Capital Appraisal Handbook on Health and Welfare

Prepared for:

Department of Health and Welfare
Limpopo Provincial Government
Polokwane

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Chapter 1. Introduction

In the past 10 years South Africa witnessed great development in securing better access to health care and protection against the costs of disease. Given the wide range of activities that are necessary for good health, there are always competing demands and insufficient resources. Thus, establishing priorities, managing scarcity, and getting the maximum value for money spent are central to health policy for the Limpopo Provincial Government.

1.1. Strategic Position Statement for Health

An important endeavor in prioritizing the objectives of the health sector was the Strategic Position Statement for Health in the Limpopo Province. Within the Health Sector Strategic Framework established by the National Health Department, the Strategic Position Statement Project was undertaken by Limpopo Province Department of Health and Welfare (DoHW) from July to October 2001. The process involved an in-depth level review of health and service needs in the province. The planning exercise set out to develop a position paper which provided scenarios: a) to address health needs, b) to achieve sustainable service delivery, c) within various given resource envelopes, c) with a long term vision of an efficient service.

The scenarios were based on a Sustainability Model provided by the National Department of Health. The Sustainability Model enabled modeling of services in relation to population and admission rates, funding and resources, and the design of service delivery options at differing levels of care. The model was analyzed for different scenario options using optimal costs for recurrent and capital costs to ensure sustainability, affordability and quality in health service delivery.

The implications of the preferred scenario; Optimal Needs Driven Scenario (scenario 4 in the plan) are the following:

1 Providing Primary Health Care (PHC) level in line with national policy and

costing framework. This would require not only building new clinics but also upgrading the existing clinics.

2 A sustainable hospital delivery system which provides quality care that is more efficient but also more equitable (in terms of access).

3 Major expansion of emergency medical services and patient transport services.

4 Improving capacity to manage the anticipated service load relating to the HIV/AIDS epidemic both at PHC and at the hospital level.

5 These improvements in health services would require an optimal allocation of resources between development and maintenance of facilities.

The framework of the Strategic Position Statement for the Health Department (SPS) emphasizes efficiency, sustainability, affordability and quality in health service delivery. To achieve a prioritization of the many identified sector investments a systematic cost-effectiveness and/or cost-benefit analyses needs to be carried out for the various potential health projects and interventions.

1.2. Objectives of the Capital Appraisal Handbook for Health

The main objective of the *Capital Appraisal Handbook for the Department of Health and Welfare* is to help public officials in the department to develop and evaluate investment projects and health policy interventions that maximize economic and social well-being in South Africa. It describes how investment possibilities can be evaluated so that the best are chosen and successfully taken from the idea stage through to the implementation phase.[1]

The methodology outlined in this Handbook is tailored to be used in a manner consistent with the realities of Limpopo Province. At the same time it represents a state-of-the-art tool for conducting an integrated financial, economic, stakeholder and risk analysis of capital investments in hospitals, clinics and related policy interventions.

[1] The project appraisal methodology employed in the handbook is based on the comprehensive appraisal manual developed by Cambridge Resources International (CRI) for the Limpopo Provincial Government.

Any rational public sector expenditure system requires the consideration of the likely efficiency of the investments before getting approved for implementation. Various methods of analysis are used worldwide to improve the efficiency of the allocation of investments in the health sector, including Cost-Effectiveness Analysis (CEA) and Cost-Utility analysis (CUA). The investment criteria proposed in this handbook follows the same approach to determine the least cost interventions for a given target level of health improvement. It will also provide information on the per unit cost, such as the cost per visit for specific types of service, the cost per patient per day, or the cost per treatment.

The investment appraisal methodology proposed in this Handbook is to provide an evaluation framework for the prioritization of hospital rehabilitation investments and is accompanied by an easy to use computer software package to facilitate the assessment of the relative efficiency of the presumed hospital investments and health interventions.

One of the outputs of the analysis, the annual budget-support needed for the operation of such facilities, is projected in a parameterized manner. Hence, the sensitivity of future budgetary funding required by the facility can be tested for changes in a number of key macroeconomic, community and service delivery variables.

The principles, objectives and information outputs generated by the SPS initiative, combined with the analytical techniques outlined in this manual will assist the department in the future to identify which investments and interventions that will achieve the greatest level of health impact per unit of expenditure and assist program managers to identify ways to improve economic efficiency in the use of the resources available for the health sector in Limpopo Province.

1.3. Overview of the Handbook

The Handbook consists of 5 Chapters. Following the introductory chapter, the second chapter comments briefly on the existing health situation in the Limpopo Province and focuses on the current project selection process. An important emphasis is given to the data generated by the Department of Health and Welfare. The third chapter establishes

the analytical framework for investment appraisal in the health sector, introducing the importance of financial and economic analysis, the scope of Cost Effectiveness Analysis and Cost Utility Analysis and the pertinence of health indicators such as Quality Adjusted Life Years (QALY).

Chapter four establishes the methodology to be applied for the appraisal of capital investments for health care and protection against the cost of illness. It serves as a manual for the use of the standardized format (Project Appraisal Parameterized Spreadsheet Model) for health projects such as new or revitalized hospitals or clinics. Finally, Chapter five contains the recommendations and conclusions.

The Annexes provide an appraisal report of two actual projects, the revitalization of the Jane Furse hospital and the revitalization of the Lebowakgomo hospital, using the proposed methodology and the Project Appraisal Parameterized Spreadsheet Model for the health sector.

Chapter 2. Current Project Selection Process

2.1 Overview

When the new Government took office in 1994, there was fragmentation and severe inequalities in health status, health infrastructure and services. Since then, there has been an intensive program of legislative and policy development to reform the health service.

Although the public sector is largely under-resourced and over-used, it is clear that the majority of South Africans will continue to depend on the public health system for the foreseeable future. Also, the high levels of unemployment and poverty suggest that the majority of citizens will not be able to make any significant contribution towards the cost of their health care.[2]

Public health spending amounts to 11% of the government's total budget, which is allocated and spent by the nine provinces. How these resources are allocated, and the standard of health care delivered, varies from province to province, however the health problems are similar. For example, a situation and health needs analysis was done in Limpopo during 1999 and finalised early in 2000[3], showing that most of the health problems were identical for the different districts.

Limpopo is one of the poorest Provinces in terms of health care funding in South Africa; the per capita funding in health care, (2003 estimate) in the Province is less than 25% of the equitable share of the national budget. Due to the budget constraint and the lack of improvement in quality services, the Province has one of the lowest admission rates nationally (65 people per 1,000 population for non-AIDS acute admission). The Province is also one of the highest in terms of population per health care facility in South Africa. In 2003, the Province had a ratio of 15,345 population per primary Health Care Facility

[2] Health Sector Strategic Framework 1999 - 2004
[3] Health Services Review by HST

(PHC). About 75,5471 people are underserved or have no access to quality health care services in the Province.[4]

There are 536 health care facilities in the Province including 471 clinics, 22 health centers, and 43 Hospitals serving a total of 5.5 million people. Many of these health care facilities reside in remote areas with poor road and communication infrastructure where it is harder to recruit and retain health professionals of all categories.

2.2 Investment Selection System

The allocation of scarce resources between building new health facilities and renovating, upgrading and/or revitalizing existing facilities is a priority for the Provincial Government of Limpopo. Currently, the DoHW is mainly focusing on improving the existing facilities in order to make a more effective use of them. Given this focus of the health sector investment policy, the main allocation decision is how to select among the existing facilities and types of service improvements for the annual investment budgets.

The DoHW's current policy for making such decisions comprise of various steps explained below:

Assessment of Current Physical Conditions of Facilities (step 1).-

The DoHW has developed a set of norms and procedures for determining the conditions of existing health facilities and maintenance and upgrading of these facilities. To evaluate the current conditions, a physical audit report for each clinic and hospital is prepared. These physical audits assess various components of the health facilities on the basis of their suitability to provide health services. Each clinic or hospital building is required to comply with the Terms of Reference Guidelines issued by the DoHW in Limpopo Province for its Capital Works and Planning Program.

[4] Department of Health and Welfare, South Africa, Strategic Plan 2003/2004

A physical audit examines and evaluates the following characteristics of the health facility: 1) General conditions of existing buildings: This covers the number and functions of rooms by type, the conditions of the external walls and roof, the conditions of ceilings, floors, windows, doors, site fencing and gates. 2) Services and equipment audit reports: These include the water source and delivery system, toilet facilities, lighting and heating arrangements, staff accommodation, and equipment. The condition of existing equipment by type is also evaluated. 3) Size and type of clinics and hospitals: An assessment is made of the suitability of the size and type of a facility for the population's needs. 4) Locality of the existing clinics and hospitals: The physical audit also assesses the suitability of the location of existing health facilities. If the current location is no longer serving the people, a recommendation is made for the relocating of the facility to another area.

Ranking Facilities based on Physical Audit (step 2).-

Based on physical audit reports, the DoHW ranks the existing clinics and hospitals into four groups in order of priority for rebuilding and upgrading: (a) facilities that are condemned, (b) facilities that are in poor condition, (c) facilities that are in good condition, and (d) facilities that are in very good condition. Since, the funds available for investment are not adequate to finance all of the rebuilding and upgrading needs, priority is given to facilities that are in condemned or in poor condition.

Selection of Health Facilities for Upgrading (step 3).-

Among all the clinics and hospitals in poor condition, the selection of specific health facilities for improvements is made based on the following factors: 1) Equity considerations: Facilities in the least developed or underserved areas in the Province are given priority. Two of the districts (Sekhukune and Bohlabela) in the Province are identified as being the least developed and underserved. This consideration is important from viewpoint of equity in access to health services. 2) Need or demand considerations: The DoHW is trying to increase coverage of health care to as many people as possible. Therefore, the population size and the health profile of people play a role in determining

the level of improvements in clinics and/or hospitals. For example, clinics with larger population settled within the clinic area are given priority. Similarly, the DoHW also gives priority to areas with higher incidence of diseases such as Tuberculosis, Malaria, Malnutrition, Diarrhea and HIV/AIDS. 3) The selection process also takes into account the accessibility of the nearest clinics and hospitals, and to some extent, the selection of clinics and hospitals is also influenced by political considerations.

Chapter 3. Analytical Framework

The analytical framework developed in this Handbook outlines the main conceptual and practical issues of health care project valuation. The proposed appraisal framework includes a Financial Cost Effectiveness Analysis of investment decisions and an Economic Cost Utility Analysis that employs a health impact indicator, the QALY (Quality Adjusted Life Years), as a measure to evaluate the economic cost of achieving improvements in the overall health of the Province's residents.

3.1 Financial Analysis

The financial analysis of a project helps determine the financial sustainability of the project and the key risks in terms of the financial costs of achieving a given outcome. The costs and revenues projections, along with the financing arrangements are the building blocks for the financial analysis of a project.

For investments in the health care sector that are being considered for private sector involvement, the financial analysis will tell us if a project is financially viable and potentially attractive to private investors. Alternatively in the case of public health projects, a financial analysis is important in order to be able to determine the most efficient option in terms of financial costs for achieving a given objective. Such an analysis is also useful to identify the sources and magnitudes of budgetary risks that such investments may entail.

Once the spending priorities are defined, the scarce budget funds can be allocated among projects based on the least cost alternatives for achieving the given priority objectives. Projects of lower priority and smaller positives outcome are effectively shifted to the next budget period, where another comparative evaluation will take place.

3.2 Cost-Effectiveness Analysis

Investments undertaken in the public health sector have a common feature: they are oriented to serve the community, with a large number of patients who do not pay for their treatment or pay less than the respective costs. For public health projects, where it is usually not practical to carry out a full cost benefit analysis, a Cost-Effectiveness Analysis (CEA) is often employed. This method can be carried out in such a way that it captures only the most important benefits, and still be a reasonable basis for making effective decisions

A pure cost-effectiveness analysis looks at a single quantified, but not monetized, effectiveness measure of the cost per unit. For example, the cost in Rand per patient day of service provided. A healthcare project that is less costly at providing an equivalent quality of per patient day service is, therefore, preferable to more expensive alternatives. Thus, the CEA does not actually measure any other benefit than the single defined quantified measure.

The cost-effectiveness analysis first computes cost-effectiveness ratios of different alternatives, and then compares the resulting ratios so that the most efficient option is chosen. CEA ensures technical efficiency when achieving the desired outcome .i.e. lives saved, patients treated, patients discharged. One way of computing the effectiveness is to obtain a ratio of costs to its benefit, for example Rand per patient-day for people using hospital services.

If there are a number of alternative solutions to providing health treatment, then the costs of each (C_i) are divided by the benefits (E_i):[5]

$$CE_i = \frac{C_i}{E_i}$$

This ratio can be interpreted as the average cost per unit of effectiveness. The selection of projects carried out according to this cost effectiveness criterion, would prefer those with the lowest ratios.

[5] Boardman, A.E., et. al, (2001), p. 438.

In a number of cases, the decision makers need to compute marginal cost-effectiveness ratios. Often, this need arises when a new, more costly but also more effective, alternative is compared with the existing situation. In terms of computation, the numerator now contains the difference between the cost of the new (with project) and old (without project) situation alternatives, and the denominator is also the difference between the effectiveness of the new and old alternatives:[6]

$$\text{Marginal CE}_i = \frac{C_i - C_O}{E_i - E_O}$$

This ratio can be interpreted as the incremental cost per unit of effectiveness. When there are several alternatives available, the marginal cost-effectiveness ratio can be used to rank the new measures versus the existing one.

It is at this point where we need to be elaborate on what is meant by the without project case. The first distinction is that the without situation is not the situation that could exist before the new project was introduced. In some cases of hospital revitalization we would expect that the level of services provided in the without project case would decline over time, due to the deterioration of the existing facilities. In other cases there might be some growth in service provision but perhaps the quality of service would decline. Hence, it is critical for the evaluation of the project that the without project situation is clearly defined over the same length of life as is expected to occur for the with project case.

Discounting is also important, many capital projects have large investment costs at the beginning and then their benefits are spread over many years. To properly compare the benefits and costs over time, the benefits and costs that occur in distant years have to be discounted back to a common base year in order to make a meaningful comparison of alternatives. Because cost effectiveness analysis does not place a monetary value on the benefits, the project analyst has to discount the quantity amounts of the effectiveness measure itself. In other words, both the costs and units of effectiveness must be

[6] Ibid, p. 439.

discounted by the same rate if the CEA is to be done correctly. The only addition to what has been discussed in previous sections is that the costs and effectiveness are now being discounted:

$$CE_i = \frac{PV \quad of \quad Costs_i}{PV \quad of \quad Effectiveness_i}$$

The question of what is the appropriate discount rate to use is often raised. For example, proponents of health projects have argued for low rate of discount to be used when comparing alternative health projects. However, there is no sound economic reason to use any discount rate other than the economic opportunity cost of funds, which in the case of South Africa is a real rate of 11.0 percent[7].

3.3 Economic Analysis

While the financial analysis of a health project focuses on its financial effectiveness, an economic analysis deals with the ultimate impact of the project on the well being of the entire society. First, the costs should be measured in terms of their economic values that may differ from their financial values. Second, the benefits should be measured in a way that captures several dimensions of the impact of the health service. For example the number of patient days or services supplied does not capture the impact of the additional number of years of life that will be experienced or the number of years of pain and suffering that have been eliminated. Consequently, in an economic analysis, the concern is with economic benefits and costs, and not just cash receipts and expenditures.

The main problem in trying to apply CBA analysis in the health sector is the correct valuation of benefits. Because the general goal of health projects is to increase the quality and length of life, it is difficult to value these outcomes in monetary units. Possible health outcomes that need to be addressed include increased life expectancy, decreased

[7] "Integrated Investment Appraisal: Concepts and Practice", Prepared for Department of Financial and Economic Development, Limpopo Provincial Government, South Africa, Cambridge Resources International, Cambridge, USA, March 2004.

morbidity, reduced disability, improved quality of life, averted future medical costs, and increased productivity.[8]

In the 1950s and 1960s benefits of health projects were often valued using a human capital approach. The benefit of an intervention was assumed to be the present value of an individual's future earnings. This approach discriminates against those who receive lower wages and those not in the workforce, such as the elderly, persons occupied with family care, housework, and children. Critics have argued that linking the value of additional life years only to economic productivity is not legitimate, and moreover, that such an approach does not take into account the very essence of CBA: the importance of individual utility in the assessment of benefits.[9] These difficulties with the measurement of the economic benefits from health investments in terms of monetary units has lead to the development of cost-utility analysis where the outcomes are measured as a change in an index of health achievement.

3.4 Cost-Utility Analysis

Cost-Utility Analysis (CUA) is a natural extension of cost-effectiveness analysis, and the difference is really the accounting for the benefits. Cost utility analysis forces the analyst to compile a composite index of outcomes, i.e., utility level as a measure of benefits. Each type of benefit (B_j) would be assigned its relative importance, or weight (w_j), in deriving the index of outcomes.

Health programs result in multiple benefits even if a single objective is actually targeted. Because a cost-benefit analysis is not appropriate, and because simple cost-effectiveness analysis omits important side benefits, cost-utility analysis provides a convenient tool of handling these problems.

In this Handbook a cost-utility approach is taken to measure the economic benefits of improving the service delivery of hospitals. Of the various versions of the health

[8] World Bank, (2000), Normative Analysis for Health Policy and Projects, Ch. 9, p. 239
[9] Hauck K., et. al., (2003), p.7, (The Economics Of Priority Setting For Health Care, WB)

indicators that could be employed, we choose to use the Quality Adjusted Years of Life (QALY) measure of health outcomes. It was chosen because of its ease of understanding, it is used in investment decision making by departments of health worldwide, and also because this measure of health outcomes has been previously estimated in considerable detail for South Africa and Limpopo Province.[10]

3.5 Quality-Adjusted Life-Years (QALY)

The conceptual framework behind the QALY index is simple, it is an index that assumes a weight of 1 corresponds to perfect health and a weight of 0 corresponds to a health state judged equivalent to death. The index itself is a measure of the relative utility one receives from one more year of life lived in a particular state of health. In order to calculate the total number of QALYs value from an investment in a health facility or an intervention it is sufficient to multiply these utility values of the given states of health by the years lived in the corresponding states. Because the total number of QALYs captures changes in both the quality of life (morbidity), as well as length of life (mortality), this can serve as the outcome measure for a wide range of health interventions or capital investments in the health sector.

The following example will illustrate the typical issues involved in the construction of a QALY index.[11] Suppose the decision makers have to choose among three alternatives mutually exclusive prenatal programs. Under the existing conditions, no babies with a particular medical condition are born alive, program A. Program B, focused on prevention of this condition, will likely result in five babies being born alive per year but with serious disabilities. Alternatively, program C will result in two live births but with low levels of disability. In order to evaluate the alternatives, a comparison in terms of

[10], Bradshaw D, Laubscher R., Igumbor EU (2003), Mortality Profile from Registered Deaths for Limpopo Province, South Africa 1997-2001. An alternative measure that is frequently used to measure the economic impact of health projects in developing countries is the Disability Adjusted Life Year (DALY). This measure places greater emphasis on the impact of disease on the loss of productivity due to both morbidity and mortality.

[11] The example that follows is adopted from Boardman, et al., (2001), p. 445.

quantity and quality must be made. Table 3.1 presents the basic QALY format in terms of additional years and their quality.

Table 3.1

The Basic QALY Format

	Additional Years of Life (Y)				
Health Status (H)	$\mathbf{Y_1}$	$\mathbf{Y_2}$	$\mathbf{Y_3}$	$\mathbf{Y_4}$	$\mathbf{Y_5}$
$\mathbf{H_1}$	$\mathbf{(Y_1H_1)}$ **A**	Y_2H_1	Y_3H_1	Y_4H_1	Y_5H_1
$\mathbf{H_2}$	Y_1H_2	Y_2H_2	Y_3H_2	$\mathbf{(Y_4H_2)}$ **B**	Y_5H_2
$\mathbf{H_3}$	Y_1H_3	Y_2H_3	$\mathbf{(Y_3H_3)}$ **C**	Y_4H_3	Y_5H_3
$\mathbf{H_4}$	Y_1H_4	Y_2H_4	Y_3H_4	Y_4H_4	Y_5H_4
$\mathbf{H_5}$	Y_1H_5	Y_2H_5	Y_3H_5	Y_4H_5	Y_5H_5

The columns show additional years of life, from a short Y_1 to a much longer duration Y_5. The rows represent the health status from the poorest H_1 to the best state H_5. Now, presume that all the three alternative policies have the same costs, and there is no uncertainty about the resulting years of life gained and health condition. Then, assume that the existing program that is already in place corresponds to the fewest years and worst health status, Y_1H_1. This situation is challenged by program B, which corresponds to Y_4H_2. At the same time, alternative C will be able to achieve a QALY level of Y_3H_3.

Given that the costs of the three alternatives are equal, the first conclusion is that programs B and C are both superior to the existing situation A. This is simply because any of the two ensure longer years and better health status than Y_1H_1. However, the hard choice between B and C still remains. The question here is really what is valued more: additional years of life or better health status. While additional years of life are easily quantifiable, the meaning of health status is not universally defined.

In fact, a vast amount of effort has gone into research on defining a heath status. Usually, health status is defined in terms of a composite index, covering most of the physical and psychological conditions. Then, every health aspect included in the index is rated on some scale from the worst to the best state. Finally, a single index is constructed from all the aspects. For instance, one of the most comprehensive classifications is based on four

dimensions: physical function (mobility and physical activity), role function (ability to care for oneself), social-emotional function (emotional well-being and social activity), and health problem (including physical deformity).[12] The usefulness of QALY index in cost utility analysis depends on the reliability of the methods used to define and to measure health status.[13]

Fortunately, considerable high quality work has been done for the case of South Africa. South Africa's National Burden of Diseases study has already prepared a classification of diseases and injuries appropriate to assess the burden of ill-health in the country[14]. This classification is an adaptation of the Global Burden of Disease list that divides the causes of death into three broad groups: the pre-transitional causes, non-communicable diseases and injuries[15]. The groups are further divided into categories and then levels based on similarities in etiology and/or the required intervention.[16] From this South African National Burden of Diseases study (Bradshaw et al, 2003) and the Catalog of Preference Scores, which contains the ranking for different types of medical conditions, we have all the data needed for the calculation of QALYs to measure the impact of health care interventions in the Province of Limpopo.

When these outcome measures are considered relative to the cost required to generate them, a basis has been created for comparing the efficiency of the various projects and programs financed by the health budget. Hence, the application of cost utility analysis will allow one to both prioritize investments in a single area such as hospital revitalization as well as allow one to compare the efficiency of expenditures in this area with other health interventions such as drug therapy.

It should be noted that QALY calculations are practical for conducting an analysis either in Financial or Economic terms. When the discounted economic costs are compared with

[12] Torrance, G.W., et. al, (1982), pp. 1043-1063.
[13] Froberg, D.G., and Kane, R.L, (1989), pp. 675-685.
[14] Bradshaw, D., et al. (2003), Initial Burden of Disease Estimates for South Africa, 2000.
[15] Murray CJ, Lopez AD (1996). The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020.
[16] Bradshaw, D., et al., (2003), p. 2 , Mortality Profile from Registered Deaths for Limpopo Province, South Africa, 1997-2001

the discounted QALYs, we obtain a cost per QALY expressed in economic prices. This value measures the economic resource cost in Rand to obtain one additional QALY for society. On the other hand, when financial costs are used, the measure will reflect the number of Rand that will have to be spent from the government budget to obtain an additional QALY.

The use of a QALY as a measure of the severity of the state of someone who has been treated in the facility for a particular disease or health condition provides us with a method of aggregating the impact of the health interventions provided. However the QALY is only one of the pieces of information needed to evaluate the impact on health of treatment. A key set of variables is the change in health status that such treatment provides. This is normally measured as the expected change in life years arising from the treatment of specific health conditions by a specific method of treatment. This information on the measurement of different treatments needs to be provided, by impacts on the number of life years gained, by the Department of Health services and the medical literature in the different areas of medical specialization.

3.6. Applications

This analytical framework will be applied to investments in the area of hospital refurbishing and renovation in Limpopo Province. The financial analysis will serve to measure the present value of the financial costs per patient bed day for the hospital upgrading investments under consideration. This measure can be used to rank the different alternatives or a cut off value can be applied by the Department as a criterion for proceeding with the investment.

For the economic analysis an estimate will be made of the present value of the economic cost per QALY of health improvement brought about by investments in hospital facilities. This index can be used both to compare with alternative investments in the hospital sector as well as to make comparison with the effectiveness of expenditures on other health care interventions. For example, the cost per QALY of expenditures made

on hospital improvements can be compared with the cost per QALY of drug therapies or inoculations. To get the maximum impact on health improvement in the Province, those activities that have a low cost per QALY should be given priority over those whose cost per QALY is higher.

For the Handbook case studies will be developed for two hospital replacement projects. These cases of projects in Limpopo Province will serve as a foundation for future capital appraisal work to be carried out by the Department of Health.

Chapter 4. Framework for Applications

In order to evaluate which investments or health policy interventions are the most beneficial and therefore should be undertaken, a standardized format for the analysis of a project has been developed. The standardized format constitutes a Project Appraisal Parameterized Spreadsheet Model (PAPSM) for the Health Sector, which is capable of calculating project's outcomes and investments decision criteria. The focus of the PAPSM is to be able to deliver all of the indicators and results required to appraise a health project with only a modest quantity of input data.

The PAPSM is a Microsoft Excel Spreadsheet model designed to estimate the cost in Rand for each unit of health improvement delivered by an investment, revitalizing or building a clinic or a hospital. Although the PAPSM emphasizes simplicity, requiring a limited amount of data that is already generated today by the health department, it presents a complete set of economic and financial results necessary to take capital investment decisions.

The PAPSM is made up of two separate computer based evaluation models, PAPSM (I) and PAPSM (NI). The first model, PAPSM (I), is applicable to the evaluation of investments that are incremental in nature, it is used when a health facility or health service delivery system already exists in the area. The investment decision is whether the existing facilities should be revitalized or expanded. In these cases the specification of the "without project" case needs to be made as well as the "with project" situation in order to evaluate the incremental impact of the new investments.

If it appears that an expansion or upgrading of the existing facilities is the appropriate decision, the PAPSM (I) model can be then used to determine the best way to do it. The model is an effective tool to find the investment strategy that would make the largest contribution to the provision of the incremental health services provided.

The second model, PAPSM (NI), is applicable for the evaluation of stand alone projects. These are projects to be undertaken when there are no existing facilities of the nature

being improved. In this sense they are not incremental because the “without project” case means that this service would not be provided for this target population in this area. Due to the nature of the situation the results of the analysis would tell us the costs per unit of the service provided. Alternatively, it can be used to evaluate whether the investment made in a local area will benefit the health users by reducing the cost to the people of seeking such services elsewhere.

4.1. Outputs of the Health Sector PAPSM

Once the project variables are introduced the PAPSM consequentially calculates the following Tables: Number of Patients (In-patients and Out-patients) expected for every year of the project, Expected Revenue and Fees Schedule, Expenses in Medicines and Supplies, Administrative Expenses, Minor Equipment outlays, Working Capital requirements and impacts, Labor Costs, projected Domestic (Rand) and Foreign ($US) price levels and consistent Inflation and Exchange Rate estimates and a summary of Capital Investments. These Tables are in turn used to calculate the cash flow statements.

The model is designed to take into account five different types of patients (variables), which can have different number of beds assigned, average daily admission, average length of stay and tariff schedules. The Annex presents a detailed example of the flexibility of the PAPSM. It is used to evaluate two different revitalization projects. The appraisal of one of them, the revitalization of the Jane Furse hospital, is divided by accommodation of patients (medical, tuberculosis, surgery, maternity and pediatrics) while for the second project, the revitalization of the Lebowakgomo hospital, the whole analysis differentiates the patients by income/wealth and how they are charged for their treatments (H0, H1, H2, H3 and Private). Thus, the model allows for a dynamic differentiation between 5 categories of patients, providing outcomes for each category.

The PAPSM calculates cash flow statements in nominal and real values (Rand), in financial and economic values for: a.) the revitalized hospital ("with project"), b.) the current situation "without project" and c.) for the incremental project (a. minus b.). From these flows of costs and revenues, the level of budgetary support required

(annually) by the facility is also projected over its future life. This projection is entirely parameterized and cab be adjusted for the growth of patients days, average length of stay, rates of inflation and all the rest of the variables that are Input variables in of the model.

An important result calculated by the model is the Cost-Effectiveness Outcome (C/E), which indicates how many Rand are spent for every patient-day of service provided, by the revitalized facility, the current facility situation and the incremental number of patient days created by the revitalization project. This indicator deals with how efficient is the current facility and the estimated per patient cost. The value of this variable for a particular facility should be compared to a norm set by the department of health of Limpopo Province or the National Department of Health. If the cost per patient-day for a particular new facility is below this norm cost per patient-day for the particular type of facility then this project should be implemented.

Another important variable calculated as a decision criteria variable (for the project selection process) is the Cost-Utility Outcome (C/U), which indicates how many Rand are spent to generate one QALY, by the revitalized facility, the current facility situation and the incremental investment. Again the cost per QALY is variable for which the department of health, over time, should develop norms. Health interventions with cost per QALY greater than the norm should be given a lower priority for implementation than those interventions with cost per QALY lower than the norms that have been set.

The PAPSM calculates the C/E indicator (cost per patient day) for the financial analysis, while both indicators, C/E and C/U (cost per QALY), for the economic analysis.

4.1.1. Financial Results

The results provided by the PAPSM encompass the following: Present Value of Inflows and Outflows, Net Present Value (NPV), Patient Days, Funding per Patient Day and Gross Costs per Patient, for each, the revitalized facility, the current situation without the project and the incremental analysis. Through these results the analyst should be able to decide the relative priority of investing in a particular revitalization project.

The level of the budgetary support needed in each year of the facilities operation, with and without revitalization project, is also estimated by the model. The values for the funding are estimated as function of the key variables that impact the operation of the facility.

In Table 17.- the PAPSM shows the financial results of the project: The Present Value (PV) of Inflows (column 1) represents the accumulated revenues from tariffs and rates paid by Out-patients and In-patients during the life of the project. Likewise, the PV of Outflows (column 2) includes all investment costs and total expenses during the life of the project. The NPV shows the overall performance of the project, generally a positive financial NPV would signal that it would be possible for an investor to carry out the project, in the public health sector this number is generally negative, thus the negative NPV figure will be equivalent to present value of the budget outlays required over the life of the project. These budgetary outlays are also estimated on an annual basis.

The Number of Patients Days shows how many patients served the hospital or clinic every day during the life of the project, this figure (column 4) is also expressed in present value terms (discounted).[17]

The total costs per patient-day (column 6) is one of the most commonly used cost-effectiveness measures, since it indicates the cost in Rand per patient every day. In theory when comparing facilities that deliver the same type of services, a more efficient hospital or clinic should spend less Rand for every patient-day, and such project should be prioritized. This factor is helpful for decision making, however its importance as an investment criteria should not be overstated; since this indicator does not take into account improvements in health or the changes in the average number of days of stay per patient visit.

[17] In the chapter "Analytical Framework" the discounting rationale is discussed in detail.

Table 4.1. (Table 17.- PAPSM)

TABLE 17.-
FINANCIAL RESULTS:
LEBOWAKGOMO HOSPITAL REVITALIZATION PROJECT
All figures in Present Values (Year 0 values)

	Inflows (Rand)	Outflows (Rand)	NPV (Rand)	Patient Days (#)	Funding Per Patient Day (Rand)	Total Costs Per Pat. Day (Rand)
	1	2	3	4	5	6
A. REVITALIZED HOSPITAL ("With Project")	73,348,450	680,311,473	-606,963,023	642,046	945	1,060
B. CURRENT SITUATION ("Without Project")	31,313,778	920,015,039	-888,701,261	528,247	1,682	1,742
C. INCREMENTAL ANALYSIS (C = A - B)	42,034,672	-239,703,566	281,738,238	113,799	-737	-682

The Funding Per Patient (column 5) is a cost-effectiveness measure since it represents how many Rand on average needs to be spent by the State for every patient day in the specific facility under consideration. This figure can be used as an input in the department's forward financial planning. In this case the revitalized hospital is so much more efficient that the department's budget would get some relief as compared to the without project situation.

Table 4.1. above shows the results for the revitalization project of the Lebowakgomo hospital: The present value of inflows illustrates that for the current facility (Groothoek) an average of 31 million Rand could be expected to be collected in fees and tariffs during the life of the project, while for the case with project (Lebowakgomo) this same value is expected to be around 73 million Rand. The marked difference between this two results is mainly due to the fact that it is expected that the revitalized hospital will treat more patients during the length of the project and to the fact that it is planned that the new facility will update all patients records allowing to properly classify its patients, hence shifting them, for charging purposes, to upper income categories, especially current H0 patients to higher categories such as H1 and H2.

The amount of funding per patient day also illustrates this fact; the revitalized facility collects, on average, a larger amount of fees from treated patients, since the average funding amount for the revitalized hospital amounts to 945 Rand, while for the current facility the State provides larger average funding of 1,682 Rand per patient day.

The present value of expenditures are 920 million Rand for the current facility (Groothoek) for the duration of the project, while for the case with project (Lebowakgomo) the total value of investment costs and operating expenses are 680 million Rand. The fact that the case "with project" has lower outflows (although this present value includes the investment costs) is manly due to the fact that the current facility is large thus, requiring a higher number of employees and a higher level of expenditures.

The present value of number of patient-days to be treated by the existing facility without the project over the same period as the project's life 528,247 (years 2004-2026), while the present value of the expected number of patient-days for the revitalized facility amounts to 642,046 patient-days for the same period.[18] Given that the present value of costs is larger for the current facility and its number of patients treated during the life of the project is lower than for the revitalized facility, it follows that the cost per patient day is lower for the revitalized hospital. While the average cost per patient day is 1,742 Rand for the current facility, for the revitalized hospital it amounts to 1,060. We can conclude that by undertaking the project Limpopo Province will save on average 682 Rand for every patient-day of service provided, for the duration of the project's life.

The results for the Jane Furse Hospital Revitalization project are also concluding. Table 4.2. shows the expected results for the capital investment in such undertaking:

Table 4.2. (Table 17.- PAPSM)

TABLE 17.-
FINANCIAL RESULTS:
JANE FURSE HOSPITAL REVITALIZATION PROJECT
All figures in Present Values (Year 0 values)

	Inflows (Rand)	Outflows (Rand)	NPV (Rand)	Patient Days (#)	Funding Per Patient Day (Rand)	Total Costs Per Pat. Day (Rand)
	1	2	3	4	5	6
A. REVITALIZED HOSPITAL ("With Project")	99,794,413	501,848,807	-402,054,394	631,537	637	795
B. CURRENT SITUATION ("Without Project")	53,153,762	308,941,751	-255,787,989	374,346	683	825
C. INCREMENTAL ANALYSIS (C = A - B)	46,640,651	192,907,057	-146,266,406	257,191	-47	-31

[18] It is assumed that the revitalized facility (with project) will have an annual percentage increase in admission of 2% while the situation without the project will face a decrease of 2% per year.

The present value of inflows illustrates that for the current facility an average of 53 million Rand could be expected to be collected in fees and tariffs during the life of the project, while for the case with the revitalization project this same value is expected to be around 100 million Rand. The manifest difference between this two results is mainly due to the fact that it is expected that the revitalized hospital will treat more patients during the length of the project.

In contrast to the Lebowakgomo revitalization project, the Jane Furse Hospital revitalization shows higher outflows for the case "with project". The present value of outflows is 308 million Rand for the current facility (without project) for the duration of the project, while for the case with the project the total value of investment costs and operating expenses is 501 million Rand. The fact that the case "with project" has higher outflows is directly related to the revitalization investment costs and slightly larger expenditures.

Although the costs are larger for the case "with project", the average funding per patient day is lower. Due to more patients being treated during the life of the project, the amount of funding per patient day for the revitalized facility amounts to 795 Rand per-patient day, while for the current facility the State provides a larger average subsidy of 825 Rand per patient-day.

It is expected that the present value of the number of patient-days to be treated by the current facility during the life of the project amounts to 374,346 (years 2004-2026), while the present value of number of patients expected by the revitalized facility amounts to 631,537 patient-days over the same period. Given that the number of patient-days during the life of the revitalized facility is considerably larger, it follows that the cost per patient day is lower for the revitalized hospital. While the average cost per patient-day is 825 Rand for the current facility, for the revitalized hospital it amounts to 795. We can conclude that by undertaking the revitalization of the Jane Furse Hospital Limpopo Province will save on average 31 Rand for every patient, every day, over the duration of the project's life.

While Table 17 of the PAPSM shows the aggregated financial results, Table 18 presents the yearly financial results: Projected Revenues from Fees and Tariffs, Projected Investment Costs and Projected Recurrent Expenses for: a.) the revitalized hospital ("with project"), b.) the current situation "without project" and c.) for the incremental project (a. minus b.). The following Tables 4.3. and 4.4. show the yearly financial results for both, the Lebowakgomo Revitalization and Jane Furse Hospital Projects:

Table 4.3.- (Table 18 PAPSM)

TABLE 18.-

YEARLY FINANCIAL RESULTS

LEBOWAKGOMO HOSPITAL REVITALIZATION PROJECT

All figures in Nominal Rand (5% annual inflation rate)

Year	2004	2005	2006	2007	2008	2009	2010	2025	2026
A. REVITALIZED HOSPITAL ("With Project")									
Number of Patient-days	60,190	63,832	67,967	72,017	72,465	72,921	73,387	80,432	80,974
Projected Revenues from Fees and Tariffs	4,853,843	6,786,688	7,800,455	8,787,375	9,444,979	10,109,258	10,820,385	27,805,023	29,614,191
Projected Investment Costs	83,759,000	26,067,300	13,685,333	4,557,570	9,724,050	1,021,025	-	-	-
Projected Recurrent Expenses	74,555,701	56,906,410	60,210,600	63,940,655	67,828,407	72,000,512	76,430,915	187,520,358	199,118,932
B. CURRENT SITUATION ("Without Project")									
Number of Patient-days	57,443	60,316	63,050	65,651	64,338	63,051	61,790	45,636	44,723
Projected Revenues from Fees and Tariffs	3,361,559	3,675,108	4,035,281	4,413,253	4,564,783	4,697,161	4,833,379	7,421,325	7,636,544
Projected Recurrent Expenses	95,694,897	101,093,295	106,996,802	113,183,210	119,296,412	126,554,343	133,850,992	311,749,956	329,917,016
C. INCREMENTAL ANALYSIS (C = A - B)									
Number of Patient-days	2,747	3,517	4,917	6,366	8,127	9,870	11,597	34,796	36,250
Projected Revenues from Fees and Tariffs	1,492,285	3,111,580	3,765,174	4,374,122	4,880,197	5,412,097	5,987,006	20,383,698	21,977,647
Projected Investment Costs	83,759,000	26,067,300	13,685,333	4,557,570	9,724,050	1,021,025	-	-	-
Projected Recurrent Expenses	(21,139,195)	(44,186,884)	(46,786,203)	(49,242,556)	(51,468,005)	(54,553,831)	(57,420,076)	(124,229,598)	(130,798,084)
D. PROJECTED BUDGETARY SUPPORT REQUIREMENTS									
A. REVITALIZED HOSPITAL ("With Project")	153,460,858	76,187,022	66,095,477	59,710,849	68,107,478	62,912,279	65,610,530	159,715,335	169,504,741
B. CURRENT SITUATION ("Without Project")	92,333,338	97,418,187	102,961,521	108,769,957	114,731,630	121,857,181	129,017,613	304,328,631	322,280,472
C. INCREMENTAL ANALYSIS (C = A - B)	61,127,520	(21,231,165)	(36,866,044)	(49,059,108)	(46,624,152)	(58,944,902)	(63,407,082)	(144,613,296)	(152,775,731)

Table 4.4.- (Table 18 PAPSM)

TABLE 18.-
YEARLY FINANCIAL RESULTS
JANE FURSE HOSPITAL REVITALIZATION PROJECT
All figures in Nominal Rand (5% annual inflation rate)

Year	2004	2005	2006	2007	2008	2009	2010	2025	2026
A. REVITALIZED HOSPITAL ("With Project")									
Number of Patient-days	50,018	56,088	65,709	70,495	71,563	72,653	73,655	85,094	85,542
Projected Revenues from Fees and Tariffs	7,513,038	8,766,888	10,892,609	12,242,985	13,107,023	13,982,109	14,901,057	36,999,894	39,190,738
Projected Investment Costs	-	43,387,668	88,374,726	-	-	-	-	-	-
Projected Recurrent Expenses	35,844,684	39,595,810	45,840,403	48,664,253	51,595,634	54,760,086	58,116,813	142,036,674	150,767,561
B. CURRENT SITUATION ("Without Project")									
Number of Patient-days	40,708	42,743	44,681	46,524	45,593	44,681	43,788	32,340	31,694
Projected Revenues from Fees and Tariffs	5,789,689	6,329,722	6,950,056	7,601,046	7,862,029	8,090,028	8,324,639	12,781,918	13,152,593
Projected Recurrent Expenses	31,094,597	32,922,446	34,879,745	36,928,885	38,388,254	41,257,817	43,648,145	102,091,005	108,072,166
C. INCREMENTAL ANALYSIS (C = A - B)									
Number of Patient-days	9,310	13,345	21,028	23,971	25,970	27,972	29,868	52,754	53,849
Projected Revenues from Fees and Tariffs	1,723,349	2,437,166	3,942,553	4,641,938	5,244,994	5,892,081	6,576,418	24,217,976	26,038,144
Projected Investment Costs	-	43,387,668	88,374,726	-	-	-	-	-	-
Projected Recurrent Expenses	4,750,087	6,673,364	10,960,657	11,735,368	13,207,379	13,502,269	14,468,668	39,945,669	42,695,395
D. PROJECTED BUDGETARY SUPPORT REQUIREMENTS									
A. REVITALIZED HOSPITAL ("With Project")	28,331,646	74,216,591	123,322,520	36,421,269	38,488,610	40,777,977	43,215,756	105,036,780	111,576,823
B. CURRENT SITUATION ("Without Project")	25,304,909	26,592,724	27,929,689	29,327,838	30,526,225	33,167,789	35,323,506	89,309,088	94,919,573
C. INCREMENTAL ANALYSIS (C = A - B)	3,026,738	47,623,866	95,392,831	7,093,430	7,962,385	7,610,188	7,892,249	15,727,693	16,657,251

4.1.2. Economic Results

The economic results provided by the PAPSM encompass the following: Present Value of Outflows, Number of Patient Days, Cost per Patient Day, total QALY'S, and Cost Per QALY, for each of the revitalized facility, the current facility situation and the incremental analysis. Since these figures are in economic values, they represent the relevant figures for the Country and its departments of health to able to decide if investing in a particular revitalization project is a priority.

In the same manner as for the financial results, Table 24.- shows an economic result; the Present Value (PV) of Outflows, the main difference is that the outflows show real resource costs, for investments and expenses during the life of the project, for the South African economy.

The Number of Patients Days measure is, naturally, identical to the figure for the financial analysis, however, the Cost Per Patient Day is an economic cost-effectiveness measure, which represent the real economic resources spent by the Country for every patient-day.

The QALY'S and Cost Per QALY measures represent a first approach at measuring the real benefit, or utility, for society, generated by securing better access to health care and protection against the costs of disease. As explained in the analytical framework of this document, the number of QALYs measure the utility of both, the additional years of life and the quality of life during these years, thus the figure in Table 24.- of the PAPSM shows the accumulated years adjusted for quality for all discharged patients during the life of the project.

In this analysis we have been using only an illustrative set of data that expresses on a per discharged patient basis, the impact of the different health care services provided through the hospital into the number additional life years that result from each of the services provided. Hence for illustrative purposes the same sets of coefficients per treatment type are used for treatments in both situations, with and without the revitalized facility. Thus,

the accuracy of the analysis using this framework will be improved as this medical information is enhanced by the DoHW of Limpopo Province over time.

Table 4.5.- (Table 24.- PAPSM)

TABLE 24.-
ECONOMIC RESULTS
LEBOWAKGOMO HOSPITAL REVITALIZATION PROJECT
All figures in Present Values (Year 0 values)

	Outflows (Rand)	Patient Days (#)	Cost Per Patient Day (Rand)	QALY'S (Life years)	Cost Per QALY (Rand)
	1	2	3	4	5
A. REVITALIZED HOSPITAL ("With Project")	619,585,545	642,046	965	493,556	1,255
B. CURRENT SITUATION ("Without Project")	845,537,052	528,247	1,601	372,326	2,271
C. INCREMENTAL ANALYSIS (C = A - B)	-225,951,507	113,799	-636	121,230	-1,016

Table 4.5.- shows the results for the revitalization project of the Lebowakgomo hospital: The present value of the real resource costs for the economy (economic outflows) for the current facility (Groothoek) amounts to an average of 845 million Rand, while for the revitalized case (Lebowakgomo) this same value is expected to be around 619 million Rand. The fact that the case ”with project” has lower outflows, although this present value includes the investment costs, is manly due to the fact that the current facility is larger thus, requiring a higher number of employees and higher levels of expenditures.

The present value of the number of patient-days serviced by the current facility during the life of the project is 372,326 (2004-2026), while the expected number of patients for the revitalized facility amounts to 493,556 patient-days over the same period. Given that the present value of costs is larger for the current facility and the number of patients treated daily during the life of the project is lower for the revitalized facility, it follows that the cost per patient day is lower for the revitalized hospital. While the average economic cost per patient day is 1,601 Rand for the current facility, for the revitalized hospital it amounts to 965. We can conclude that by undertaking the revitalization of the Lebowakgomo Hospital, Limpopo Province will save resources equivalent to 636 Rand for every patient-day over the duration of the project’s life.

In terms of Quality Adjusted Life Years, the number of life years obtained by the different types of treatment amount to 372,326 for the current facility during the life of the project (years 2004-2026), while the life years obtained by the revitalized facility amount to 493,556. On average the revitalization project will increase the quality adjusted years of life of the population by 121,230 over the current situation.[19]

Knowing that the present value of costs is larger for the current facility and that the number of life years during the life of the project is higher for the revitalized facility, it follows that the cost per quality adjusted year of life is lower for the revitalized hospital. While the average economic cost per QALY is 2,271 Rand for the current facility, for the revitalized hospital it amounts to 1,255. We can conclude that by undertaking the project the Limpopo Province will save resources equivalent to 1,016 Rand for every life year gained by its interventions in the revitalized facility.

The results for the Jane Furse Hospital Revitalization project are also similar. The following Table shows the expected results for the capital investment in such undertaking:

Table 4.6.- (Table 24.- PAPSM)

TABLE 24.-
ECONOMIC RESULTS
JANE FURSE HOSPITAL REVITALIZATION PROJECT
All figures in Present Values (Year 0 values)

	Outflows (Rand)	Patient Days (#)	Cost Per Patient Day (Rand)	QALY'S (Life years)	Cost Per QALY (Rand)
	1	2	3	4	5
A. REVITALIZED HOSPITAL ("With Project")	454,858,248	631,537	720	420,407	1,082
B. CURRENT SITUATION ("Without Project")	282,124,698	374,346	754	213,058	1,324
C. INCREMENTAL ANALYSIS (C = A - B)	172,733,550	257,191	-33	207,349	-242

In its financial analysis the Jane Furse Hospital revitalization shows higher resource costs (outflows) for the case “with project” than “without” the project. The present value of

[19] The absolute values of the numbers of Quality Adjusted Life Years in these cases should be used with great caution because of the crude medical assumptions used to asses the impact of various treatments on the change in the years of life brought about by the variety of treatments.

economic outflows is 454 million Rand for the current facility (without project) for the duration of the project, while for the case with the project the total economic value of investment costs and expenses amounts to approximately 282 million Rand. The fact that the case ”with project” has higher outflows is directly related to the revitalization investment costs and slightly larger operating expenditures.

Although the economic resource costs are larger for the case “with project”, the average cost per patient day is lower. Due to more patients being treated during the life of the project, the cost per patient-day for the revitalized facility amounts to 720 Rand per patient day, while for the current facility the State bears a larger cost of 754 Rand per patient-day. We can conclude that by undertaking the project Limpopo Province will save resources of 33 Rand for every patient-day, for the duration of the project’s life.

In terms of Quality Adjusted Life Years, the number of life years obtained by the different types of treatment amount to 213,058 for the current facility during the life of the project (years 2004-2026), while the quality adjusted life years obtained by the revitalized facility amount to 420,407. On average the revitalization project will increase the number of quality adjusted life years by 207,349 over the current situation.[20]

Given that the present value of costs is larger for the current facility and the number of life years during the duration of the project is higher for the revitalized facility, it follows that the cost per life year is lower for the revitalized hospital. While the average economic cost per QALY is 1,324 Rand for the current facility, for the revitalized hospital it amounts to 1,082. We can conclude that by undertaking the Jane Furse Hospital revitalization project the Limpopo Province will save resources equivalent to 242 Rand for every life year gained by the health services provided by the revitalized facility.

[20] The absolute values of the numbers of Quality Adjusted Life Years in these cases should be used with great caution because of the crude medical assumptions used to asses the impact of various treatments on the change in the years of life brought about by the variety of treatments.

4.1.3. Other Options: Results for a Non-Incremental Model

Since the Health Sector Strategic Framework established by Limpopo Province Department of Health and Welfare (DoHW) will focus primarily in the Revitalization of existing facilities until year 2010, both of the case studies under analysis deal with incremental projects, where the comparison between the facility without the project and the facility with the revitalization project is necessary. However, an alternative model for a "stand alone" investment project has also been developed. This alternative model is similar in regard to input variables and results to the "incremental" model presented above, yet the outcomes are presented for the capital investment project under analysis alone without the comparison with another existing facility. This option will allow the DoHW to carry forward investment appraisal analysis for new clinics or hospitals and for other investments that are not required to be evaluated on an incremental basis.

4.2. Data Requirements for the PAPSM

In order for the Department of Health to be able to use this appraisal tool with ease, the requirements of information by the PAPSM have been limited to only the essential variables required to calculate the C/E and C/U ratios from the economic and financial points of view. The Table of Parameters of the model does not contain any variable that needs to be inputted for "informational" purposes only, all variables required are necessary to carry out the cost effectiveness/utility analysis.

There are 3 types of variables in the PAPSM: Input variables, Macro-input variables and Dependent variables. The input variables, painted light blue in the PAPSM, consist of specific information for each hospital or clinic revitalization investment to be evaluated:

Table 4.7.-

Input Variables (PAPSM Tables 1,2,3 and 5)

REVITALIZED HOSPITAL ("With Project")

- **General Information of the Project**
  - Name of the Project
  - Construction and Operation Starting Years
  - Operation Profile of the Revitalized Facility
  - Maximum Occupation Capacity
- **Main Variables for the Project**
  - **Capacity and Utilization**
    - **In-patient**
      - Number of Usable Beds
      - Average Daily In-Patient Admission
      - Average Length of Stay in Days
      - Annual Increase in Admission
    - **Out-patient**
      - General OPD clinic headcount
      - Specialist OPD clinic headcount
      - CAS (Casualty) headcount
      - Annual Increase in Admission
      - Out-patient Visit/Patient-day
  - **Tariff Fee Schedule**
    - Average fee In-patients
    - Average fee Out-patients
  - **Administrative Expenses**
    - General Expenses
    - Services: Tel, Water, Electricity
  - **Labor Costs**
    - Skilled/Semiskilled
    - Unskilled
    - Professional & Special Services
  - **Medicines, Supplies and Minor Equipment**
    - Medicines and Supplies
    - Minor Equipment
- **Estimated Project Investment Costs**
  - Land
  - Buildings
  - Equipment
  - Cost Over-run Factor
- **Treatment Impact Variables**
  - Treatment by Disease
  - Life Years Increased by Treatment
  - Percentage of Discharged Patients

CURRENT SITUATION ("Without Project")

- **General Information of the Project**
  - Name of the Project
  - Construction and Operation Starting Years
- **Main Variables for the Project**
  - **Capacity and Utilization**
    - **In-patient**
      - Number of Usable Beds
      - Average Daily In-Patient Admission
      - Average Length of Stay in Days
      - Annual Increase(Decrease) in Admission
    - **Out-patient**
      - General OPD clinic headcount
      - Specialist OPD clinic headcount
      - CAS (Casualty) headcount
      - Annual Increase(Decrease) in Admission
      - Out-patient Visit/Patient-day
  - **Tariff Fee Schedule**
    - Average fee In-patients
    - Average fee Out-patients
  - **Administrative Expenses**
    - General Expenses
    - Services: Tel, Water, Electricity
  - **Labor Costs**
    - Skilled/Semiskilled
    - Unskilled
    - Professional & Special Services
  - **Medicines, Supplies and Minor Equipment**
    - Medicines and Supplies
    - Minor Equipment
  - **Value of Existing Assets**
    - Land
    - Building
    - Equipment
- **Estimated Project Investment Costs**
  - Land
  - Buildings
  - Equipment
  - Cost Over-run Factor
- **Treatment Impact Variables**
  - Treatment by Disease
  - Life Years Increased by Treatment
  - Percentage of Discharged Patients

All values are located in the first two pages of the model in the Table of Parameters which serves as a control panel of the model (the Excel cell value contains an empty light blue cell that turns orange when a number is typed).

The macro-input variables which are general parameters necessary for the calculation of any health project, but that do not vary between projects. These variables would change

from time to time and it is important to maintain them up to date, but they are the same for all projects. Thus they do not need to be re-entered every time an analysis is carried out.

Table 4.8.-

Macro-Input Variables (PAPSM Table 4.)

Macroeconomic Parameters

EXCHANGE & INFLATION RATES

- Average Domestic Inflation Rate
- Average Foreign Inflation Rate (US$)
- Real Exchange Rate (R/US$)
- Appreciation/Depreciation Factor

WORKING CAPITAL

- Accounts Receivable (% of revenues)
- Bad Debts (% of accounts receivable)
- Accounts Payable (% of total purchases)
- Cash Balance (% of revenue)

TAXES

- Import Duty on Equipment

DISCOUNT RATES

- Economic Opportunity Cost of Capital (Real)
- Financial Cost of Funds (Real)

REAL GROWTH IN WAGE RATES

- Skilled/Semiskilled Categories
- Unskilled Labor

It is important to note that there could be a project whose peculiarities require some changes in the macro-input variables. In the PAPSM these cells are painted green and turn orange once a value is typed.

For practical purposes, in the PAPSM all dependent variables, cells painted white, are either calculations or results and no data should be typed, however the possibility of modifying the content of these cells for singular projects is available. In order to evaluate an incremental project all input variables, light blue cells, and macro-input variables, light green cells, should contain a value, every time a value is entered in such cells they will turn orange.

4.2.1. Input Variables

The input variables are located in the first tables of the PAPSM model, namely; Table 1. which contains the General Information of the Project, Table 2. where the Main Variables for the Project are located, Table 3. related to the Estimated Project Investment Costs, and Table 5. where the parameters for the calculation of the Quality Adjusted Life Years (QALY) are located.

General Information of the Project.-

Table 4.9.- (Table 1.- PAPSM)

TABLE 1.-
General Information of the Project

Name of the Project:						
Construction starts on year:	2004					
Operation starts on year:	2005					
The Revitalized Facility (With Project) will operate during construction ? =	Yes / No					
Year	**2004**	**2005**	**2006**	**2007**	**2008**	
If Yes: Operation Profile of the Revitalized Facility						Cumulative Percentage
Maximum Occupation Capacity						Percentage

In Table 1., besides the name of the project, five important parameters are defined; when construction starts, when the operation starts, if the clinic or hospital will operate during construction and its operation profile for those years, and finally, the forecasted occupation level for the first 12 years of the revitalized facility. The PAPSM will arrange all tables and cash flows to begin on the year the project starts operating, however if the old facility will keep operating during the revitalization (if "yes" is selected), the cash flows will show revenues, costs and QALY's for the years of construction.

The operation profile for such construction years, including costs and number of patients treated, can be defined in order to show the facing out process of the old facility and the staggered facing in of the revitalized facility. For example, lets assume that certain facility with be revitalized in the next four years, and it is expected that it will have four

equal consecutive steps of implementation until the fourth year when all operations will be carried out by the revitalized facility (with project); than the input variable “Operation Profile of the Revitalized Facility” would be 25%, 50%, 75% and 100% for the first, second, third and fourth year, respectively, determining, for example, that for the first year 75% of the operation costs and number of patients treated will be those of the old facility without the revitalization project, while 25% will correspond to the estimated values for the revitalized facility.

If the facility being revitalized will not operate during construction (if “no” is selected), than all values except investment costs will have a zero value until the project starts operation.

The expected occupation/utilization of the revitalized facility is an input variable for the first 12 years of the project, after this period it is assumed the occupation forecasted for the last year (year 12) will repeat itself for the remaining operating life of the project.

Main Variables for the Project.-

Table 2. contains most of the values(data) required to evaluate the project. There are five main areas: Capacity and Utilization, Tariff Fee Schedule, Administrative Expenses, Labour Costs, Allowances and Bonus, Professional and Special Services, and Medicines, Supplies and Minor Equipment. All this parameters should be introduced for both, the revitalized hospital ("with project") and the "without project" situation. In the case of the without project situation also the estimated Value of Existing Assets should be entered.

Capacity and Utilization.-

Table 4.10.- (Table 2.- PAPSM)

TABLE 2.-
Main Variables for the Project

REVITALIZED HOSPITAL ("With Project")						
Capacity and Utilization						
In-patient						
Patient Differentiation	**H-0**	**H-1**	**H-2**	**H-3**	**Private**	
Number of Usable Beds						Beds
Average Daily In-Patient Admission						
Average Length of Stay						Days
Annual Percentage Increase in Admission		(Increment untill full capacity is reached)				
Out-patient						
General OPD clinic headcount		Patients				
Specialist OPD clinic headcount		Patients				
CAS (Casualty) headcount		Patients				
	H-0	**H-1**	**H-2**	**H-3**	**Private**	
Distribution						
Annual Increase in Admission						
Out-patient Visit/Patient-day						

CURRENT SITUATION ("Without Project")						
Capacity and Utilization						
In-patient						
Patient Differentiation	**H-0**	**H-1**	**H-2**	**H-3**	**Private**	
Number of Usable Beds						Beds
Average Daily In-Patient Admission						
Average Length of Stay						Days
Annual % Increase(Decrease) in Admission		(Increment untill full capacity is reached)				
Out-patient						
General OPD clinic headcount		Patients				
Specialist OPD clinic headcount		Patients				
CAS (Casualty) headcount		Patients				
	H-0	**H-1**	**H-2**	**H-3**	**Private**	
Distribution						
Annual Increase in Admission						
Out-patient Visit/Patient-day						

Table 4.10. shows the Capacity and Utilization variables required in the PAPSM for the with and without project situations. All the input variables are similar for both cases, however, it is important to note that an annual increase in the percentage of admissions could be expected for the revitalization project situation, while the without project situation it is likely to have constant levels of admission or a negative growth rate (annual decrease) in admissions.

As mentioned, the model allows the differentiation of patients in regard to some defined criteria. Thus, in the PAPSM the 5 categories of differentiation will be entered only once and the labels will repeat themselves automatically through the model. Table 2. shows an example where the defined “Patient Differentiation” is based on the income level, where

a patient defined as "H0" would receive a completely free treatment and the "private" would pay most of the cost of the treatment.

The data for Number of Usable Beds, Average Daily In-Patient Admission, and Average Length of Stay should also be distinguished for each of the categories. Since for outpatients is more difficult to estimate the number of patient through each category the model provides a distribution coefficient for the calculation.

The Annual Increase in Admission for out-patient parameter is initially linked to the one for in-patients, however the PAPSM is designed to make a distinction, thus a different growth(decrease) can be used for each. If a growth rate that will exceed the physical capacity of the hospital on a specific year is introduced, the model will automatically calculate the increase in the first years until it reaches the full capacity, than it will remain constant (at full capacity) for the remaining of the projects life.

The Out-patient Visit/Patient-day parameter is a macro-input variable, since the relationship between a patient day for an in-patient to an out-patient should be similar for any health project in the Limpopo province. The estimated value, taking into account the local cost relationships, is 6.8 out-patients is equivalent to one patient day[21]. It is important to note that calculations for this parameter for other countries have found similar results[22].

Tariff Fee Schedule.-

Table 4.11.- (Table 2.- PAPSM)

Tariff Fee Schedule						
	H0	H1	H2	H3	PRIVATE	
Average fee In-patients						Per Day
Average fee Out-patients						Per Day

[21] The relationship between rates charged to in-patients and out-patients is equivalent.
[22] Similar results [7.2] are found by Anderson G. M. et. al., Data Watch 135, Comparison Of Hospital Costs In California, New York, and Canada.

The tariff schedule for in-patient and out-patient is also divided by 5 categories of "Patient Differentiation", depending on the categories the tariff fees will vary. For example the difference will be very significant if the categories are based precisely on fees played (H0, H1, etc).

Administrative Expenses and Medicines, Supplies and Minor Equipment.-

Table 4.12.- (Table 2.- PAPSM)

Administrative Expenses		
General Expenses		Rand per year
Services: Tel, Water, Electricity		Rand per year
Medicines, Supplies and Minor Equipment		
Medicines and Supplies		Rand per year
Minor Equipment		Rand per year

The PAPSM takes into account 4 large groups of recurrent expenses;

- General Expenses,
- Services: Tel, Water, Electricity,
- Medicines and Supplies
- Minor Equipment.

This broad categories include a significant amount of detailed expenses that could be disaggregated in other "worksheet" of the model. However it should be emphasized that the analysis will not be different when the total sum of each of such expenses is directly inserted in the model.

It is important to comment that the growth rates estimated for the "Annual Increase in Admission" are also used as growth rates in the values of the expenses and costs of the project, to maintain a direct correlation between an increased amount of patients with a respective increase in costs.

Labour Costs, Allowances and Bonus, and Professional and Special Services.-

Table 4.13.- (Table 2.- PAPSM)

Labor Costs (operation of the facility)						
	Number	Wage		Allowances and Bonus	
Skilled/Semiskilled Category			Rand/month		Percentage of Basic Wage
Unskilled Category			Rand/month		Percentage of Basic Wage
Professional & Special Services		Rand per year			

The total number of workers, Skilled, Semiskilled and Unskilled required for the operation of both, the revitalized hospital ("with project") and the current situation "without project", should be introduced in the model. The wage levels are considered macro-input variables since most hospitals and clinics should pay an similar wage, however if the project requires a different wage level the PAPSM is designed to take each projects specific values.

Estimated Project Investment Costs.-

Table 4.14.- (Table 3.- PAPSM)

TABLE 3.-
Estimated Project Investment Costs (Rand of Year 0)
REVITALIZED HOSPITAL ("With Project")

Year	2004	2005	2006	2007	2008	2009	2010	2011
Land	-	-	-	-	-	-	-	-
Decommissioning of the Old Facility	-	-	-	-	-	-	-	-
Buildings								
Capital Investment 1								
Capital Investment 2								
Capital Investment 3								
Capital Investment 4								
Equipment								
Equipment 1								
Equipment 2								
Equipment 3								
Equipment 4								
TOTAL	-	-	-	-	-	-	-	-

Cost Over-run Factor	0%	Percentage

Table 3. contains the capital investment parameters, the model permits the entry of 4 major infrastructure items (buildings) and 4 major categories of equipment, for each of the first 8 years of the project. If applicable, the model also permits to include the estimation of costs of the Land to be used (for cases of revitalization projects carried out in a different location as the current facility) and potential costs related to the decommissioning or tearing down and cleaning up costs of the old buildings. It is

assumed that there would be no major investments after the programmed construction period. All recurrent minor investments are allocated in Table 2, as mentioned above. For the purpose of calculating the residual value of the capital assets at the end of the project valuation period, for every major category of the capital goods, the estimated economic life needs to be entered.

There is also the possibility of including an estimation of a Cost Overrun Factor. In general this variable is very useful for conducting the risk analysis of the project (either sensitivity, scenarios or Monte Carlo analysis), since it allows to test; what would happen to the estimated results if the construction and equipment were to cost more (or less) than the figure estimated in the base case. Consequently, it is expected that for this variable the base cased would contain a zero value (for practical purposes the cell will remain painted light blue until a value other than zero is entered).

Treatment Impact Variables and Quality Adjusted Life Years (QALY) Parameters.-

Table 4.15.- (Table 5.- PAPSM)

TABLE 5.-
Treatment Impact Variables and Quality Adjusted Life Years (QALY) Parameters

	Type of Treatment "With Project"	Type of Treatment "Without Project"	Expected Years of Life Increased By Treatment "With Project"	Expected Years of Life Increased By Treatment "Without Project"	QALYs
Infectious and Parasitic Diseases					0.86
Endocrine, Nutritional and Metabolic Diseases					0.83
Diseases of the Blood and Blood-Forming Organs					0.98
Diseases of the Nervous System and Sense Organs					0.84
Diseases of the Circulatory and Respiratory System					0.89
Diseases of the Digestive System					0.89
Diseases of the Genitourinary System					0.86
Diseases of the Skin and Subcutaneous Tissue					0.92
Diseases of the Musculoskeletal System and Connective Tissue					0.89
Injury and Poisoning					0.87
Maternity					0.99
Total	0%	0%			
Percentage of Discharged Patients					

The QALY parameters have been already calculated in the PAPSM through the preference scores revealed by the population. The complete preference scores list, including how were the preferences determined and the measurement technique can be found in the International Catalog of Diseases[23]. However the PAPSM in its Worksheet labeled “Preference Scores” contains a summarized list with the average preference score

[23] Murray CJ, Lopez AD (1996). The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020.

for 70 different health states. The QALY calculation used here were calculated in a manner which resolves some of the limitations of other methods employed elsewhere.[24]

The input data that needs to introduced for every investment valuation is the treatment structure being provided by the facility under analysis. Namely, the analyst will have to determine the average percentage of patients treated for each of the 11 categories of treatment differentiated in the PAPSM. Naturally the total should add up to a 100%, meaning that every patient should fall in one of the 11 summarized categories provided. For practical purposes a legend in red color stating "*The total must add up to 100% !*" will appear until the chart is completed.

Under the assumption that the life of every patient discharged will be improved for the remaining of her/his healthy life span, the Years Of Life Increased By Treatment variables represent the average expected impact of each category of treatment on the life expectancy of patients discharged. This parameter is considered an Input variable, since the average impact of treatment can be introduced for every new investment or revitalization project, however it should be noted that the average years of life increased by each treatment should be similar for every hospital or clinic in the Province, thus it could be also considered an Macro-input variable.

The Treatment Impact Variables Table includes an important macro-input variable, the Percentage of Discharged Patients, this variable deals with the fact that not every patient will have the fortune of being discharged, some will have no possibility of improvement in their health due to treatment or will perish, thus such patients will not be included in the calculation of the utility being provided by treatment. These variable should be similar from one hospital or clinic to the other in the Province, thus, if updated regularly, it can be used for the appraisal of all health projects.

[24] For a detailed explanation see: Prieto l, Sacristan J., (2003) p. 2, *Problems and solutions in calculating QALYs*

4.2.2. Macro-Input Variables

The macro-input variables are located in the table of parameters in Table 4, and in the economic cash flows. These variables are general macroeconomic parameters necessary for the calculation of any health project, but generally they do not vary between projects. These variables should be updated from time to time, but will be similar for all projects, thus they do not need to be entered every time an investment appraisal is conducted in the model.

Table 4.16.- (Table 4.- PAPSM)

TABLE 4.-
Macroeconomic Parameters

EXCHANGE & INFLATION RATES			**TAXES**		
Average Domestic Inflation Rate		Projected Annual Rate	Import Duty on Equipment		
Average Foreign Inflation Rate (US$)		Projected Annual Rate			
Real Exchange Rate (R/US$)			**DISCOUNT RATES**		
Appreciation/Depreciation Factor		Annual Rate	Economic Opportunity Cost of Capital (Real)		Annual
			Financial Opportunity Cost of Capital (Real)		Annual
WORKING CAPITAL			**REAL GROWTH IN WAGES**		
Accounts Receivable		of revenue	Skilled/Semiskilled Categories		Percentage per year
Bad Debts		of accounts receivable	Unskilled Labor		Percentage per year
Accounts Payable		of total purchases			
Cash Balance		of revenue			

The table includes annual inflation rates, tax rates, the real growth in wages, financial and economic opportunity costs of capital outlays for the Republic of South Africa (discount rates), and working capital figures. Most hospitals and clinics would have a very similar amount of accounts payable and receivables, similar cash requirements and also similar percentage of patients that end up not paying their debt; however the PAPSM allows to introduce such changes for specific cases if necessary.

The other macro-input variables are the economic conversion factors to transform financial costs into economic costs, they are located in the second column of the Economic Cash Flow for the revitalized hospital ("with project"), the current situation "without project" and for the incremental project. The purpose of these variables is to convert financial values into economic values, this step is crucial in order to work with real resource costs for the South African economy. The theory behind the economic

analysis calculations is explained in detail in the comprehensive appraisal manual developed by Cambridge Resources International (CRI) for the Limpopo Provincial Government.

For practical purposes a computer based software package was developed to provide easy access to these economic conversion factors.[25] The program is called South African Conversion Factors Easy Access (SACFEA), and it can be used by analysts involved in the economic and social appraisal of investments to search for the commodity specific conversion factors for most of South Africa's goods and services. SACFEA is a user-friendly program that guides the user to the desired Commodity Specific Conversion Factor through a few steps.[26]

These conversion factors are used in the PAPSM as macro-input variables since it is expected that very similar types of investments for most revitalization projects will take place. However it should be noted that the analyst is required to revise each of the investment cost and their structure in order to be able to use the correct conversion factor for every item of the cash flow.

4.2.3. Input Variables for the Non-Incremental PAPSM

The PAPSM for non incremental projects has similar input variables as the described above; the main difference is that the inputs for the "without project" situation are not necessary. Since such model forecasts the operating costs and patients treated for a facility alone, without comparing the results of the revitalized facility with an existing facility (without project), the data input requirements are limited to those of the projected capital investment.

[25]The computer based system of conversion factors was developed by Cambridge Resources International Inc, Cambridge, Massachusetts, USA.
[26] For a detailed step-by-step instruction, the analyst should refer to the SACFEA's version 2.4 manual.

There are three new variables that need to be introduced in the case of the stand alone facility. They arise because without this facility some of the patients would have travelled to other places for treatment. First we need to specify the proportion of the total patients that will be using the new facility who would have otherwise have received treatment elsewhere (Percentage of Patients Otherwise Treated Elsewhere). Second, for these patients there will be savings in transportation costs if they are to voluntarily move from where they would have obtained treatment to the new facility. This variable means that the incremental transportation cost savings reduces the economic cost of building and operating the new facility (Travel Cost Savings for Patients). The third variable is the average operating costs saved per day of the alternative health facility when a patient moves from that place to our new facility. This variable (Operating Costs Savings By Other Facilities) applies only to those patients of the new facility that would have obtained the service elsewhere. See Annex II. Hence, the input data tables differ to the incremental model described above on the following:

Table 1: General Information of the Project, remains identical to the incremental PAPSM, however it should be noted that the Operation Profile of the Revitalized Facility takes into account the costs and number of patients of both the current facility without the project and the revitalized facility with the project, while for the non incremental model only takes into account a portion of such operating costs and number of patients until the project is in full operation.

Table 2: Main Variables of the Project, remains the same for all the variables of the capital investment project (naturally there are no input variables for the without project situation).

Table 3: Estimated Project Investment Costs remains equal except for the estimated potential costs related to the decommissioning or tearing down of the old facility's buildings.

Table 4: Macroeconomic Parameters, remains identical in all its macro-input variables.

Table 5: Treatment Impact Variables and Quality Adjusted Life Years (QALY) Parameters, remains equal except for the variables Type of Treatment Without Project and Expected Years of Life Increased By Treatment Without Project, which are not longer required, and introduces the three new variables described above (Percentage of Patients Otherwise Treated Elsewhere, Travel Cost Savings for Patients and Operating Costs Savings By Other Facilities).

Chapter 5. Conclusion

The main objective of this document is to help public officials in the Department of Health and Welfare to appraise and prioritize investment projects and health policy interventions that maximize economic and social well-being in South Africa.

The methodology proposed amalgamates entirely with other Local and National efforts towards improving the quality of expenditures and capital investments, focusing on the optimization of public expenditures in the health sector.

The project appraisal framework proposed includes a Financial Analysis and an Economic Analysis of investment decisions that employs a health impact indicator, the QALY (Quality Adjusted Life Years), as a measure to evaluate the economic cost of achieving improvements in the overall health of the Province's residents.

This index can be used both to compare with alternative investments in the hospital sector as well as to make comparison with the effectiveness of expenditures on other health care interventions.

In order to simplify the valuation process to determine which investments or health policy interventions are the most beneficial and therefore should be undertaken, a Project Appraisal Parameterized Spreadsheet Model (PAPSM) for the Health Sector has been developed, capable of calculating project's outcomes and investments decision criteria with the input of a reasonable amount of data.

The results provided by the PAPSM are: Annual net financial outflows, present value of inflows and outflows, annual budgetary requirements, patient days, funding required per patient-day, cost per patient-day and QALYs produced. These results can be used to assist decision makers of the Province and its Department of Health in prioritizing the potential revitalization and hospital expansion projects.

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ANNEX I

Project Appraisal Parameterized Spreadsheet Model (PAPSM)

Input Variables:

PAPSM For Incremental Projects

ANNEX II

Project Appraisal Parameterized Spreadsheet Model (PAPSM)

Input Variables:

PAPSM For Stand Alone Projects

ANNEX III

Project Appraisal Parameterized Spreadsheet Model (PAPSM)

Case Study One:

The Revitalization Project of the Lebowakgomo Hospital

ANNEX IV

Project Appraisal Parameterized Spreadsheet Model (PAPSM)

Case Study Two:

The Revitalization Project of the Jane Furse Hospital