

# Economic Evaluation of an Eye Hospital in Terms of Net Present Value and Profitability Index

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## ABSTRACT

**Introduction:** Hospital projects are highly cost intensive and therefore, it takes few years to become a profit oriented entity. The success of these hospital projects can be measured through various economic evaluation methods. Economic evaluation can also be called as an effort to analyze inputs and outputs together and logically help decision makers evaluate whether a certain level of output is worth the amount of resources expended to produce it.

**Method of the study:** The present study was planned to do the economic evaluation of an Eye hospital, in Haryana state. Two parameters were considered for evaluating the project, i.e. Net Present Value (NPV) and Profitability Index (PI). The data used in the study was from 2010-2011 to 2016-2017. This includes actual and projected data.

**Result and conclusion:** A positive NPV explain the project is worthwhile and making profits, with current cost and revenue projections. PI for this center is found out to be 3.47 which also emphasize that the project is a value for money proposition.

**Keywords:** Economic evaluation, Net present value, Profitability index.

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## INTRODUCTION

Economic evaluation is a 'comparative analysis of alternative courses of action in terms of both their costs and returns'.<sup>1</sup> It can also be called as an effort to analyze inputs and outputs together and logically help decision makers evaluate whether a certain level of output is worth the amount of resources expended to produce it. Two essential

features of this definition are worth noting. Firstly, economic evaluation involves a comparison between alternative courses of action. Secondly, the options are evaluated in terms of both their costs and their benefits. The oldest type of economic evaluation is cost benefit analysis through which questions primarily of allocative efficiency are addressed. Even if not everything can be valued in monetary terms, a cost-benefit framework is still useful as all impacts on costs and benefits can be laid out in a 'balance sheet' to highlight where trade-offs can be, or are being made between tangible items (usually costs) and some intangibles.<sup>2</sup>

With the rise in healthcare costs, it is very essential to economically evaluate the healthcare units so as to find the ways of increasing the profits and minimize costs and wastage.<sup>3</sup> Health care economic analyses are becoming increasingly important in the evaluation of healthcare interventions, including many within ophthalmology. Encompassed with the realm of healthcare economic studies are cost-benefit analysis, cost-effectiveness analysis, cost-minimization analysis, and cost-utility analysis.<sup>5</sup> These specific techniques of economic evaluation can be used to address whether a program, project or intervention offers good value of money. The techniques of economic evaluation offer a systematic framework for identifying, measuring and valuing the resource inputs (costs) to a healthcare project and associated benefits (health outcomes and revenue generated).

Apart from the patient care, budgeting and revenue generation are two important areas which are looked upon by the hospital managers. The main focus is to minimize the costs and maximize the earned revenue. To do so, the management must have thorough understanding of the costs involved in the system and the outcomes and benefits as to ensure that the hospital project is a valuable proposition or not. Resources are scarce, especially healthcare resources. Therefore all organization's involved in healthcare are concerned with the securing value for money from their investments. Organizations need to be able to calculate the return precisely, a project yields. When a cost-benefit analysis is performed, a comparative assessment of all the anticipated benefits from the project and all the costs to introduce the project, operationalize and support it, are identified.

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Cost-benefit analyses help to:

- Decide whether to undertake a project or decide which of several projects to undertake.
- Frame appropriate project objectives.
- Develop appropriate before and after measures of project success.
- Prepare estimates of the resources required to perform the project work.

Thus, a cost-benefit analysis is most helpful tool in management arsenal. The present study was planned to do the economic evaluation at an Eye hospital, in Haryana state. The main aim of the study is to analyse whether the center is viable or not.

The costs involves in the economic evaluation could be resource costs: capital costs (new and existing buildings or equipment); staffing costs (physicians, nurses, physiotherapists, etc.); consumable costs (drugs, dressings, etc.); nonpatient related costs (administration and overhead costs); costs incurred in nonhealth care sectors (social services, etc.); and costs incurred by patients and their families (transportation, parking, child care, etc.).<sup>9</sup> These costs could be fixed or variable. The outcomes could be in terms of health utility, Quality Adjusted Life Years (QALY), revenue and time trade-offs.<sup>2</sup> An economic evaluation study carried out by Goor et al (2010) compared the costs involved at the hospital's end in glaucoma follow-up group and glaucoma specialist group assuming that the health outcomes in both the groups are same.<sup>4</sup> The results of the study showed that healthcare costs were significantly lower in glaucoma follow-up unit. Thus, this method of treatment could be adopted at other eye hospitals as well.

When considering the role of economic evaluation in health technology assessment, identify four stages at which economic evaluation can take place.<sup>6</sup> These are early developmental (stage 1); maturing innovation (stage 2); close to widespread diffusion (stage 3); and moving into practice (stage 4). Stage 1 comprises the systematic review of evidence relating to the cost and effectiveness of existing experience and the use of informal clinical opinion to assess the potential value of the new technology. Stage 2 includes modeling studies using the data from existing clinical studies, and the pilot studies of economic data collection alongside controlled trials. Stage 3 involves economic data collection alongside RCTs and refined modeling studies using systematic overviews of clinical data. Finally, stage 4 involves economic data collection alongside pragmatic trails and modeling studies to generalize results to other settings or to extrapolate to the long-term.

Tallying up all the cost components may yield overlapping areas of similar resource use, such as two variously busy clinics (one a very busy clinic and the other a not so busy

clinic). In this case it becomes difficult to disentangle the true proportion of overhead expenses (electricity, heat, rent of hospital space, etc.) which is being consumed separately. Under such circumstances, the aim is to make a reasonable estimate of the various amounts involved, including such matters as the number of employees, the size or area of clinic space used, the number and volume of patients seen, etc.<sup>8</sup>

As a general rule, if an investment has a positive (+) profitability index ( $>1$ ), then the project should be undertaken. However, if an investment has a negative (-) profitability index ( $<1$ ), the project should be rejected.

- If  $PI > 1$ , Good Investment
- If  $PI < 1$ , Bad Investment

There exists a linear relationship between NPV and PI.

- If profitability index  $> 1$ , NPV is positive (+).
- If profitability index  $< 1$ , NPV is negative (-).

## OBJECTIVES

Broad objective of the study is to do cost benefit analysis to understand the financial return of the eye center project. However, the specific objectives of the study are to:

1. Calculate the total year wise costs involved in the eye center.
2. Study the revenue pattern of the center through various procedures.
3. Calculate net present value and profitability index.

## RESEARCH METHODOLOGY

The study is both descriptive and exploratory in nature. All the cost and revenue were taken from the audited finance records. A performa was made to identify different types of cost since hospital's inception. A separate sheet was prepared to calculate the year wise revenue from the patient and medical and consumable store.

### The Present Value Concept

A project will be worth doing if the total of its benefits is at least as high as the sum of its costs, measured in monetary terms. Given that benefits and costs will continue over several years, and that the value of rupee today are worth more than the promise of rupees next year, both situation must be converted to a common time period, conventionally taken to be the present period. Accordingly, the net benefit of the project will be its net present value (NPV), defined as the present value of the benefits (PVB) less the present value of the costs (PVC). Net present value concept is a management tool to improve decision-making, taking. Discounting concept into account. The discounting part take cares the inflation while calculating present value for a project.

## Profitability Index

Profitability is an important parameter (ratio) that explains the relationship between the costs of a project and benefits in terms revenue. The value of 1 is taken as minimum acceptable measure on this index.<sup>7</sup> Any value less than one, would indicate that the project's present value is lower than original investment. As the values of the profitability index (PI) increase, so does the financial return and worthiness of the proposed project. PI quantify the amount of value created per unit of investment. It is significantly different from return on investment which is used to evaluate the efficiency of an investment or to compare the efficiency of various investments options.

## Data Collection Plan

The data used in the study was from 2010-2011 to 2016-2017. This includes actual and projected data. For the calculation purpose, year 2010 is considered as year zero. The data for the 0 to 3 years is the real time data. Remaining data is projected based on the trend seen from the actual data.

- 0 year initial investment
- 1 years: Oct 2010 to Mar 2011
- 2 years: Apr 2011 to Mar 2012
- 3 years: Apr 2012 to Mar 2013
- 4 years: Apr 2013 to Mar 2014
- 5 years: Apr 2014 to Mar 2015
- 6 years: Apr 2015 to Mar 2016
- 7 years: Mar 2016 to Apr 2017

The study is done based on the data collected or projected from 2010 to 2017. The main reason for taking these 7 years time frame is because of two facts, one that major equipments installed in the center were procured in the year 2013 and these equipments life is considered as 5 years. Secondly, the building is on lease agreement till 2017.

## Data Analysis

Cost benefit analysis is done by calculating NPV and PI. Following formula is used to calculate both these indicators.

$$\text{Net present value (NPV)} = \sum_{t=0}^n \frac{Rt}{(1+i)^t}$$

$Rt$  = Net Gain or profit (total revenue-total cost)

$i$  = Discount rate. It is taken as 10% in this study

$n$  = No. of years

$$\text{Profitability index} = \frac{\text{NPV} + \text{Initial capital investment}}{\text{Initial capital investment}}$$

## STUDY FINDINGS

Total expenditure year wise on the project, were divided into capital expenditure and running expenditure for different

years. Capital expenditure includes cost of purchase of equipment, hospital information system (LEKHI), software licence, hardware costs and furnishing and other costs. Running expenditure includes the rent, cost of consumables, salary of the permanent employee and visiting consultants (Allocated Cost), petty cash for routine expenditure and yearly software licence renewal cost. Marketing expenses, staff and patient welfare expenses, travel expenses, phone bill, electricity bill, water bill and local vendor payment for supplies, repair and maintenance cost are included in petty cash. Total initial investment for the hospital in year zero is mentioned in Table 1. These costs are only the initial capital investment for the project.

The project was launched in the year 2010. Table 2 shows the year wise total costs incurred by the center under various heads. In the Table 2, cost from 2010-2011 to 2012-2013 are real time data and from 2013-2014 to 2016-2017 are the projected costs based on the trend seen in past 2 to 3 years. While making the projections, opinion of the promoters were also taken to understand if they have any immediate future investment plan. For making the calculation few assumptions were made, e.g. cost projections were made for the period 2013-2014 to 2016-2017 for different cost heads, e.g., consumables @ 15% increase annually, salary 15% increase annually and petty cash 25% annually. Rent and software renewal will remain same year as it is under long-term-agreement.

The revenue generating departments include OPD, cataract clinic, retina clinic, glaucoma clinic, Lasik clinic, oculoplasty services, squint clinic and pediatric eye services. The revenue is generated by performing diagnostic tests and carrying out surgeries in different clinics. Table 3 shows the year wise revenue generated by different specialties and the total revenue. It is observed from the Table 4 that from 2010 to 2013, revenue showed 20% increase annually and this is used as basis of revenue projections.

Graph 1 shows the graphical representation of the revenue pattern from 2010-2011 to 2016-2017.

**Table 1:** Capital investment in year zero

S. no.	Capital expenditure	Rate (in ₹)	Amount (in ₹)	Share (%)
1	Equipment (complete)		21950701	95.4
2	Lekhi Software (11 centers)	2000000	181818	0.8
3	Licence per center	200000	200000	0.9
4	Hardware cost	280000	280000	1.2
5	Furnishing and other cost	400000	400000	1.7
	Total		23012519	100

**Table 2:** Year-wise expenditure (actual and projected)

Year	Consumables	Equipment	Software purchase	Salary	Rent	Software renewal	Petty cash	Total cost
2010	–	23012519	–	–	–	–	–	–
2010-11	2472244	–	–	2991298	1500000	–	960000	7923542
2011-12	5686161	–	–	6879986	3000000	100000	2400000	18066147
2012-13	6539085	46000000	448333	7911984	3000000	100000	3000000	66999402
2013-14	7519948	–	–	9098781	3000000	100000	3750000	23468729
2014-15	8647940	–	–	10463598	3000000	100000	4687500	26899038
2015-16	9945131	–	–	12033138	3000000	100000	5859375	30937644
2016-17	11436901	–	–	13838109	3000000	100000	7324218	35699228

Total cost and total revenue is depicted in the Table 3. It shows that except for the years 2010 and 2012 to 2013, there is substantial net gain or profit. In these above-mentioned 2 years, cost is much higher than revenue due to heavy investment by the organization.

Net present value (NPV) for the project was calculated from 1 to 7 years based on the actual data of 3 years and projected data of subsequent 4 years. The NPV is calculated for the entire life cycle of the project but, in this case, we wanted to know the status of the project in the first 6 years of operation. After 2017, there may be expansion depending upon the performance of the center and market potential. Therefore, the NPV and PI for the project till 2017 are done to decide the future course of action.

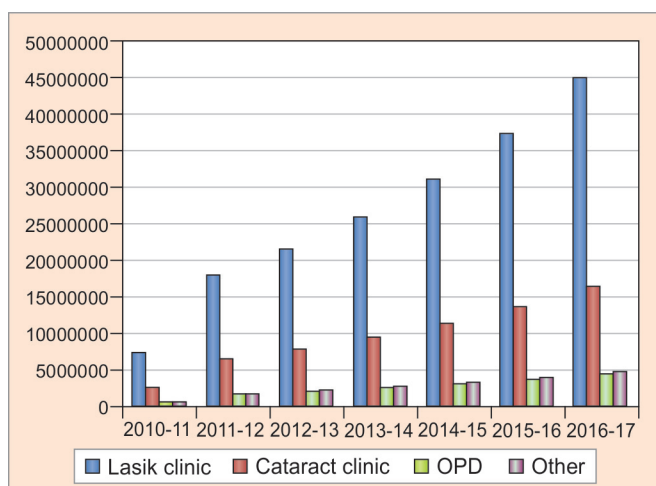
$$\text{Net present value (NPV)} = \frac{\text{Initial investment} + \text{Net gain}}{1 + 0.01^n}$$

$$\text{NPV} = 56918501$$

A positive NPV explain the project is worthwhile and making profits, with current cost and revenue projections. The project can be further being taken further and the promoters may look for more opportunity by expansion.

$$\text{Profitability index} = \frac{\text{NPV} + \text{initial capital investment}}{\text{Initial capital investment}}$$

PI for this center is 3.47 which shows that for every ₹ 1 spent, 3.47 rupees will be earned by the eye center.

**Graph 1:** Year-wise revenue generation trend from different specialties

Result of PI and NPV interpret that the project is viable and successful.

## CONCLUSION

This research gives a unique and valuable insight toward the cost centers and revenue generation centers of the eye care unit. Cost centers include the capital cost, running cost and the petty cash. The revenue centers are the different specialties offered by the center and OPD, diagnostic tests and surgeries within the specialty. Also, the NPV and PI of the project are positive, i.e. the project is viable and profitable. For each rupee spent, the eye center earns approx ₹ 3.5.

Cost benefit analysis is one of the key items of any business case. It is the analysis of costs of a project that includes some consideration of both the cost and the pay-back in monetary terms. Measuring costs is an exacting process and relies upon clearly defining that the cost inputs selected for analysis are 'Measured in appropriate physical and natural units'.<sup>4</sup>

The PI is also known as benefit/cost ratio. It is present value of future values (NPV) plus the initial investment, divided by the initial investment. The NPV is a discounted cash flow (DCF) technique. It relies on the concept of opportunity cost to place a value on cash inflows arising from capital investment.

Opportunity cost is the calculation of what is sacrificed or foregone as a result of a particular decision. It is also referred to as the 'real' cost of taking some action. Present

**Table 3:** Year-wise cost, revenue and net gain or profit of the eye center

Year	Total cost	Revenue	Net gain (profit)
2010	23012519	–	–23012519
2010-11	7923542	11879180	3955638
2011-12	18066147	28510038	10443891
2012-13	66999402	34212044	–32787358
2013-14	23468729	41054454	17585725
2014-15	26899038	49265344	22366306
2015-16	30937644	59118414	28180770
2016-17	35699228	70942096	35242868

**Table 4:** Year-wise trend of revenue generation by different specialties

Year	Lasik clinic	Cataract clinic	OPD	Others	Total revenue (in ₹)	Data type
2010-11	7507643	2760721	794717	816099	11879180	Actual
2011-12	18018343	6625733	1907322	1958640	28510038	Actual
2012-13	21622012	7950879	2288786	2350367	34212044	Actual
2013-14	25946414	9541055	2746544	2820441	41054454	Projected
2014-15	31135697	11449266	3295852	3384529	49265344	Projected
2015-16	37362836	13739120	3955023	4061435	59118414	Projected
2016-17	44835404	16486943	4746027	4873722	70942096	Projected

value is the cash equivalent now of a sum receivable at a later date. If the money is not spent now and banked, the opportunity cost includes both the initial sum and the interest earned.

NPV is a technique where cash inflows expected in future years are discounted back to their present value. This is calculated by using a discount rate equivalent to the interest that would have been received on the sums, had the inflows been saved. A positive NPV means that the project is worthwhile because the cost of tying up capital is compensated for by the cash inflows that result. When more than one project is being appraised, the project with the highest NPV is taken up.

In this study, total costs and revenue data is analyzed to calculate the year wise net loss or net gain of the eye center. Total initial capital investment of the project is ₹ 23012519.18. Ninety-five percent of the initial capital investment is done on the equipment. Analysis of the cost centers data from 0 to 3 years revealed that petty cash, consumable cost and salary showed a 25, 15 and 15% increase respectively, on annual basis.

Analysis of the revenue of the 1 to 3 years showed that there is approximately 20% increase in the revenue every year. The analysis of 2012 to 2013 revenue data showed that Lasik clinic and cataract clinic contributed 63 and 23% of the total revenue generated in the year.

The center suffered a net loss in the 3rd year due to huge capital investment on equipment and software. For the rest of the years, the center shows net gain and is profitable.

Net present value calculated for the project for 7 years is 56918501. A positive NPV means that the cash flows will be positive. NPV is basically a tool to determine whether a decision or project of a firm will add value to it or not. When the  $NPV > 0$ , this means that the investment will add value to the firm and may be accepted. However, it must also be remembered while looking at the NPV that time is also a factor. In this case, the NPV for the eye center project is calculated based on the 7 years data so the NPV value tells that the project will be profitable at time 't' which is 7 years in this case.

When the present worth of all future cash flows exactly equals the initial investment, the NPV would be zero

(because there is no rupee amount difference) whereas the PI would be 1.0 (because there is no proportionate difference). Profitability index measures the ratio between cash flow to investment. Therefore, the higher the ratio the more cash flows to investment. Profitability index = 1 means that the desired rate of return have been achieved (i.e. the price paid for the project based upon its future cash flows discounted at rate of return is exactly right). In case of our center, the PI is 3.47. It means that the center has exceeded its goal. For each penny spent, ₹ 3.47 will be the earned amount.

NPV reflects the net increase in firm's wealth and PI gives a ratio. In case of this eye center, both the NPV and PI are positive which means that the project is viable and is profitable.

## LIMITATIONS

This study was based on actual data of two and a half years and projected data of 4 years. The outcome of the research could be more accurate and precise if there had been more actual data as compared to the projected data.

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