Technical efficiency score **Factor**	**0.4856** **Value**	**Step 1: Increase output to achieve technical efficiency**	**Step 2: eliminate excess input and shortage outputs to achieve mix efficiency**	**Total projection**
(I) # of AIHs	1'462.00	-	-	0.00%
(I) # of beds	45.00	-	-	0.00%
(I) # of physicians	14.00	-	(1.04)	-7.40%
(I) # of non-physician personnel	118.00	-	(12.08)	-10.24%
(O) # of Inpatients	1'522.06	3'134.23	110.64	113.19%
(O) Average length of stay	2.73	5.63	-	105.92%
(O) # of patients days	4'161.00	8'568.35	-	105.92%

Technical efficiency is achieved by dividing each output with the obtained efficiency score. This increases each output in the same proportion. Mix efficiency is achieved by reducing either the respective inputs by the respective number identified in the slack analysis or by increasing the output by the respective slack number. Total projection is obtained by the sum of both movements.

1.24 4.5 ANALYSIS OF HOSPITALS OPERATING UNDER OUTSOURCING MODEL

To compare further the efficiency differences between the outsourcing model and the traditional public model, we run the analysis separate per group of

hospitals operating under the outsourcing model and the group operating under the traditional public model. Whereas the analysis of the totality of hospitals as presented earlier in table 8 identified two outsourcing hospitals with a 100% technical efficiency score, the analysis of the group of outsourcing hospitals, as presented in table 11 below, identified additional two hospitals with 100% technical efficiency score. Overall, all outsourcing hospitals achieved a higher efficiency in the analysis among the group of the outsourcing hospitals than in the analysis together with the traditional public hospitals as presented in table 8 earlier. The average efficiency of the group of outsourcing hospitals is 78.9% compared to 72.01% for the outsourcing hospitals within the group consisting of all hospitals.

Table 11 - Comparison between efficiency ratio outsourcing models versus all hospitals

DMU	Technical efficiency - outsourcing hospitals	Rank - outsourcing hospitals (total 8)	Technical efficiency - all hospitals	Rank - all hospitals (total 16)
HT7	1.0000	1	0.9437	7
HT6	1.0000	1	0.7895	8
HT2	1.0000	1	1.0000	1
HT4	1.0000	1	1.0000	1
HT1	0.7215	5	0.5920	11
HT3	0.6291	6	0.5472	12
HT5	0.5090	7	0.4364	15
HT8	0.4533	8	0.4522	14
Average	**0.7891**		**0.7201**	

1.25 4.6 ANALYSIS OF HOSPITALS OPERATING UNDER TRADITIONAL PUBLIC MODEL

The analysis of all hospitals, as presented in table 8 earlier, identified three traditional public hospitals with 100% technical efficiency score. In the analysis

among the traditional public hospitals only presented in table 12 below, one additional traditional public hospital was given the technical efficiency score of 100.0%. Hospital HT7 scored a technical efficiency score of 1 instead of the score of 94.7% returned in the analysis with all hospitals.

As in the separate analysis of the group of outsourcing models, all traditional public hospitals achieved a higher score in the analysis within their peer group than together with outsourcing models. The average technical efficiency score of the traditional public hospital however is with 81.5% considerably higher than the average of 73.8% achieved in the analysis of all hospitals.

The result that the traditional public hospitals return in the separate analysis per organization model a higher technical efficiency score than the outsourcing hospitals indicates that the traditional public hospitals have a higher efficiency than the outsourcing hospitals. However this shall be further understand through the analysis of the cumulated projection per factor.

Table 12 - Comparison between technical efficiency ratio traditional public models versus all hospitals

DMU	Score - traditional public hospitals	Rank -traditional public hospitals (total 8)	Score - all hospitals	Rank - all hospitals (total 16)
HB 7	1.0000	1	1.0000	1
HB 6	1.0000	1	1.0000	1
HB 2	1.0000	1	0.9467	6
HB 4	1.0000	1	1.0000	1
HB 1	0.7931	5	0.4856	13
HB 5	0.7561	6	0.6513	9
HB 8	0.6350	7	0.6167	10
HB 3	0.3328	8	0.2035	16
Average	**0.8146**		**0.7380**	

1.26 4.7 CUMULATED PROJECTION PER FACTOR

Based on the projection and the comparison of the data and projected value, we can calculate the reduction or increase potential per input and output factor for the analyzed set of hospitals overall.

As shown in table 13 below, for the group of all hospitals, the relative biggest potential to increase output is with 48.93% the average length of stay. The split of the results of all hospital per organization model returns a quite equal contribution to the identified increase potential of 25.02% from the traditional public hospitals and 23.91% of the outsourcing hospitals. However, taking into account that the outsourcing hospitals are smaller on average, the output shortage for the number of patients days and the number of inpatients appears to be bigger for the outsourcing hospitals.

Based on our analysis the number of patient days could be increased by 21.38% with again equal contribution of 11.88% and 9.50% from the traditional public hospitals and the outsourcing hospital respectively. The number of in patients could be increased by 14.16%.

For the input factors, the largest relative reduction potential is identified for the number of physicians , followed by the number of authorization for

internalizations. The other input factors, the number of non-physician personnel and the number of beds have reduction potential of 7.09% and 1.72% respectively.

Table 13 - Accumulated projection per factor – all hospitals

	Factor	Data	Projection	Difference	% of total	% of group
All hospitals	(I) # of AIHs	44'734.00	37'170.11	(7'563.89)	-16.91%	-16.91%
	(I) # of beds	1'222.00	1'201.02	(20.98)	-1.72%	-1.72%
	(I) # of physicians	653.00	436.72	(216.28)	-33.12%	-33.12%
	(I) # of non-physician personnel	2'789.00	2'591.33	(197.67)	-7.09%	-7.09%
	(O) # of Inpatients	90'237.64	103'014.88	12'777.24	14.16%	14.16%
	(O) Average length of stay	62.28	92.75	30.47	48.93%	48.93%
	(O) # of patients days	199'240.30	241'843.71	42'603.41	21.38%	21.38%
	Factor	**Data**	**Projection**	**Difference**	**% of total**	**% of group**
Traditional public hosptials	(I) # of AIHs	33'106.00	29'140.80	(3'965.20)	-8.86%	-11.98%
	(I) # of beds	786.00	785.57	(0.43)	-0.04%	-0.05%
	(I) # of physicians	401.00	328.46	(72.54)	-11.11%	-18.09%
	(I) # of non-physician personnel	1'716.00	1'653.44	(62.56)	-2.24%	-3.65%
	(O) # of Inpatients	73'008.38	80'598.37	7'589.99	8.41%	10.40%
	(O) Average length of stay	22.36	37.94	15.58	25.02%	69.71%
	(O) # of patients days	150'168.30	173'840.71	23'672.41	11.88%	15.76%
	Factor	**Data**	**Projection**	**Difference**	**% of total**	**% of group**
Outsourcing hospitals	(I) # of AIHs	11'628.00	8'029.31	(3'598.69)	-8.04%	-30.95%
	(I) # of beds	436.00	415.45	(20.55)	-1.68%	-4.71%
	(I) # of physicians	252.00	108.26	(143.74)	-22.01%	-57.04%
	(I) # of non-physician personnel	1'073.00	937.89	(135.11)	-4.84%	-12.59%
	(O) # of Inpatients	17'229.26	22'416.51	5'187.25	5.75%	30.11%
	(O) Average length of stay	39.92	54.81	14.89	23.91%	37.29%
	(O) # of patients days	49'072.00	68'003.01	18'931.01	9.50%	38.58%

To further understand the performance per organization model, the accumulated projection will be analyzed separate per group of hospitals with the same organization model and the results obtained shall be compared to the results obtained in the analyses will all hospitals.

To compare the performance of the two groups per organization model we compare the shortage per output factor returned by each model:

For the number of inpatients, the traditional public hospital return with 7.58% compared to 19.73% of the outsourcing hospital a lower shortage output. The same is valid for the number of patient days where the shortage of the traditional public hospitals is 15.95% compared to 24.34% for the traditional public hospitals. For the output factor average length of stay, the shortage in output is with 33.70% higher for the traditional hospitals compared to 26.20% of the outsourcing hospitals.

The excess input of all factors is higher for the outsourcing hospitals.

Table 14 - Accumulated projection per factor – Traditional public hospitals

Factor	Data	Projection - separate	Difference - separate	% - separate
(I) # of AIHs	33'106.00	30'874.99	(2'231.01)	-6.74%
(I) # of beds	786.00	767.46	(18.54)	-2.36%
(I) # of physicians	401.00	314.08	(86.92)	-21.68%
(I) # of non-physician personnel	1'716.00	1'629.07	(86.93)	-5.07%
(O) # of Inpatients	73'008.38	78'539.49	5'531.11	7.58%
(O) Average length of stay	22.36	29.89	7.54	33.70%
(O) # of patients days	150'168.30	174'114.78	23'946.48	15.95%

Table 15 - Accumulated projection per factor – Outsourcing hospitals

Factor	Data	Projection - separate	Difference - separate	% - separate
(I) # of AIHs	11'628.00	6'851.68	(4'776.32)	-41.08%
(I) # of beds	436.00	406.54	(29.46)	-6.76%
(I) # of physicians	252.00	176.77	(75.23)	-29.85%
(I) # of non-physician personnel	1'073.00	984.04	(88.96)	-8.29%
(O) # of Inpatients	17'229.26	20'628.48	3'399.21	19.73%
(O) Average length of stay	39.92	50.38	10.46	26.20%
(O) # of patients days	49'072.00	61'014.66	11'942.66	24.34%

5 CONCLUSIONS

1.27 5.1 IDENTIFICATION OF BEST PRACTICE PERFORMERS

With the analysis of all 16 hospitals, five hospitals were identified with 100% technical efficiency score. Whereof three operate the traditional public organizational model and two are organised based on the outsourcing model. From the three traditional bureaucratically organized hospitals two are rather small hospitals with a number of beds and number of physicians below the average of 76 (number of beds) and of 41 (number of physicians) of the analyzed group. The third traditional public hospital together with two hospitals that operate an outsourcing model are larger hospitals.

In the analysis of the 8 hospitals with an outsourcing model two hospitals with 100% technical efficiency score were identified. Both are rather small hospitals.

The analysis of the group consisting of the 8 traditional public hospitals revealed one hospital with 100% technical efficiency score.

Through the use of the Data Envelopment Analysis we were able to identify best practice performers, both within the total group of analyzed hospitals and also separate per group each consisting of the hospitals operating either the traditional public organizational model or the outsourcing model. Furthermore, the results received from the analysis of all hospitals or in the group per organization model were fairly consistent. Hence, the hypothesis that by comparison of the

differences between the performances of public hospitals in Bahia best practice performers can be identified has proved true.

The identification of best practice performers can be useful in order to use the respective hospital as role model for others. Furthermore, the results of this analysis, given that the underlying data has proved the necessary consistency, could be used as one factor to distribute the available resources by seeking to allocate the available resources to the most efficient hospitals

1.28 5.2 IDENTIFICATION OF DIMENSIONS TO BE IMPROVED

For the group of all hospitals, the relative biggest potential to increase output is with 48.93% the average length of stay. The number of patient days could be increased by 21.38%. The number of inpatients could be increased by 14.16%.

For the input factors, the largest relative reduction potential is identified for the number of physicians, followed by the number of authorization for internalizations.

The deviations identified were consistent both for the analysis of all hospitals and the analysis by organizational model with the exception that the outsourcing hospitals appear to have a higher reduction potential in number of AIHs, whereas the traditional hospitals appear to have a higher potential to increase the average length of stay compared to the outsourcing hospitals.

The conclusion can be drawn that the major area to increase output are the average length of stay, however the other output factors, the number of patient days and the number of inpatients show a considerable potential for increase.

Among the input factors, the largest excess appears to be the number of physicians and the number of authorization for hospital internalization, whereas the other input factors, the number beds and the number of non-physicians personnel return lower values for reduction potential.

1.29 5.3 COMPARISON OF THE PERFORMANCE OF THE OUTSOURCING MODEL COMPARED TO THE TRADITIONAL PUBLIC MODELS

We started with the initial hypothesis that the outsourcing model, being the more modern model, has a significant higher performance than the traditional public model. Out of the 16 hospitals, the number of traditional public hospital identified with 100% technical efficiency score and the number of outsourcing hospitals with 100% technical efficiency score was equally distributed. Based on this result, the performance of both organization models appear to be similar.

The separate analysis of the technical efficiency per organisation model returned higher technical efficiency rates for both organization model, however, the traditional public hospitals returned a higher technical efficiency than the outsourcing hospitals. This inicates that the traditional public hospitals have a higher efficiency than the outsourcing hospitals. In the separate analysis, for both organizational models one additional hospital was identified as technically efficient.

In the analysis of the accumulated projection per factor and organization model, compared to the traditional public hospitals, the outsourcing hospitals returned larger excess for all input factors and larger shortage for two of the three

outputs. Based on this we draw the conclusion that the outsourcing hospitals have a lower efficiency than the traditional public hospitals. Based on these results, the hypothesis that the outsourcing hospitals have a higher efficiency than the traditional public hospitals must be denied.

1.30 5.4 OTHERS

1.30.1 5.4.1 Data quality

The data that was made available for this analysis has been very limited, both in apparent data quality, but also in quantity. Therefore, the results and conclusions drawn from this analysis should be treated with the respective caution.

An effective management requires the monitoring of key financial and operational information. Hence, the experiences we made with the availability of such data within public hospitals indicates, that management can rely only to a very limited extend on sound and concise data to base their decisions on. In order to allow a representative conclusion about the different performance of organizational model, first of all a sound set of data has to prepared, which allows not only the analysis at a specific point in time, but also the historic development of the hospital's or hospital group's performance. Therefore, an important finding of this project is that there seems to be a considerable lack of information at the different hospital analyzed and it may be recommended to focus to generate a sound database of management information in order to efficiently manage and guide these hospitals in the future

Drucker (1990) points out the importance for organizations to be built around information and communication. Hence the limited availability of data in the analyzed set of hospitals gives the impression, that the organizations do not have the necessary instrument to evaluate performance and hence, lack the most important factor to be a performance orientated organization.

1.30.2 5.4.2 Limitations and recommendations for future studies in this area

As discussed above, this study has been fairly limited by the quality of the data received. Respectively, the results obtained thereof shall rather be seen as an indication, how DEA could be applied to analyze the performance of hospitals. The review of literature has proved, that the method of analysis has been successfully used for the analysis of hospitals, both in other Estates of Brazil and abroad.

Nevertheless, the specific results the hospitals as well as the conclusion shall therefore be threatened with caution.

In this analysis, a total of 16 hospitals have been analyzed. This limited number may result in an unproportional importance of outliers. Better results may be obtained by analyzing a larger number of hospitals, where the effect of outliers are softened more by the group.

As a consequence of the limited amount of data available, a total of six factors thereof four input factors and two output factors where analyzed. The inclusion of a larger number of factors may result to a more reliable result

Regarding the factors analyzed, the input factors did mainly represent capacity related factors such as number of beds or physicians. Ideally, we could include also financial or other physical capacity factors such as the area constructed. The output factors analyzed were mainly pure production output such as number of patient days and average length of stay. It could be for benefit of the analysis to analyze quality related factors such as the number of hospital infections or other production outputs such as the number of passes away. This factors where requested in the questionnaire, however, respective information could not or only be partially obtained from the hospitals.

An other potential area for improvement area the analyzed input and output factors: the factors where not differentiated per clinical specialty. A more comprehensive analysis may consider separate input and output factor per clinical specialty.

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APPENDIX

Projection – all hospitals

DMU I/O	Score Data	Projection	Difference	%
HB 1	0.4856			
# of AIHs	1'462.00	1'462.00	-	0.00%
# of beds	45.00	45.00	-	0.00%
# of physicians	14.00	12.96	(1.04)	-7.40%
# of non-physician personnel	118.00	105.92	(12.08)	-10.24%
# of Inpatients	1'522.06	3'244.87	1'722.81	113.19%
Average lenght of stay	2.73	5.63	2.90	105.92%
# of patients days	4'161.00	8'568.35	4'407.35	105.92%
HB 2	0.95			
# of AIHs	1'544.00	1'544.00	-	0.00%
# of beds	35.00	34.57	(0.43)	-1.23%
# of physicians	7.00	7.00	-	0.00%
# of non-physician personnel	81.00	81.00	-	0.00%
# of Inpatients	1'551.13	2'290.06	738.93	47.64%
Average lenght of stay	4.05	4.28	0.23	5.63%
# of patients days	6'278.00	6'631.32	353.32	5.63%
HB 3	0.20			
# of AIHs	3'360.00	2'321.14	(1'038.86)	-30.92%
# of beds	75.00	75.00	-	0.00%
# of physicians	30.00	17.58	(12.42)	-41.40%
# of non-physician personnel	134.00	134.00	-	0.00%
# of Inpatients	479.37	2'355.64	1'876.28	391.41%
Average lenght of stay	2.59	12.72	10.13	391.41%
# of patients days	1'241.00	8'483.71	7'242.71	583.62%
HB 4	1.00			
# of AIHs	1'920.00	1'920.00	-	0.00%
# of beds	30.00	30.00	-	0.00%
# of physicians	3.00	3.00	-	0.00%
# of non-physician personnel	74.00	74.00	-	0.00%
# of Inpatients	2'155.24	2'155.24	-	0.00%
Average lenght of stay	3.05	3.05	-	0.00%
# of patients days	6'570.00	6'570.00	-	0.00%
HB 5	0.65			
# of AIHs	2'161.00	2'099.01	(61.99)	-2.87%
# of beds	40.00	40.00	-	0.00%
# of physicians	18.00	8.47	(9.53)	-52.94%
# of non-physician personnel	45.00	45.00	-	0.00%
# of Inpatients	723.96	1'111.49	387.53	53.53%
Average lenght of stay	3.03	4.64	1.62	53.53%
# of patients days	2'190.00	3'832.58	1'642.58	75.00%

HB 6	1.00			
# of AIHs	2'256.00	2'256.00	-	0.00%
# of beds	37.00	37.00	-	0.00%
# of physicians	7.00	7.00	-	0.00%
# of non-physician personnel	31.00	31.00	-	0.00%
# of Inpatients	799.74	799.74	-	0.00%
Average lenght of stay	3.79	3.79	-	0.00%
# of patients days	3'029.50	3'029.50	-	0.00%
HB 7	1.00			
# of AIHs	15'603.00	15'603.00	-	0.00%
# of beds	462.00	462.00	-	0.00%
# of physicians	242.00	242.00	-	0.00%
# of non-physician personnel	1'042.00	1'042.00	-	0.00%
# of Inpatients	61'168.38	61'168.38	-	0.00%
Average lenght of stay	1.99	1.99	-	0.00%
# of patients days	121'442.80	121'442.80	-	0.00%
HB 8	0.62			
# of AIHs	4'800.00	1'935.65	(2'864.35)	-59.67%
# of beds	62.00	62.00	-	0.00%
# of physicians	80.00	30.45	(49.55)	-61.94%
# of non-physician personnel	191.00	140.53	(50.47)	-26.43%
# of Inpatients	4'608.50	7'472.95	2'864.45	62.16%
Average lenght of stay	1.14	1.85	0.71	62.16%
# of patients days	5'256.00	15'282.45	10'026.45	190.76%
HT1	0.59			
# of AIHs	1'344.00	433.40	(910.60)	-67.75%
# of beds	24.00	24.00	-	0.00%
# of physicians	27.00	7.73	(19.27)	-71.36%
# of non-physician personnel	134.00	55.77	(78.23)	-58.38%
# of Inpatients	843.15	1'424.15	581.00	68.91%
Average lenght of stay	2.29	3.88	1.58	68.91%
# of patients days	1'934.50	3'889.77	1'955.27	101.07%
HT2	1.00			
# of AIHs	406.00	406.00	-	0.00%
# of beds	64.00	64.00	-	0.00%
# of physicians	11.00	11.00	-	0.00%
# of non-physician personnel	152.00	152.00	-	0.00%
# of Inpatients	312.00	312.00	-	0.00%
Average lenght of stay	17.83	17.83	-	0.00%
# of patients days	5'564.00	5'564.00	-	0.00%
HT3	0.55			
# of AIHs	2'304.00	1'139.80	(1'164.20)	-50.53%
# of beds	40.00	40.00	-	0.00%
# of physicians	59.00	8.17	(50.83)	-86.15%
# of non-physician personnel	72.00	72.00	-	0.00%
# of Inpatients	448.34	819.34	371.00	82.75%
Average lenght of stay	4.23	7.74	3.50	82.75%
# of patients days	1'898.00	3'924.06	2'026.06	106.75%

HT4	1.00			
# of AIHs	545.00	545.00	-	0.00%
# of beds	110.00	110.00	-	0.00%
# of physicians	40.00	40.00	-	0.00%
# of non-physician personnel	240.00	240.00	-	0.00%
# of Inpatients	8'921.46	8'921.46	-	0.00%
Average lenght of stay	2.51	2.51	-	0.00%
# of patients days	22'411.00	22'411.00	-	0.00%
HT5	0.44			
# of AIHs	2'400.00	2'149.55	(250.45)	-10.44%
# of beds	50.00	50.00	-	0.00%
# of physicians	15.00	8.55	(6.45)	-42.99%
# of non-physician personnel	140.00	120.72	(19.28)	-13.77%
# of Inpatients	1'277.50	2'927.48	1'649.98	129.16%
Average lenght of stay	3.14	7.20	4.06	129.16%
# of patients days	4'015.00	9'200.64	5'185.64	129.16%
HT6	0.79			
# of AIHs	2'640.00	2'619.65	(20.35)	-0.77%
# of beds	50.00	49.86	(0.14)	-0.27%
# of physicians	13.00	13.00	-	0.00%
# of non-physician personnel	119.00	119.00	-	0.00%
# of Inpatients	3'732.13	4'727.27	995.15	26.66%
Average lenght of stay	1.83	3.23	1.40	76.43%
# of patients days	6'825.50	11'749.33	4'923.83	72.14%
HT7	0.94			
# of AIHs	1'658.00	404.91	(1'253.09)	-75.58%
# of beds	22.00	22.00	-	0.00%
# of physicians	49.00	4.09	(44.91)	-91.65%
# of non-physician personnel	90.00	52.40	(37.60)	-41.78%
# of Inpatients	541.42	573.74	32.33	5.97%
Average lenght of stay	4.72	5.00	0.28	5.97%
# of patients days	2'555.00	2'707.55	152.55	5.97%
HT8	0.45			
# of AIHs	331.00	331.00	-	0.00%
# of beds	76.00	55.59	(20.41)	-26.85%
# of physicians	38.00	15.72	(22.28)	-58.64%
# of non-physician personnel	126.00	126.00	-	0.00%
# of Inpatients	1'153.27	2'711.07	1'557.81	135.08%
Average lenght of stay	3.35	7.42	4.06	121.16%
# of patients days	3'869.00	8'556.66	4'687.66	121.16%

1.31 Projection – Traditional public hospitals

DMU I/O	Score Data	Projection	Difference	%
HB 1	0.7931			
# of AIHs	1'462.00	1'462.00	-	0.00%
# of beds	45.00	34.21	(10.79)	-23.97%
# of physicians	14.00	8.32	(5.68)	-40.54%
# of non-physician personnel	118.00	78.91	(39.09)	-33.13%
# of Inpatients	1'522.06	1'919.19	397.14	26.09%
Average length of stay	2.73	3.45	0.71	26.09%
# of patients days	4'161.00	6'518.85	2'357.85	56.67%
HB 2	1.00			
# of AIHs	1'544.00	1'544.00	-	0.00%
# of beds	35.00	35.00	-	0.00%
# of physicians	7.00	7.00	-	0.00%
# of non-physician personnel	81.00	81.00	-	0.00%
# of Inpatients	1'551.13	1'551.13	-	0.00%
Average length of stay	4.05	4.05	-	0.00%
# of patients days	6'278.00	6'278.00	-	0.00%
HB 3	0.33			
# of AIHs	3'360.00	3'360.00	-	0.00%
# of beds	75.00	69.32	(5.68)	-7.57%
# of physicians	30.00	13.67	(16.33)	-54.43%
# of non-physician personnel	134.00	134.00	-	0.00%
# of Inpatients	479.37	2'665.80	2'186.43	456.11%
Average length of stay	2.59	7.78	5.19	200.49%
# of patients days	1'241.00	10'689.14	9'448.14	761.33%
HB 4	1.00			
# of AIHs	1'920.00	1'920.00	-	0.00%
# of beds	30.00	30.00	-	0.00%
# of physicians	3.00	3.00	-	0.00%
# of non-physician personnel	74.00	74.00	-	0.00%
# of Inpatients	2'155.24	2'155.24	-	0.00%
Average length of stay	3.05	3.05	-	0.00%
# of patients days	6'570.00	6'570.00	-	0.00%
HB 5	0.76			
# of AIHs	2'161.00	2'161.00	-	0.00%
# of beds	40.00	37.92	(2.08)	-5.20%
# of physicians	18.00	7.27	(10.73)	-59.61%
# of non-physician personnel	45.00	45.00	-	0.00%
# of Inpatients	723.96	1'023.05	299.08	41.31%
Average length of stay	3.03	4.00	0.98	32.27%
# of patients days	2'190.00	3'978.37	1'788.37	81.66%
HB 6	1.00			
# of AIHs	2'256.00	2'256.00	-	0.00%
# of beds	37.00	37.00	-	0.00%
# of physicians	7.00	7.00	-	0.00%
# of non-physician personnel	31.00	31.00	-	0.00%
# of Inpatients	799.74	799.74	-	0.00%
Average length of stay	3.79	3.79	-	0.00%
# of patients days	3'029.50	3'029.50	-	0.00%

HB 7	1.00			
# of AIHs	15'603.00	15'603.00	-	0.00%
# of beds	462.00	462.00	-	0.00%
# of physicians	242.00	242.00	-	0.00%
# of non-physician personnel	1'042.00	1'042.00	-	0.00%
# of Inpatients	61'168.38	61'168.38	-	0.00%
Average length of stay	1.99	1.99	-	0.00%
# of patients days	121'442.80	121'442.80	-	0.00%
HB 8	0.64			
# of AIHs	4'800.00	2'568.99	(2'231.01)	-46.48%
# of beds	62.00	62.00	-	0.00%
# of physicians	80.00	25.82	(54.18)	-67.73%
# of non-physician personnel	191.00	143.16	(47.84)	-25.05%
# of Inpatients	4'608.50	7'256.96	2'648.46	57.47%
Average length of stay	1.14	1.80	0.66	57.47%
# of patients days	5'256.00	15'608.12	10'352.12	196.96%

1.32

1.33

1.34 Projection- Outsourcing hospitals

DMU I/O	Score Data	Projection	Difference	%
HT1	0.7215			
# of AIHs	1'344.00	832.84	(511.16)	-38.03%
# of beds	24.00	24.00	-	0.00%
# of physicians	27.00	27.00	-	0.00%
# of non-physician personnel	134.00	72.15	(61.85)	-46.16%
# of Inpatients	843.15	1'168.53	325.38	38.59%
Average lenght of stay	2.29	3.18	0.89	38.59%
# of patients days	1'934.50	3'687.19	1'752.69	90.60%
HT2	1.00			
# of AIHs	406.00	406.00	-	0.00%
# of beds	64.00	64.00	-	0.00%
# of physicians	11.00	11.00	-	0.00%
# of non-physician personnel	152.00	152.00	-	0.00%
# of Inpatients	312.00	312.00	-	0.00%
Average lenght of stay	17.83	17.83	-	0.00%
# of patients days	5'564.00	5'564.00	-	0.00%
HT3	0.63			
# of AIHs	2'304.00	185.88	(2'118.12)	-91.93%
# of beds	40.00	30.92	(9.08)	-22.71%
# of physicians	59.00	6.73	(52.27)	-88.60%
# of non-physician personnel	72.00	72.00	-	0.00%
# of Inpatients	448.34	712.62	264.28	58.95%
Average lenght of stay	4.23	6.73	2.50	58.95%
# of patients days	1'898.00	3'548.67	1'650.67	86.97%
HT4	1.00			
# of AIHs	545.00	545.00	-	0.00%
# of beds	110.00	110.00	-	0.00%
# of physicians	40.00	40.00	-	0.00%
# of non-physician personnel	240.00	240.00	-	0.00%
# of Inpatients	8'921.46	8'921.46	-	0.00%
Average lenght of stay	2.51	2.51	-	0.00%
# of patients days	22'411.00	22'411.00	-	0.00%
HT5	0.51			
# of AIHs	2'400.00	275.06	(2'124.94)	-88.54%
# of beds	50.00	50.00	-	0.00%
# of physicians	15.00	14.41	(0.59)	-3.94%
# of non-physician personnel	140.00	112.89	(27.11)	-19.36%
# of Inpatients	1'277.50	2'555.33	1'277.83	100.03%
Average lenght of stay	3.14	6.18	3.03	96.48%
# of patients days	4'015.00	7'888.70	3'873.70	96.48%

HT6	1.00			
# of AIHs	2'640.00	2'640.00	-	0.00%
# of beds	50.00	50.00	-	0.00%
# of physicians	13.00	13.00	-	0.00%
# of non-physician personnel	119.00	119.00	-	0.00%
# of Inpatients	3'732.13	3'732.13	-	0.00%
Average lenght of stay	1.83	1.83	-	0.00%
# of patients days	6'825.50	6'825.50	-	0.00%
HT7	1.00			
# of AIHs	1'658.00	1'658.00	-	0.00%
# of beds	22.00	22.00	-	0.00%
# of physicians	49.00	49.00	-	0.00%
# of non-physician personnel	90.00	90.00	-	0.00%
# of Inpatients	541.42	541.42	-	0.00%
Average lenght of stay	4.72	4.72	-	0.00%
# of patients days	2'555.00	2'555.00	-	0.00%
HT8	0.45			
# of AIHs	331.00	308.90	(22.10)	-6.68%
# of beds	76.00	55.63	(20.37)	-26.80%
# of physicians	38.00	15.63	(22.37)	-58.86%
# of non-physician personnel	126.00	126.00	-	0.00%
# of Inpatients	1'153.27	2'684.98	1'531.72	132.82%
Average lenght of stay	3.35	7.40	4.05	120.59%
# of patients days	3'869.00	8'534.61	4'665.61	120.59%

1.35

1.36 Reference set – All hospitals

DMU	Score	Rank	Reference set (lambda)	Score	Reference set (lambda)	Score	Reference set (lambda)	Score	Reference set (lambda)	Score
HB 4	1	1	HB 4	1						
HB 6	1	1	HB 6	1						
HB 7	1	1	HB 7	1						
HT2	1	1	HT2	1						
HT4	1	1	HT4	1						
HB 2	0.94672	6	HB 4	0.618032	HB 6	3.52E-02	HB 7	1.46E-02	HT2	0.124988
HT7	0.943658	7	HB 4	0.127165	HB 7	3.58E-03	HT2	0.258286		
HT6	0.789488	8	HB 4	1.031795	HB 7	4.09E-02				
HB 5	0.651345	9	HB 6	0.872924	HB 7	6.38E-03	HT2	7.43E-02		
HB 8	0.616691	10	HB 7	0.12171	HT2	9.02E-02				
HT1	0.592039	11	HB 7	2.22E-02	HT2	0.214841				
HT3	0.547199	12	HB 6	0.398167	HB 7	6.41E-03	HT2	0.348528		
HB 1	0.485625	13	HB 4	0.405203	HB 7	3.75E-02	HT2	0.242227		
HT8	0.452162	14	HB 7	1.66E-03	HT2	0.376515	HT4	0.279334		
HT5	0.436383	15	HB 4	0.967283	HB 7	1.26E-02	HT2	0.23711		
HB 3	0.203497	16	HB 6	0.750678	HB 7	2.59E-02	HT2	0.551028		

1.37 Data analyzed – Traditional public hospitals group

Hospital	(I)# of AIHs	(I)# of beds	(I)# of physicians	(I)# of non-physician personnel	(O)# of Inpatients	(O)Average length of stay	(O)# of patients days
HB 1	1'462	45	14	118	1'522	3	4'161
HB 2	1'544	35	7	81	1'551	4	6'278
HB 3	3'360	75	30	134	479	3	1'241
HB 4	1'920	30	3	74	2'155	3	6'570
HB 5	2'161	40	18	45	724	3	2'190
HB 6	2'256	37	7	31	800	4	3'030
HB 7	15'603	462	242	1'042	61'168	2	121'443
HB 8	4'800	62	80	191	4'609	1	5'256

1.38 Reference set – Traditional public hospitals group

DMU	Score	Rank	Reference set (lambda)	Score	Reference set (lambda)	Score
HB 1	0.7931	5	HB 2	0.8468	HB 7	0.0099
HB 2	1.0000	1	HB 2	1.0000		
HB 3	0.3328	8	HB 2	1.4691	HB 6	0.4839
HB 4	1.0000	1	HB 4	1.0000		
HB 5	0.7561	6	HB 2	0.2560	HB 6	0.7827
HB 6	1.0000	1	HB 6	1.0000		
HB 7	1.0000	1	HB 7	1.0000		
HB 8	0.6350	7	HB 4	0.5239	HB 7	0.1002

1.39 Weights – Analysis - Traditional public hospitals group

DMU	Score	V(1)	V(2)	V(3)	V(4)	U(1)	U(2)	U(3)
HB 1	0.7931	0.0009	-	-	-	0.0002	0.2478	-
HB 2	1.0000	0.0005	-	0.0392	-	0.0003	0.1435	-
HB 3	0.3328	0.0005	-	-	0.0094	-	0.3863	-
HB 4	1.0000	-	0.0333	-	-	0.0002	0.1536	-
HB 5	0.7561	0.0004	-	-	0.0080	-	0.3306	-
HB 6	1.0000	-	-	-	0.0323	0.0005	0.1490	-
HB 7	1.0000	0.0001	-	-	-	0.0000	-	-
HB 8	0.6350	-	0.0254	-	-	0.0002	0.1170	-

1.40 Slack analysis – Traditional public hospitals group

DMU	Score	Excess # of AIHs S-(1)	Excess # of beds S-(2)	Excess # of physicians S-(3)	Excess # of non-physician personnel S-(4)	Shortage # of Inpatients S+(1)	Shortage Average length of stay S+(2)	Shortage # of patients days S+(3)
HB 1	0.7931	-	10.79	5.68	39.09	-	-	1'272.17
HB 2	1.0000	-	-	-	-	-	-	-
HB 3	0.3328	-	5.68	16.33	-	1'225.36	-	6'960.08
HB 4	1.0000	-	-	-	-	-	-	-
HB 5	0.7561	-	2.08	10.73	-	65.50	-	1'081.76
HB 6	1.0000	-	-	-	-	-	-	-
HB 7	1.0000	-	-	-	-	-	-	-
HB 8	0.6350	2'231.01	-	54.18	47.84	-	-	7'331.55

1.41 Data analyzed – Outsourcing hospitals group

Hospital	(I)# of AlHs	(I)# of beds	(I)# of physicians	(I)# of non-physician personnel	(O)# of Inpatients	(O)Average lenght of stay	(O)# of patients days
HT1	1'344	24	27	134	843	2	1'935
HT2	406	64	11	152	312	18	5'564
HT3	2'304	40	59	72	448	4	1'898
HT4	545	110	40	240	8'921	3	22'411
HT5	2'400	50	15	140	1'278	3	4'015
HT6	2'640	50	13	119	3'732	2	6'826
HT7	1'658	22	49	90	541	5	2'555
HT8	331	76	38	126	1'153	3	3'869

1.42 Reference set – outsourcing hospital group

DMU	Score	Rank	Reference set (lambda)	Score	Reference set (lambda)	Score	Reference set (lambda)	Score
HT1	0.7215	5	HT2	0.0427	HT4	0.1017	HT7	0.4584
HT2	1.0000	1	HT2	1.0000				
HT3	0.6291	6	HT2	0.3679	HT4	0.0670		
HT4	1.0000	1	HT4	1.0000				
HT5	0.5090	7	HT2	0.3074	HT4	0.2757		
HT6	1.0000	1	HT6	1.0000				
HT7	1.0000	1	HT7	1.0000				
HT8	0.4533	8	HT2	0.3744	HT4	0.2879		

1.43 Weights – Outsourcing hospitals group

DMU	Score	V(1)	V(2)	V(3)	V(4)	U(1)	U(2)	U(3)
HT1	0.7215	-	0.0575	0.0002	-	0.0007	0.1951	-
HT2	1.0000	-	0.0156	-	-	0.0002	0.0531	-
HT3	0.6291	-	-	-	0.0221	0.0005	0.1787	-
HT4	1.0000	0.0018	-	-	-	0.0001	-	-
HT5	0.5090	-	0.0393	-	-	-	0.0838	0.0002
HT6	1.0000	-	0.0157	0.0167	-	0.0003	-	-
HT7	1.0000	-	0.0455	-	-	0.0000	0.1000	0.0002
HT8	0.4533	-	-	-	0.0175	-	0.0940	0.0002

1.44 Slack analysis – Outsourcing hospitals group

DMU	Score	Excess # of AIHs S-(1)	Excess # of beds S-(2)	Excess # of physicians S-(3)	Excess # of non-physician personnel S-(4)	Shortage # of Inpatients S+(1)	Shortage Average lenght of stay S+(2)	Shortage # of patients days S+(3)
HT1	0.7215	511.16	-	-	61.85	-	-	1'006.14
HT2	1.0000	-	-	-	-	-	-	-
HT3	0.6291	2'118.12	9.08	52.27	-	-	-	531.87
HT4	1.0000	-	-	-	-	-	-	-
HT5	0.5090	2'124.94	-	0.59	27.11	45.29	-	-
HT6	1.0000	-	-	-	-	-	-	-
HT7	1.0000	-	-	-	-	-	-	-
HT8	0.4533	22.10	20.37	22.37	-	141.00	-	-