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# PROJECT EVALUATION

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**Prepared by:** MIT Students

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NOTE: All amounts given are in actual dollars

## **BACKGROUND**<sup>i,ii,iii</sup>

On November 11, 1954 the honorable John Joseph Cahill, the Premier of New South Wales at the time, convened a conference to discuss the establishment of an opera house in New South Wales, Sydney, Australia. At the conference, Cahill expressed his desire for “proper facilities for the expression of talent and the staging of the highest forms of entertainment...that will be a credit to the State not only today but for hundreds of years.” Out of the 21 possible sites of the proposed opera house, Bennelong Point, a peninsula of 2.23 hectares (240000 ft<sup>2</sup>) was chosen on May 17, 1955. The tram shed, which was located there, was removed: a change welcomed by the Opera House Committee and the residents of Sydney.

On February 1, 1956, the international competition for the national opera house was commenced. The competition, arranged by Premier Cahill and the government of New South Wales, provided competitors with a 25-page booklet with black and white photos of Bennelong Point. Detailed in the booklet were the requirements for the opera house including a large hall for symphony concerts, large-scale opera, ballet and dance, choral, pageants, and mass meetings that could seat 3000-3500 people and a small hall for dramatic presentations, intimate opera, chamber music, concerts, recitals, and lectures that could seat 1200. The structure also required a restaurant with a capacity of 250 and two meeting rooms, one for 100 people and one for 200 people. The competition closed in late 1956 with 233 entries representing 28 countries, including Australia, England, Germany, French Morocco, Iran, and Kenya.

In early January of 1957, 38-year old Danish architect, Jørn Utzon, was announced as the winner of the competition by Cahill at the Art Gallery of New South Wales. Utzon had designed the opera house without first having seen the site in person and he relied on photographs, shipping maps, and firsthand accounts. The judges chose Utzon’s design based on its pure originality and creativity, realizing that it would “clearly be a

controversial design.” However, they were still convinced of its merits to New South Wales and Sydney. The original drawing featured Utzon’s structurally unrealizable, but aesthetically pleasing roof design.

On July 19, 1957, the Sydney Opera House Lottery Fund was established. As it would turn out, the lotteries<sup>iv</sup> would pay for the majority of the initial construction cost, as the government of New South Wales did not want to pay for the project.

With Utzon’s approval, Ove Arup and Partners was appointed as the structural engineers for the project in 1958 and construction of the Sydney Opera House began in 1959. It was expected to take four years to complete with an estimated cost of AUS \$7 M. However, even working together with Arup, Utzon did not come up with the final spherical design of the roof until sometime between 1961 and 1962; three to four years after construction began.

The Sydney Opera House would be one of the first major projects designed using computer-aided design (CAD)<sup>v</sup> and presented major revolutionary architectural concepts and engineering challenges. It was also one of the first major projects, which employed the use of computers to analyze internal load effects on the members that would support the roof structure<sup>vi</sup>.

Altogether, the Sydney Opera House took fourteen years to complete and construction costs amounted to nearly AUS \$102 M (actual dollars). Since its initial opening in 1973, the Sydney Opera House has undergone numerous renovations and expansions and hosted many performances.

## **THE STAKEHOLDERS<sup>vii</sup>**

A project the magnitude of the Sydney Opera House, a public sector endeavor, had many stakeholders. The following analysis of the stakeholders classifies them using the Mitchell criteria, which determines and places stakeholders on the basis of whether or not they possess any combination of the three following qualities: power, legitimacy, and urgency. In addition to this, the stakeholders will be evaluated within two different timeframes: during the construction of the Sydney Opera House (1959-1973) and the modern day era.

## Stakeholders during the initial construction period

When the Sydney Opera House Project first started to take form in the mid 20<sup>th</sup> century, the government of New South Wales (NSW) was given a task to create a theater, which was intended to serve the arts. This makes the NSW government the very first stakeholder of the project. From the Mitchell perspective, the government was probably a definitive stakeholder, exhibiting power, legitimacy, and urgency, since they were given the responsibility to facilitate the creation of such a project.

Chronologically, the next stakeholders are the judging panel of the international competition to design the future opera house. These stakeholders can be classified as dependent, because they were appointed by the government of New South Wales to choose a design for the opera house; however, they lacked the power to do anything further once the design was chosen.

The main stakeholder throughout the initial construction process (1959-1973) was Jørn Utzon, whose design was chosen out of a total of 233 entries. Since the project lacked a proper manager, Utzon, along with Ove Arup, the chief structural engineer working on the project, facilitated and oversaw the construction of the project. Together, they worked for four years before arriving at the final design for the roof. This keen sense of architectural vision caused some problems, as Utzon would pay more attention to the design aspect of the structure rather than the time and cost objectives. However, because he was essentially the project manager, nearly everything he said went through, which classifies him as a definitive stakeholder under the Mitchell framework. Arup, who was for the most part Utzon's second in command, is also considered a definitive stakeholder.

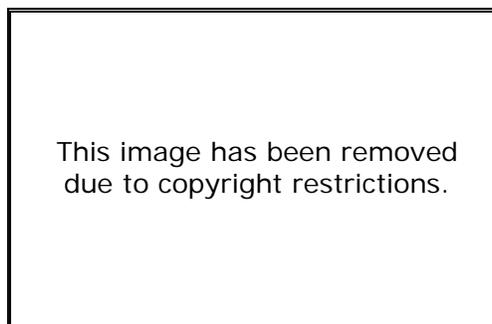


Figure 1: Utzon working on a model of the Opera House<sup>viii</sup>

In 1966, due to financial issues, Jørn Utzon resigned from the project before its completion, and the government eventually hired Hall, Todd, and Littlemore. Utzon left with some of the original blueprints of the building, so Hall, Todd, and Littlemore had to spend time and money on additional designs<sup>ix</sup>. This makes the Hall, Todd and Littlemore definitive stakeholders, because after Utzon left, they essentially assumed the roles of project manager.

In 1967, at the request of the Australian Broadcasting Commission (ABC), the New South Wales government changed the proposed larger opera hall into the concert hall because symphony concerts, which were managed by ABC, were predicted to be more popular and able of drawing larger audiences than opera. Thus, the revenues to the opera house would increase. The Australian Broadcasting Commission, at this point in time, was a dependent stakeholder, because they had legitimate and urgent concerns for a concert hall, but they had to rely on the NSW government to do their bidding.

The funding for the Sydney Opera House was done primarily through lotteries, which had participants who were most likely poor, as we will discuss in a later part of the project. Without the lottery contestants, there would have been insufficient funding for the opera house. However, besides funding this endeavor, these contestants really had no power. These stakeholders also did not exhibit legitimacy or urgency; the contestants participated in the lotteries with their own benefits in mind. It can therefore be argued that they did not quite have any interest in the Opera House and only sought to win the jackpot, thus, they have none of the three qualities detailed by Mitchell so they are classified as non-stakeholders. However, this term could be a little misleading, because without their funding from the lotteries, it is doubtful whether or not the Sydney Opera House would be around today.

There was also an Opera House Committee formed in 1954, and the Sydney Opera House Executive Committee (SOHEC) replaced this entity in 1957. The Committee was Utzon's main client, that is, instead of interacting with the Government of New South Wales, Utzon only interacted with the Committee. The Committee had 3 advisory panels, one for architectural and constructional aspects, one for traffic and one for music and drama<sup>x</sup>. It continued to make requests of changes to the design and capacity based on requests from the Australian Broadcasting Commission and other individuals even into 1959, when

construction has already began<sup>xi</sup>. It was therefore a definitive stakeholder, as it was Utzon's main client until 1960. At this point the government became concerned with the progress made and decided to take control of the project directly under the *Sydney Opera House Act of 1960*, which effectively gave the Minister of Public Works authority to supervise the work<sup>xii</sup>.

### Present day stakeholders

Today, the Sydney Opera House remains an icon to the theatrical, structural and architectural worlds. The New South Wales government continues to be a primary stakeholder, overseeing the operations of the opera house. The section of government that maintains the theater is the Sydney Opera House Trust Fund, who operates the theater on behalf of the NSW government. Although the group was created a while ago, they continue to help operate the Sydney Opera House.

A public attraction such as the Sydney Opera House attracts a lot of locals and tourists every year. The main source of revenue for such a structure comes from admission fees, concert sales, tours and other public events. This makes the public discretionary stakeholder, because though they have no power or urgency, they exhibit legitimacy. Their presence adds immense value to the operations of the Opera House and their absence would in essence destroy the primary aim of this iconic building. Their concerns and measures of satisfaction are therefore legitimate concerns of those in power.

However, if the public insists on change, for whatever reason, their salience in the eyes of the government could quickly increase. If, for example, the public suddenly becomes unsatisfied with the operations of the opera house, they could form protests group and boycott ticket sales. These actions would give the public qualities of legitimacy and urgency, making them dependent stakeholders. They would be dependent on the government of New South Wales to take action. It is important to note that this is only a theoretical situation and is meant to exemplify the dynamic nature of the Mitchell classification of stakeholders.

## MAJOR ISSUES THAT AFFECTED THE PROJECT

There were many uncertainties and risks associated with the Sydney Opera House project. First, the design competition, though it was a good incentive, failed to evaluate how much experience the entrants had with large-scale design projects. Jørn Utzon's shell-like structure won the competition, even though his designs were only partially completed. His designs were well ahead of their time and even as of 1959, when the government ordered for construction to begin, there still existed no known methods to construct the proposed roof structure<sup>xiii</sup>. To further complicate the initial problem, the design required that the roof spanned completely without columns, as Utzon wanted an open area with a ceiling of structural ribs<sup>xiv</sup>.

The Sydney Opera House project had no project manager, and it was assumed that Utzon would take the initiative for all decisions regarding design, construction, or development<sup>xv</sup>. There were no project evaluation measures or officials in place, and for that reason, goalposts and implementation methods kept on changing. Some sections of the opera house were even built then later demolished, re-designed and built again<sup>xvi</sup>.

One aspect that was under great debate was the design of the opera house roof. As mentioned earlier, there was no known way to implement the original design. Therefore Utzon revised the design, however, it still proved to be a challenging and expensive task to actualize.

Along with the uncertainty related to the roof, there was also uncertainty about government expectations of the project. Originally, the structure was to have two theaters; however, government later told Utzon that they wanted four theaters, which required him to redesign parts of the building, thus delaying construction. Due to these delays and changes in the building blueprint, both the original cost and time estimates of AUS \$7 million and four years, respectively, seemed uncertain. As the costs continued to increase, an issue arose as to how this large-scale project would be funded<sup>xvii</sup>.

The government initially gave no limit to available finances, and then four years later limited the funding resulting in discouragement, frustration and eventual withdrawal of Jørn Utzon in 1966<sup>xviii</sup>. The government later increased the funding massively, but Jørn Utzon had already left, with some of the initial blueprints, so new designs and

modifications had to be put in place. A group of Australian architects led by Peter Hall<sup>xix</sup> took over and eventually completed the project, but since Utzon took his ideas with him, new design plans had to be created. It should be noted that because no such feat had been attempted before, cost estimates were highly inaccurate. In the end, the building was finally completed for AUS \$102 million<sup>xx</sup>, an amount much greater the initial estimate given AUS \$7 million.

## **COSTS AND BENEFITS**

### **Initial Analysis**

The foundations began mid 1959. It was initially not clear how they even achieve the structure, as it had never been done before. They also had no precedents for comparison; it was therefore difficult to come up with feasible estimates. The other issue was that actual construction began before the design could be completed which led to a great amount of waste because some parts had to be built then demolished then built up again; in addition Civil and Civic, the contractors, said that 700 drawings had been issued, almost half had come after the expiry of the initial contract, and that there had been 695 amendments issued in the first phase of the project alone.<sup>xxi</sup> Estimates for the entire cost of construction had risen from AUS \$7.2 M in 1957 to \$9.8 M in 1958 to \$18 M in 1961 to \$24.5 M in 1962 to \$34.8 M in 1964 and to \$48.4 M in 1965.<sup>xxii</sup> By 1968 costs estimates had risen to AUS \$85 M.<sup>xxiii</sup>

The lack of proper planning prior to the execution of this plan was partially responsible for the manner in which the estimates changed.

### **Lotteries used for financing**

The Government of New South Wales would give no more than AUS £100,000 and declared that the rest of the funding would come from public lotteries<sup>xxiv</sup> and a public appeal fund. The original appeal fund raised about AUS \$900,000 and the rest of the \$102M that the Opera House ended up costing came from the profits of the lottery<sup>xxv</sup>. In November of 1957, Opera House Lottery No.1 went on sale. Tickets were £5 each (\$10) with a first prize of £100,000 (\$200,000)<sup>xxvi</sup>. This lottery was revamped in 1960 with the costs of

tickets reduced to £3 (\$6) each and one-off prizes of \$200,000 introduced. The Opera House Lotteries raised more than \$105 million towards the construction of the Sydney Opera House<sup>xxvii</sup>.



**Fig 2: Sydney Opera House original lottery ticket from ~1957-1958<sup>xxviii</sup>**

The major benefit of using the lotteries as the major source of financing is that unlike loans or mortgages you pay back much less than you gain from the process. It also saved the government from spending its own revenue, and in doing so kept the government from using funds that would have taken out of more essential public projects such healthcare, education and infrastructure. However, was this really good for the general public? It has been shown in America, for example in public state lotteries, that for the most part:

*The average [lottery] expenditure in dollars for households making \$10,000 is about the same as for those making \$60,000. One implication of this pattern of demand is that the tax implicit in lottery finance is regressive, in the sense that as a percentage of income, tax payments decline as income increases.<sup>xxix</sup>*

It can therefore be argued, that even in the case of the Sydney Opera House, it was the relatively less wealthy that ended up bearing a disproportionate part of the cost of putting this relatively luxurious and iconic structure, which they probably would not use as much. So though this venture directly spared the government any direct expenditure, it

may in essence not have been very beneficial for the not so wealthy who readily bought up the lotteries to raise the AUS \$ 100 million.

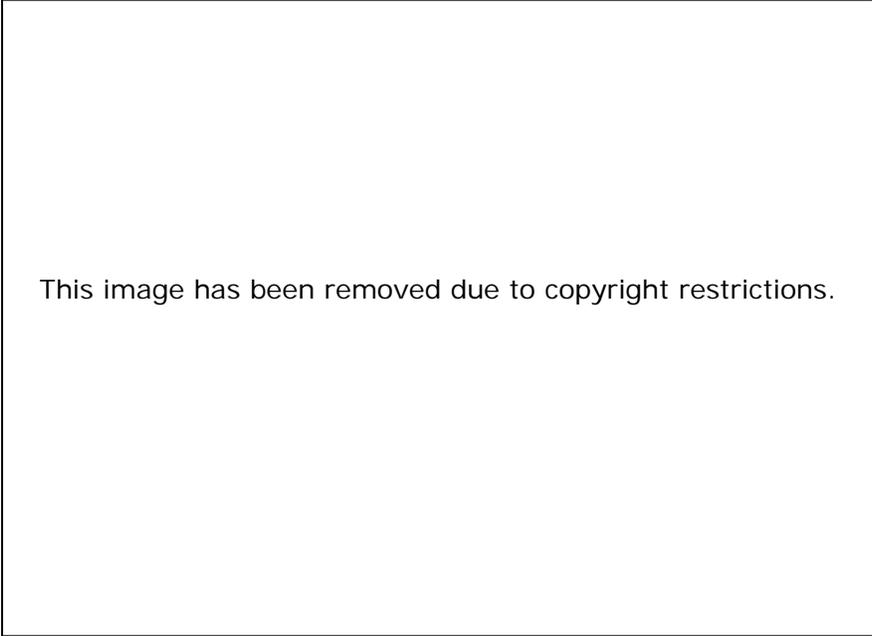
## **SIGNIFICANT DECISIONS THAT AFFECTED DESIGN AND IMPLEMENTATION**

During the design process and implementation of the building there were significant changes to the original plans. First of all, the construction of the opera house was underway before the designs were finalized, resulting in cost overruns and organizational chaos. Because of the major uncertainty in the design, costly mistakes were made during production. For example, huge supporting columns were built, demolished, and rebuilt for a cost of \$300,000 when the design changed from the original blueprint.<sup>xxx</sup>

Utzon was quite stubborn and he refused to listen to the engineers' solution for the roof, resulting in additional delays and costs. For the first six years of the operation Utzon worked from Europe and refused to delegate tasks. Though Utzon had brilliant architectural skills, he was not the best manager<sup>xxxii</sup>. His main concern during this time was the architectural aesthetics of the roof design. This resulted in bottlenecks in the construction and caused delays. These increased delays, in turn, led to high staff turnovers.<sup>xxxii</sup>

Because it was still not known how the roof would actually be constructed, even years into the construction, the design blueprints kept on changing (as shown Fig. 3 below). Michael Baume, in the Sydney Opera House Affair narrates:

*Civil and Civic, the contractors said that 700 drawings had been issued, almost half had come after the expiry of the initial contract, and that there had been 695 amendments issued in the first phase of the project alone. In addition, many of the items priced in the initial estimates that cost a total of 1.1\$ M were replaced with new items that cost \$3.2 M.*<sup>xxxiii</sup>



This image has been removed due to copyright restrictions.

**Figure 3: The Evolution of the Sydney Opera House Design. The general form went from just a free-hand form, into a parabolic, then ellipsoid form. The final shape chosen was spherical, because of the ease of construction and ease of calculating the structural integrity.<sup>xxxiv</sup>**

The final solution was then chosen from spherical sections. The spherical selections were selected because, they were easy to construct from pre-cast forms, and it was easier to perform a structural analysis than in the other models. This final development is shown in Figure 4, below.

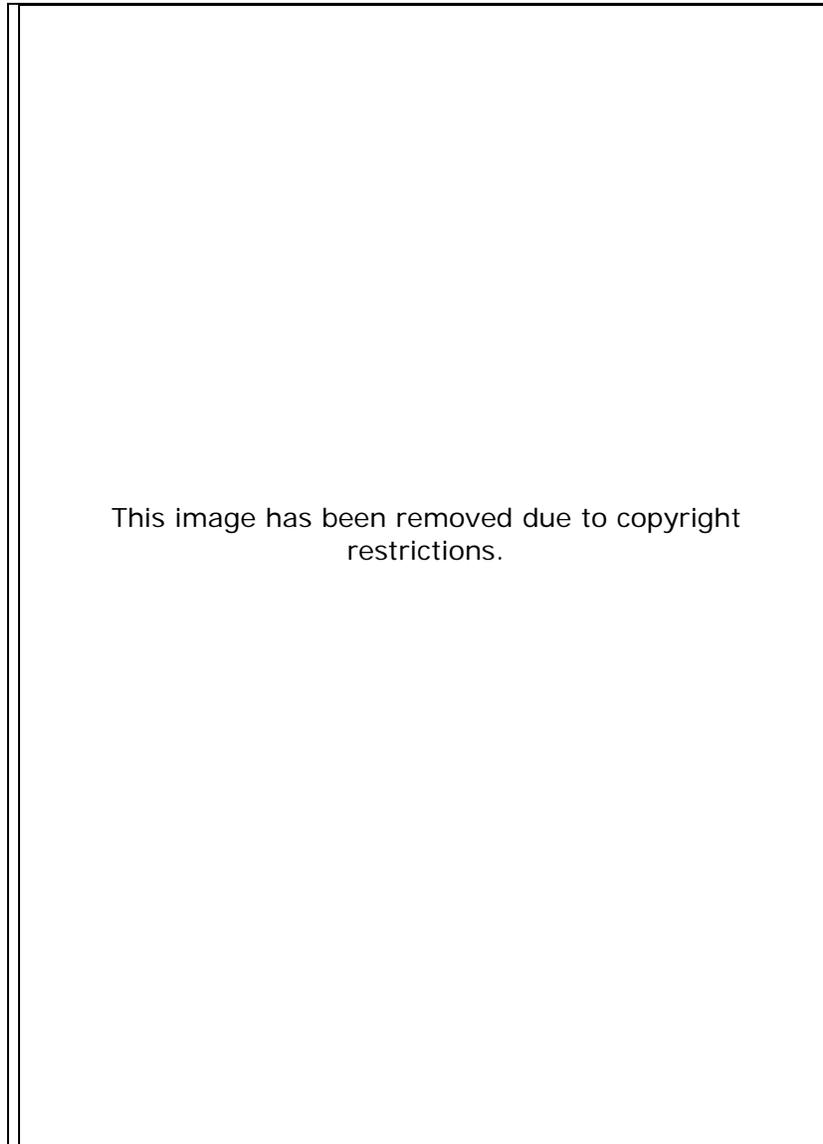


Figure 4: Utzon's Final Solution to the roof problem; pre-cast spherical shapes<sup>xxxv</sup>

**The four significant changes to the design after Utzon left<sup>xxxvi</sup> :**

After Utzon's resignation from the project in 1966, a group of Australian architects led by Peter Hall took over. As mentioned above, Utzon took some of his designs with him, forcing Hall and company to come up with new designs. During this stage of construction, the design underwent four significant changes.

The first significant change to the design was to the cladding of the podium and the paving. Utzon's original intention was to use a system of prefabricated plywood mullions.

The system that was actually constructed was made to deal with the glass, which was different from Utzon's design.

Second, there was a major change in the purposes of each of the planned rooms. The major hall, which was meant to be a multipurpose opera or concert hall, became solely a concert hall. To accommodate the operas, the minor hall, which was originally intended for stage productions, had to be converted to serve both operas and stage productions.

Third, two more theaters were added to the design. This overhaul of the design completely changed the layout of the interiors. The stage machinery, which had previously been designed and fitted inside the major hall, had to be pulled out and thrown away.

Fourth, the movement and redesign of the various rooms had significant impacts on the acoustics of the building. Utzon had originally designed the interior with acoustics in mind. His original designs were modeled and found to be acoustically perfect. However, Utzon's interior designs, including the plywood corridor designs, as well as his seating designs were completely scrapped by Peter Hall and company. Therefore, the current internal organization is not optimal.

## **STATUS OF THE PROJECT**

The building currently has 5 main auditoria and nearly 1000 rooms, a reception hall, 5 rehearsal studios, 4 restaurants, 6 theatre bars, an extensive foyer, library, and administrative offices.<sup>xxxvii</sup> The building covers about 1.8 hectares (4.5 acres) of its 2.2 hectares (5.5 acre) site and has about 4.5 hectares (11 acres) of usable floor space. There are 645 km (400 miles) of electrical cable within this complex and its energy needs are equivalent to the needs of a town of 25,000 people. More than these impressive features however, the Sydney Opera House became and remains a world-class performing arts center, and the iconic symbol of Sydney, and to some extent, Australia<sup>xxxviii</sup>.

In 2007, UNESCO named the Sydney Opera House a World Heritage Site. Today the institution conducts 3000 events yearly, which draw annual audiences of about 2 million. The Sydney Opera House also provides guided tours to 200,000 each year.<sup>xxxix</sup>

## OUR ANALYSIS OF THE RELEVANT COSTS AND BENEFITS

The main aims of the financial analysis were as follows:

- To attempt to figure out whether the Sydney Opera House was and currently is a profitable venture.
- To see whether it would be a self-sustainable venture in the coming years.
- To attempt to figure out what the value of the Sydney Opera House is to the people of New South Wales, and Australia in general; and figure out either what they pay for having this iconic building or what they receive in payments for having this building.

For details on any of these conclusions or calculation methodology, please refer to the appendix.

### Analysis of Initial Construction Costs:<sup>xi</sup>

The construction period of the Sydney Opera House lasted from about 1957-1973. The initial construction can be broken down into three stages. Stage I, the construction of the platform, lasted from 1957-1963, with Utzon as architect. Stage II, the implementation of the roof, lasted from 1963-1967, again with Utzon as the main architect. It should also be noted that Ove Arup helped Utzon come up with the final spherical design of the roof. Stage III, the final stage of construction, which consisted of fabricating the interior, lasted from 1967-1973 and was led by Peter Hall.

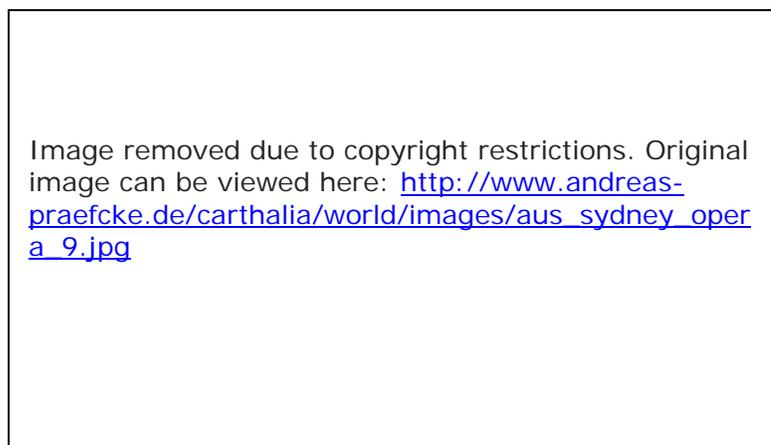


Figure 5: Construction of the Sydney Opera House<sup>xii</sup>

The costs (in actual millions) in Australian dollars for each stage, respectively, were AUS \$5.2 M, AUS \$13.2 M, and AUS \$80.4 M. The reason why Stage III cost that much is because the architects, Hall, Todd, and Littlemore had to start some aspects of the design from scratch. Upon his resignation in 1966, Utzon took some of the initial blueprints with him, forcing Peter Hall to come up with new plans, resulting in a large increase in the price.

The following is an analysis of the present value (PV) of these costs. It is assumed that the costs of each stage can be represented as a lump-sum cost at the end of that stage's year. This analysis also neglects the effect of inflation. Using this information, it is possible to estimate an amount that had to be paid per year (an annuity) during each stage of the project. This can be done using the sinking fund payment equation,  $A = F[A/F, i, N]$ . In this case the discount rate ( $i$ ) is chosen to be 8%, a typical value given to projects funded by the public sector.  $N$  varies with each stage and is found by subtracting the start year of that period from the end year of that period. Using the lump-sum values, the value in 2010 can also be determined using the future value given the present value formula,  $F = P[F/P, i, N]$ .  $N$  varies with each stage and is found by subtracting the year of the lump-sum 2010 (the year that the cost should be discounted to). The results are summarized in the Table 1, below.

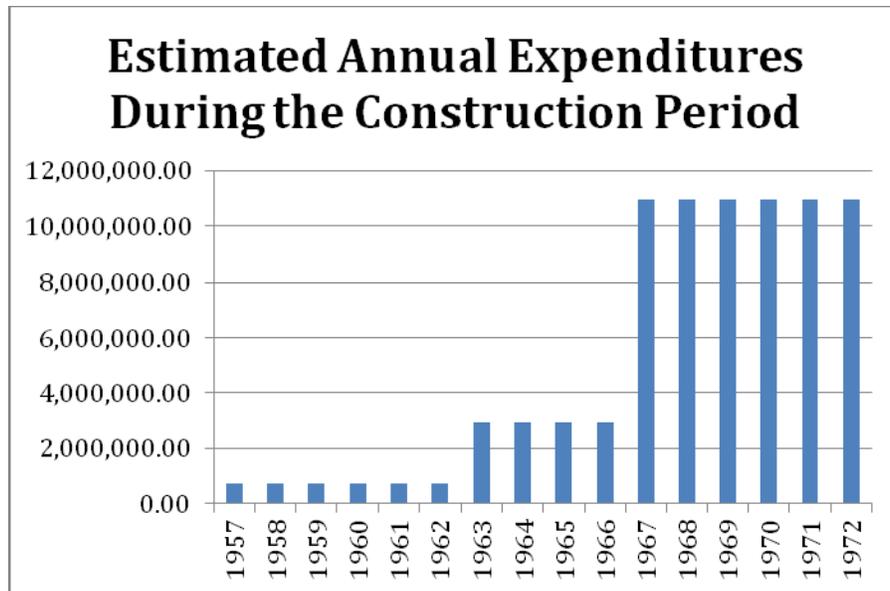
**Table 1: Construction Costs for the 3 key stages**

Year	Stage	Cost (Actual Million)	Cost Per Year (Discounted at 8%)	2010 Value of Costs (Discounted at 8%)
1957	Stage 1 start		708,840.01	
1958			708,840.01	
1959			708,840.01	

1960			708,840.01	
1961			708,840.01	
1962			708,840.01	
1963	Stage 1 end, Stage 2 start	5,200,000.00	2,929,354.62	193,606,463.28
1964			2,929,354.62	
1965			2,929,354.62	
1966			2,929,354.62	
1967	Stage 2 end, Stage 3 start	13,200,000.00	10,959,757.05	361,239,653.59
1968			10,959,757.05	
1969			10,959,757.05	
1970			10,959,757.05	

1971			10,959,757.05	
1972			10,959,757.05	
1973	Stage 3 end	80,400,000.00		1,386,548,297.03
...				
2010			Present Value of construction costs:	1,941,394,413.90

The following graph shows the annual expenditures during the construction period of the Sydney Opera House. It should be noted that all these funds other than an initial AUS \$ 100,000 given by the government, were obtained via public lotteries.



**Graph 1: Estimated Construction Expenditure**

By looking at the table above, it is seen that the 2010 value of the construction costs is about AUS \$2 billion, which is quite a large number considering the fact that the costs in actual million was about AUS \$100 M. The conversion from Australian dollars to US dollars is about a 1 to 1 ratio. This shows the powerful effect of figuring out future values given past values. In retrospect, \$2 billion may not be that much, considering how much the government spends every day. In our initial assumptions, we thought that the value of being such an iconic structure throughout all these years would outweigh this cost. However, our cash flows from the period of operation tell a different story.

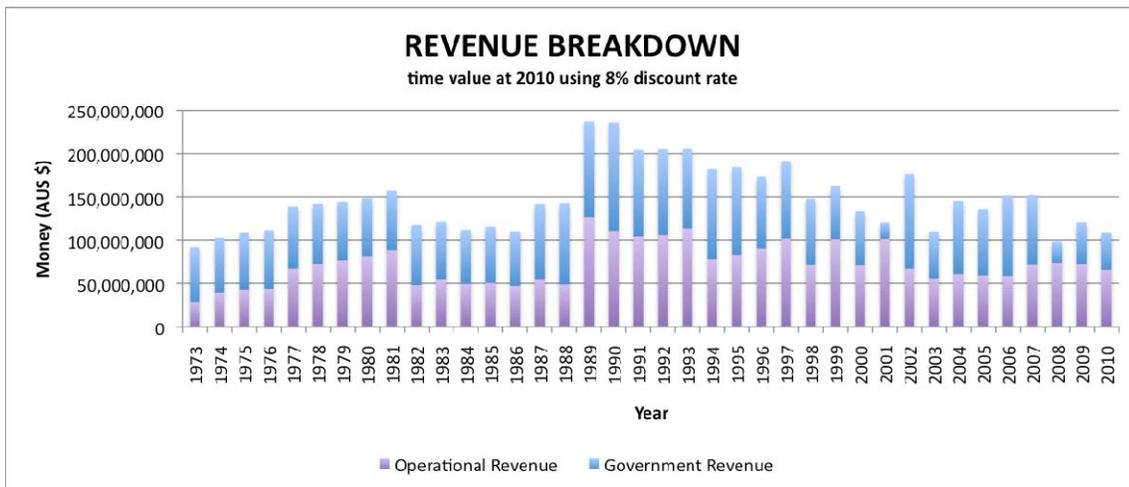
It is important to note that this analysis was only performed for the costs of the initial construction period. Since 1973, the Sydney Opera House has gone through several renovations and transformations, from exterior and interior upgrades to creation of an underground parking lot. These renovations have increased its costs and expenditure significantly.

**Analysis of Operational Period (1973-2010):**

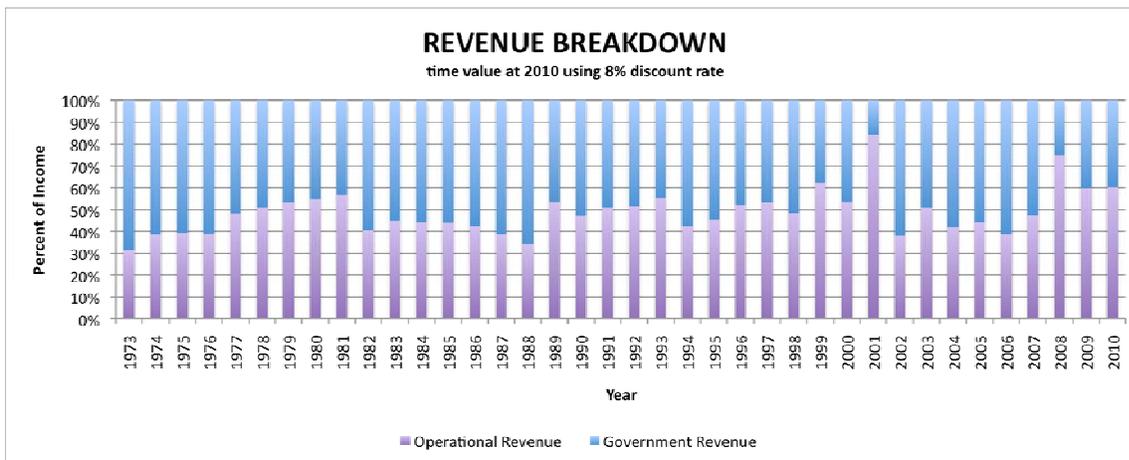
For the period it has been in operation, we use the annual financial reports for the exact details of the revenue and expenditure.

Revenue<sup>xlii</sup>

The Sydney Opera House receives great volumes of money each year. For purposes of comparison, we bring all the revenue received since the official opening until 2010 and discount them at 8% to bring all the values to present value as of 2010. We use 8% because it is a typical approximate discount rate in long-term public service project. We classify this as a public project because the government allocates most of the revenue to it, as we will see in the cash flow diagrams shown below. The revenue received *from operations* came from tickets sales, shows, merchandizing, catering, festivals and tours, and grants from private donors.



**Graph 2: Revenue Breakdown for Operation period (2010 AUS\$)**



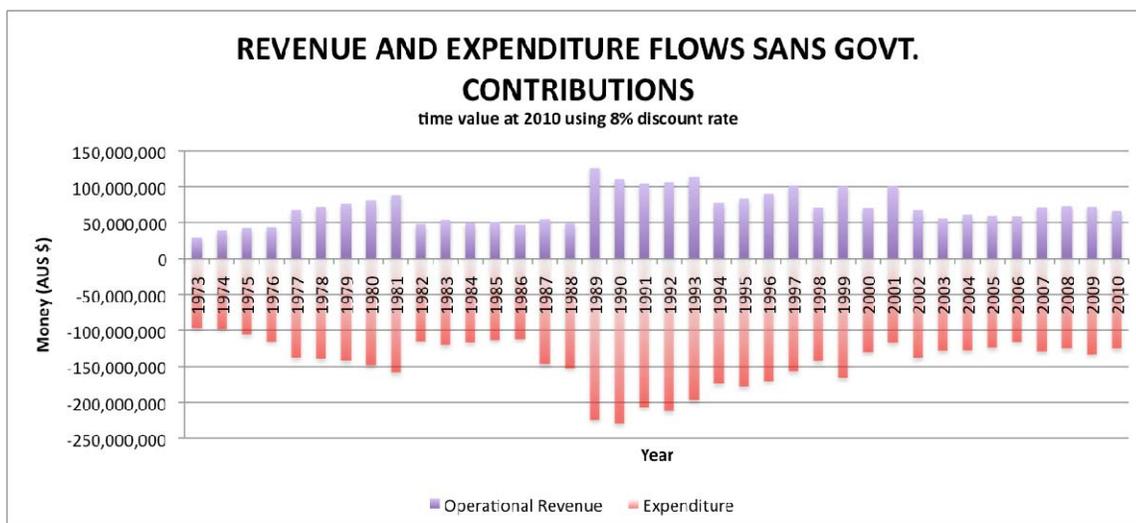
**Graph 3: Revenue Breakdown for Operation period (%)**

In the top-most cash flow diagram, we look at volumes of money received in the second we see what fractions came purely from the government and what came from operations of the House. Over the years the Sydney Opera House has been open, they have received a total of ~AUS \$ 5.6 billion (2010 value); of that AUS \$2.85 billion dollars has been from the government.

**Expenditure<sup>xliii</sup>**

When we look additionally into the expenditure over the years, we note that the expenditure was always greater than the operational revenue, and had it not been for the government endowments, the Sydney Opera House would perpetually be in debt. The values given for expenditure mostly arose from salaries of staff, depreciation of the property and maintenance & repairs. This building is always in need of great amount of repair, maintenance and renovation, and thus renovations and repair form a great part of the expenditure.

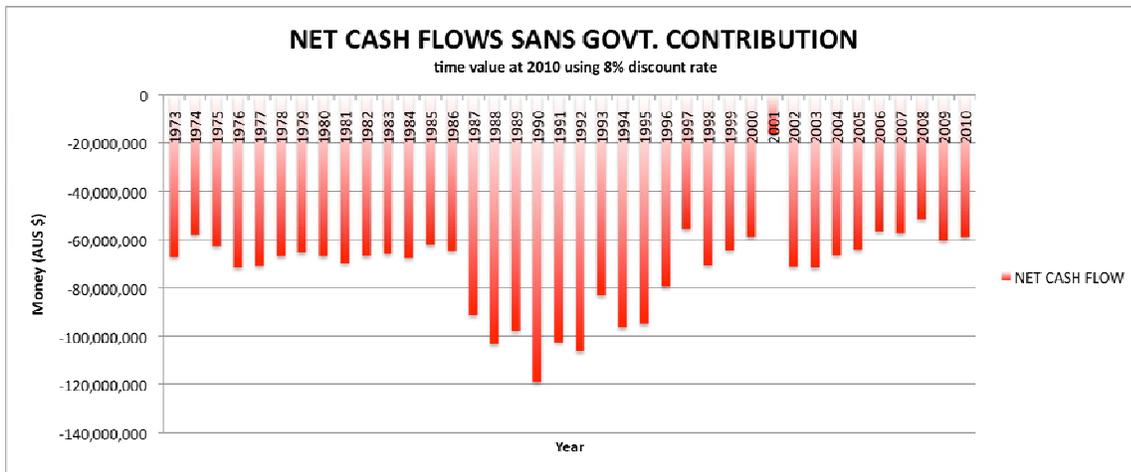
The total expenditure over the years the Sydney Opera House has been in operation amounts to ~AUS\$ 5.5 billion, a number very close to the total revenues received. In following cash flow diagrams we compare the expenditure to the revenues, with and without the government contributions, in an attempt to analyze whether the project would be self-sustainable, and the answer seems to be a resounding “no” seeing that there is not a single year where the operational revenue would meet the expenditure.



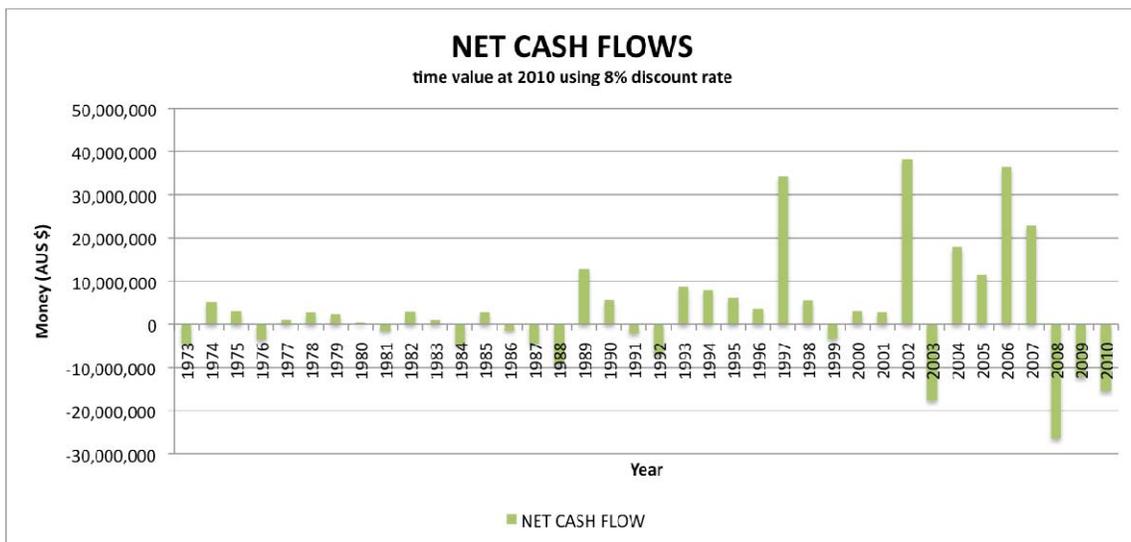
**Graph 4: Operational Revenue and Expenditure Breakdown without Government Contributions (2010 AUS \$)**

**Net Cash Flows**

The net cash flows clarify the magnitude of the expenditure even further. The NPV of the Total Summation of Net Cash Flows in 2010 value comes to AUS \$100 million, which looks somewhat dismal considering the amount of money that has been invested into this project. We should note that this amount does not include the NPV of construction costs.



**Graph 5: Net Cash Flows without Government Contributions (2010 AUS \$)**



## Graph 6: Net Cash Flows (2010 AUS \$)

### CRITIQUE OF THE PROJECT AND PROJECT EVALUATION PROCESS

#### Was it a profitable venture?

In this financial analysis, two periods were looked at: the construction period and the period during which the Sydney Opera House was operated. The present values (in 2010) of the costs and benefits incurred during these time periods were calculated using a discount rate of 8%.

During the construction period, only costs were incurred and the present value of the construction cost is about AUS \$2 B. From 1973 to the present day, the present value of the costs is about AUS \$5.5 B. During this same time period, benefits from operations and government revenues have a present value of about AUS ~\$5.6 B. Subtracting the benefits from the costs results in a net cash flow of about AUS ~\$100 M. It is important to note that about AUS \$2.9 B of the revenue (a little over half!) was from the government. It can then be concluded that AUS \$2.7 B was accumulated through the actual operation of the opera house. If the cost (AUS \$5.5 B) is subtracted from the operating revenues, the present value net cash flow is AUS -\$2.8 B, which is a large deficit. It is important to note that this does not take into account the construction costs. Adding in the construction costs brings the operational cash flow even lower to about AUS -\$4.8 B.

The results from the analysis show that from a strictly financial standpoint, the Sydney Opera House was not a viable project at all. So why is it that the Sydney Opera House is still standing today despite its financial flaws? This question will be addressed in the next section.

#### How we are attempting to quantify its value to the people of New South Wales?

From the analysis, it shows that the Sydney Opera House is not a profitable project. However, today it remains an apex in the world of architecture for its innovative design. It also hosts over a thousand operas, concerts, etc. per year. Its iconic value to the citizens of New South Wales and Australia is most likely what is keeping the structure in commission. Its iconic value is quite hard to quantify, however, as seen above the opera house's

operational activities would have not been enough to break even. The government of New South Wales has contributed a present value of almost AUS \$3 B to the opera house to help keep it in function. The government might know that the Sydney Opera House is not doing well financially; however, to the people of New South Wales it remains an important icon. Therefore, as a rough estimate, the iconic value of the opera house to the public can be estimated as the government’s contribution throughout the years, a value of nearly AUS \$3 B.

**Is it financially sustainable for the future?**

In the past ten years, it seems that the Sydney Opera House has at least been contributing 50% of the revenue solely through its operations. Even though this is over half of their revenues through their years, the ratio of operational revenue to government revenue should be much higher. Considering the fact that in these next years, the Sydney Opera House plans to undergo more renovations and total refurbishment, currently valued at AUS \$800 billion<sup>xliv</sup>, additional costs will be accrued. The opera house is already in huge debt and this will only increase in the next decade or so. Operational revenues will probably not increase much, so therefore government revenue must increase to help finance these expenditures. Because the Sydney Opera House is such an icon, the government will probably continue to fund it for a while. However, at one point the government may realize that it cannot continue to fund the opera house, and will eventually suspend funding. Therefore, it **does not seem** that the Sydney Opera House is **definitely** financially sustainable for the future.

**Additional Information: What does the AUS \$ 800 million Total Refurbishment recommended in 2010 really mean?**

The table below compares it to current maintenance costs from the past decade.

**Table 2: Maintenance Costs for 2000-2010**

Year	Expenditure In Actual Dollars (AUS \$)	Expenditure in 2010 dollars using 8% (AUS \$)	Expenditure in 2010 dollars using 5% (AUS \$)	Expenditure in 2010 dollars using 2.5% (AUS \$)
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2000	15,467,000	33,392,093	25,194,113	19,799,068
2001	13,493,000	26,972,569	20,932,072	16,850,908
2002	15,310,000	28,337,742	22,619,843	18,653,748
2003	15,109,000	25,894,171	21,259,880	17,959,853
2004	16,420,000	26,056,476	22,004,370	19,042,166
2005	16,987,000	24,959,476	21,680,195	19,219,231
2006	18,344,000	24,956,809	22,297,247	20,248,344
2007	14,821,000	18,670,192	17,157,160	15,960,596
2008	15,968,000	18,625,075	17,604,720	16,776,380
2009	17,849,000	19,276,920	18,741,450	18,295,225
2010	17,939,000	17,939,000	17,939,000	17,939,000

Seeing that they need to add about \$800 million to the maintenance budget to keep it in operation; if for example the maintenance was prioritized such that only about AUS \$40 million was used every year for the next ten years, this would mean that the Sydney Opera House would need to on average triple expenditure on maintenance to handle both the regular annual maintenance works and carry out the required renovation. For this to remain a feasible option, we would need to consider other options for funding: Would the government be willing to finance this? Would the people of New South Wales find this a worthy venture to invest in for the next ten year? Based on current operational revenue, would this be considered a profitable venture by private financiers? Currently, the future seems bleak for many of these options seeing that its operational revenue already does not meet the annual expenditure.

### **Critique of the Project and Conclusions from Our Project Evaluation Process**

From this project, and the mistakes made therein, we learn:

We learn the importance of planning well before implementing a project. Complete designs would have saved this project a great amount of money and time.

We learn that it is important to consult with other experts when embarking on an unprecedented venture. The initial cost estimates and structural sketches had been given with out structural expertise, this also led to many iterations of the design, and could have been avoided to some extent.

The choice material and final design greatly influence final maintenance costs. In the case of the Sydney Opera House, the final design and material choice has led to high maintenance costs over the years due to its very delicate form.

The project has shown the importance of implementing a good project management strategy, especially when implementing a large-scale unprecedented plan. Utzon was known to be a brilliant architect but very poor manager. Seeking a project manager would have been of great benefit to this process.

It also shows as the importance of having government backing. Government support and approval of this plan enabled it to have large access to public funds created via a public lottery, and this ensured that the finances were always catered for during the construction period. In the operating life, the government has also continued to keep the Opera House afloat.

### **Comments on the Project Evaluation Process**

The financial analysis given in this report is by no means 100% accurate. Several assumptions were made throughout the financial analysis to simplify the process. First of all, we only know for sure the exchange rate of the AUS \$ to the US \$ in 2010, it is therefore slightly difficult to get a feel for what the Actual 1972 Australian Dollars means in 1972 US\$ as we do not have exchange rate data to span the length of the project. We therefore bring all AUS \$ to 2010 value and then compare these values to USD. We do note that this is an approximation and that there are many economic nuances that this simplification does not address.

In addition, when discounting the cash flows back to the present day, a discount rate of 8% is assumed throughout, as this the discount rate assigned to most public sector projects.<sup>xlv</sup> The discount rate can easily change from year to year, especially during the various construction stages of the project. Also, it has been assumed that the construction costs for the three stages are paid as a lump sum at the end of each stage, which can then be modeled as an annuity. In reality, the costs probably varied from year to year. There may also be a little variation between the actual cash flows from 1973-2010 and what is shown above. Although the official financial reports of the Sydney Opera House were obtained,

there was a lot of financial data that it was difficult to sift through what was actually relevant for the financial analysis.

However, had these simplifications and assumptions not been made, it would have been very difficult to carry out a financial analysis. There are too many different variables and dynamic elements that would have to be accounted for to perform a flawless analysis. Despite these circumstances, the authors feel that they have captured the essence of a thorough financial analysis of the Sydney Opera House.

## APPENDIX

### General Formulas

It is possible to estimate an amount that had to be paid per year (an annuity) during each stage of the project. This can be done using the sinking fund payment equation:

$$A = F[A/F, i, N] = F * [i / ((1+i)^N - 1)]$$

N is the amount of years the annuity has to be paid to meet a certain future value F given a certain discount rate, i.

Given a past cash flow, it is possible to discount it to the future using the following equation:

$$F = P[F/P, i, N] = P * (1+i\%)^N$$

N varies by year and is found by subtracting the year of the past value from 2010 (the year that the cash flow should be discounted to). The discount rate (i) is taken to be 8% as mentioned above.

### Revenue From Operational Period

YEAR	Revenue from Operations (Actual Millions)	Revenue from Operations (2010, 8%)	Revenue from Government (Actual Millions)	Revenue from Government (2010, 8%)	Revenue Total (Actual Millions)	Revenue Total (2010, 8%)
1973	1,680,424	28,979,957	3,652,295	62,986,112	5,332,719	91,966,069
1974	2,470,982	39,457,071	3,950,000	63,074,279	6,420,982	102,531,350
1975	2,887,411	42,691,372	4,456,000	65,883,494	7,343,411	108,574,866
1976	3,183,170	43,578,023	4,980,000	68,176,865	8,163,170	111,754,888
1977	5,301,379	67,200,543	5,692,000	72,152,075	10,993,379	139,352,618
1978	6,166,970	72,382,239	5,950,000	69,835,644	12,116,970	142,217,883
1979	7,030,687	76,407,182	6,252,000	67,944,669	13,282,687	144,351,852
1980	8,044,039	80,944,404	6,700,000	67,419,801	14,744,039	148,364,206
1981	9,525,351	88,750,314	7,331,000	68,304,942	16,856,351	157,055,256
1982	5,543,835	47,827,254	8,100,000	69,879,562	13,643,835	117,706,816
1983	6,800,960	54,326,487	8,400,000	67,099,716	15,200,960	121,426,203
1984	6,681,000	49,415,036	8,495,000	62,832,021	15,176,000	112,247,056
1985	7,393,000	50,630,777	9,518,000	65,183,787	16,911,000	115,814,564
1986	7,413,000	47,007,173	10,000,000	63,411,807	17,413,000	110,418,980
1987	9,386,000	55,109,558	14,811,000	86,962,248	24,197,000	142,071,806
1988	8,950,000	48,657,037	17,342,000	94,280,484	26,292,000	142,937,521
1989	25,123,000	126,465,004	21,937,000	110,427,210	47,060,000	236,892,215
1990	23,796,000	110,912,136	26,749,000	124,675,943	50,545,000	235,588,079
1991	24,109,000	104,047,237	23,248,000	100,331,418	47,357,000	204,378,655

<b>1992</b>	26,442,000	<b>105,662,748</b>	24,903,000	<b>99,512,874</b>	51,345,000	<b>205,175,621</b>
<b>1993</b>	30,775,000	<b>113,868,056</b>	24,832,000	<b>91,878,848</b>	55,607,000	<b>205,746,904</b>
<b>1994</b>	22,673,000	<b>77,676,398</b>	30,472,000	<b>104,395,324</b>	53,145,000	<b>182,071,722</b>
<b>1995</b>	26,245,000	<b>83,253,578</b>	31,842,000	<b>101,008,209</b>	58,087,000	<b>184,261,787</b>
<b>1996</b>	30,872,000	<b>90,677,042</b>	28,246,000	<b>82,963,971</b>	59,118,000	<b>173,641,013</b>
<b>1997</b>	37,349,000	<b>101,575,227</b>	33,086,000	<b>89,981,471</b>	70,435,000	<b>191,556,697</b>
<b>1998</b>	28,382,000	<b>71,470,704</b>	30,328,000	<b>76,371,063</b>	58,710,000	<b>147,841,768</b>
<b>1999</b>	43,319,000	<b>101,004,270</b>	26,262,000	<b>61,233,503</b>	69,581,000	<b>162,237,773</b>
<b>2000</b>	32,908,000	<b>71,045,904</b>	28,687,000	<b>61,933,081</b>	61,595,000	<b>132,978,985</b>
<b>2001</b>	50,683,000	<b>101,315,552</b>	9,513,000	<b>19,016,531</b>	60,196,000	<b>120,332,083</b>
<b>2002</b>	36,277,000	<b>67,146,195</b>	59,168,000	<b>109,515,839</b>	95,445,000	<b>176,662,034</b>
<b>2003</b>	32,736,000	<b>56,103,751</b>	31,583,000	<b>54,127,712</b>	64,319,000	<b>110,231,463</b>
<b>2004</b>	38,496,000	<b>61,088,314</b>	53,206,000	<b>84,431,235</b>	91,702,000	<b>145,519,549</b>
<b>2005</b>	40,482,000	<b>59,481,339</b>	51,646,000	<b>75,884,918</b>	92,128,000	<b>135,366,257</b>
<b>2006</b>	43,351,000	<b>58,978,557</b>	68,279,000	<b>92,892,826</b>	111,630,000	<b>151,871,383</b>
<b>2007</b>	56,937,000	<b>71,724,222</b>	63,672,000	<b>80,208,382</b>	120,609,000	<b>151,932,605</b>
<b>2008</b>	62,923,000	<b>73,393,387</b>	21,363,000	<b>24,917,803</b>	84,286,000	<b>98,311,190</b>
<b>2009</b>	66,930,000	<b>72,284,400</b>	44,834,000	<b>48,420,720</b>	111,764,000	<b>120,705,120</b>
<b>2010</b>	65,942,000	<b>65,942,000</b>	43,456,000	<b>43,456,000</b>	109,398,000	<b>109,398,000</b>
<b>TOTAL</b>	<b>945,208,208</b>	<b>2,738,480,446</b>	<b>902,941,295</b>	<b>2,853,012,388</b>	<b>1,848,149,503</b>	<b>5,591,492,834</b>

### Expenditure from Operational Period

YEAR	Total Expenditure (Actual Millions)	Total Expenditure (2010, 8%)
<b>1973</b>	5,589,187	<b>96,389,029</b>
<b>1974</b>	6,095,830	<b>97,339,258</b>
<b>1975</b>	7,139,149	<b>105,554,776</b>
<b>1976</b>	8,423,109	<b>115,313,488</b>
<b>1977</b>	10,902,158	<b>138,196,296</b>
<b>1978</b>	11,880,747	<b>139,445,314</b>
<b>1979</b>	13,063,675	<b>141,971,702</b>
<b>1980</b>	14,708,134	<b>148,002,906</b>
<b>1981</b>	17,021,782	<b>158,596,622</b>
<b>1982</b>	13,306,993	<b>114,800,844</b>
<b>1983</b>	15,062,691	<b>120,321,702</b>
<b>1984</b>	15,836,000	<b>117,128,649</b>
<b>1985</b>	16,503,000	<b>113,020,386</b>
<b>1986</b>	17,637,000	<b>111,839,405</b>
<b>1987</b>	24,939,000	<b>146,428,432</b>
<b>1988</b>	27,983,000	<b>152,130,710</b>
<b>1989</b>	44,532,000	<b>224,166,683</b>
<b>1990</b>	49,336,000	<b>229,952,982</b>
<b>1991</b>	47,857,000	<b>206,536,506</b>
<b>1992</b>	53,087,000	<b>212,136,687</b>

<b>1993</b>	53,253,000	<b>197,037,061</b>
<b>1994</b>	50,822,000	<b>174,113,257</b>
<b>1995</b>	56,165,000	<b>178,164,878</b>
<b>1996</b>	57,923,000	<b>170,131,066</b>
<b>1997</b>	57,799,000	<b>157,191,532</b>
<b>1998</b>	56,502,000	<b>142,281,648</b>
<b>1999</b>	71,036,000	<b>165,630,308</b>
<b>2000</b>	60,187,000	<b>129,939,219</b>
<b>2001</b>	58,788,000	<b>117,517,484</b>
<b>2002</b>	74,778,000	<b>138,408,859</b>
<b>2003</b>	74,634,000	<b>127,909,560</b>
<b>2004</b>	80,415,000	<b>127,608,499</b>
<b>2005</b>	84,317,000	<b>123,889,335</b>
<b>2006</b>	84,868,000	<b>115,461,977</b>
<b>2007</b>	102,413,000	<b>129,010,885</b>
<b>2008</b>	107,022,000	<b>124,830,461</b>
<b>2009</b>	123,094,000	<b>132,941,520</b>
<b>2010</b>	124,878,000	<b>124,878,000</b>
<b>TOTAL</b>	<b>1,799,797,455</b>	<b>5,466,217,926</b>

### Net Cash Flows from Operational Period

<b>YEAR</b>	<b>Net Cash-flow (Actual Millions)</b>	<b>Net Cash-flow (2010, 8%)</b>	<b>Sans Govt. Net Cash-flow (2010, 8% )</b>
<b>1973</b>	-256,469	-4,422,960	-67,409,072
<b>1974</b>	325,153	5,192,092	-57,882,187
<b>1975</b>	204,262	3,020,091	-62,863,404
<b>1976</b>	-259,939	-3,558,600	-71,735,465
<b>1977</b>	91,221	1,156,322	-70,995,753
<b>1978</b>	236,223	2,772,569	-67,063,075
<b>1979</b>	219,012	2,380,150	-65,564,519
<b>1980</b>	35,905	361,300	-67,058,501
<b>1981</b>	-165,431	-1,541,366	-69,846,308
<b>1982</b>	336,842	2,905,972	-66,973,590
<b>1983</b>	138,269	1,104,501	-65,995,215
<b>1984</b>	-660,000	-4,881,593	-67,713,614
<b>1985</b>	408,000	2,794,178	-62,389,609
<b>1986</b>	-224,000	-1,420,424	-64,832,232
<b>1987</b>	-742,000	-4,356,626	-91,318,874
<b>1988</b>	-1,691,000	-9,193,190	-103,473,674
<b>1989</b>	2,528,000	12,725,532	-97,701,679
<b>1990</b>	1,209,000	5,635,097	-119,040,845
<b>1991</b>	-500,000	-2,157,851	-102,489,269
<b>1992</b>	-1,742,000	-6,961,066	-106,473,940
<b>1993</b>	2,354,000	8,709,843	-83,169,006

<b>1994</b>	2,323,000	7,958,465	-96,436,859
<b>1995</b>	1,922,000	6,096,909	-94,911,300
<b>1996</b>	1,195,000	3,509,946	-79,454,025
<b>1997</b>	12,636,000	34,365,165	-55,616,305
<b>1998</b>	2,208,000	5,560,120	-70,810,944
<b>1999</b>	-1,455,000	-3,392,535	-64,626,038
<b>2000</b>	1,408,000	3,039,766	-58,893,315
<b>2001</b>	1,408,000	2,814,599	-16,201,933
<b>2002</b>	20,667,000	38,253,175	-71,262,664
<b>2003</b>	-10,315,000	-17,678,097	-71,805,809
<b>2004</b>	11,287,000	17,911,050	-66,520,185
<b>2005</b>	7,811,000	11,476,922	-64,407,996
<b>2006</b>	26,762,000	36,409,406	-56,483,420
<b>2007</b>	18,196,000	22,921,720	-57,286,663
<b>2008</b>	-22,736,000	-26,519,270	-51,437,074
<b>2009</b>	-11,330,000	-12,236,400	-60,657,120
<b>2010</b>	-15,480,000	-15,480,000	-58,936,000
<b>TOTALS</b>		<b>125,274,909</b>	<b>-2,727,737,479</b>

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