BARTLETT SCHOOL OF PLANNING

UCL

PROJECT PROFILE

Greece

Rion Antirion Bridge

omega centre

Centre for Mega Projects in Transport and Development

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CONTENTS

G BIBLIOGRAPHY

H GLOSSARY

List of figures

List of tables

A INTRODUCTION

Type of project

The Rion–Antirion Bridge is considered a landmark of Greece's 21st century. Its 2.252km deck makes it the longest multi-span cable-stayed bridge in the world. The cable-stayed component of the bridge has three central openings of 560m each and two of 286m each at the edges. These are based on four pylons, whose height above sea level reaches 159m and which are founded at depths ranging from 48m to 64m with pedestals (see figure 2). The access bridges are 378m on the side of Rion and 252m on the side of Antirion (Papanikolas 2004, www.minenv.gr, accessed on 2/12/2009, www.gefyra.gr, accessed on 10/07/2009).

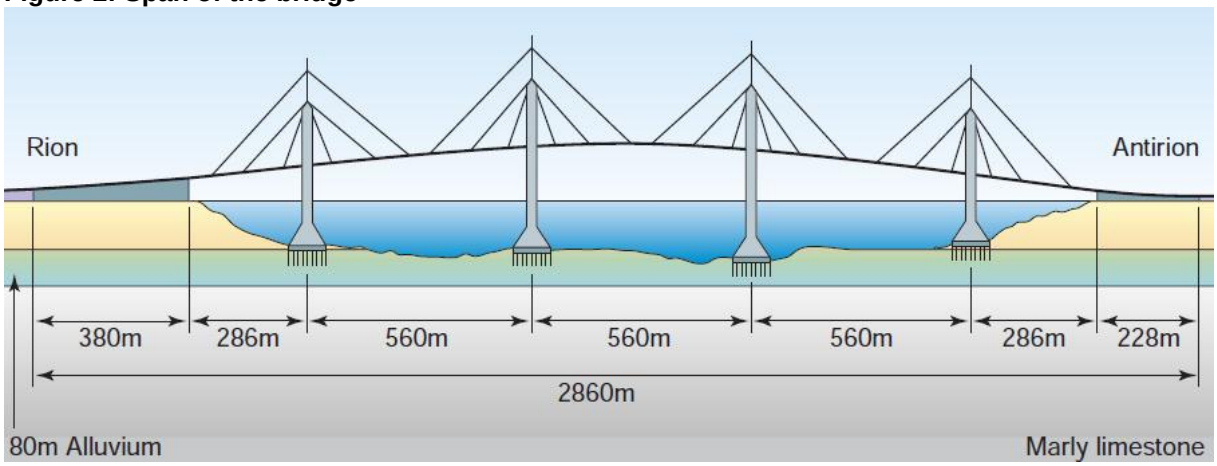
Figure 1: The Rion-Antirion Bridge

(source: www.iabse.gr accessed on 16/07/2009)

The Bridge has been designed and constructed in order to cope with the exceptionally difficult physical conditions in the straits between Rion and Antirion: high water depth; deep strata of weak soil; very strong seismic activity; strong winds; and fault displacements. In addition, the risk of heavy ship collision had to be taken into account as well as the non-stop serviceability of the link (Combault, 2008, Kouloumbis, 1978, Efpalinos Techniki, 1992). For these reasons, quite innovative techniques needed to be developed, such as improving the strength of the in-situ soil by means of inclusions and suspending the bridge deck on its full length so as to be as isolated as possible (Combault, 2008). The technical innovations that have been employed for the realisation of this project are manifested by their numerous references in the scientific and technical literature. As a result of the innovative character of its structure, Rion-Antirion Bridge has been awarded nine international awards by the international scientific community, out of which we distinguish the following (www.gefyra.gr, accessed on 10/07/2009):

- Outstanding Structure Award 2006, of the International Association for Bridge and Structural Engineering (IABSE);
- Award for Outstanding Concrete Structures 2006, of the International Federation for Structural Concrete (fib);
- Outstanding Civil Engineering Achievement Award 2005, of the American Society of Civil Engineers (ASCE) (for the first time awarded to a project outside the US).

Figure 2: Span of the bridge



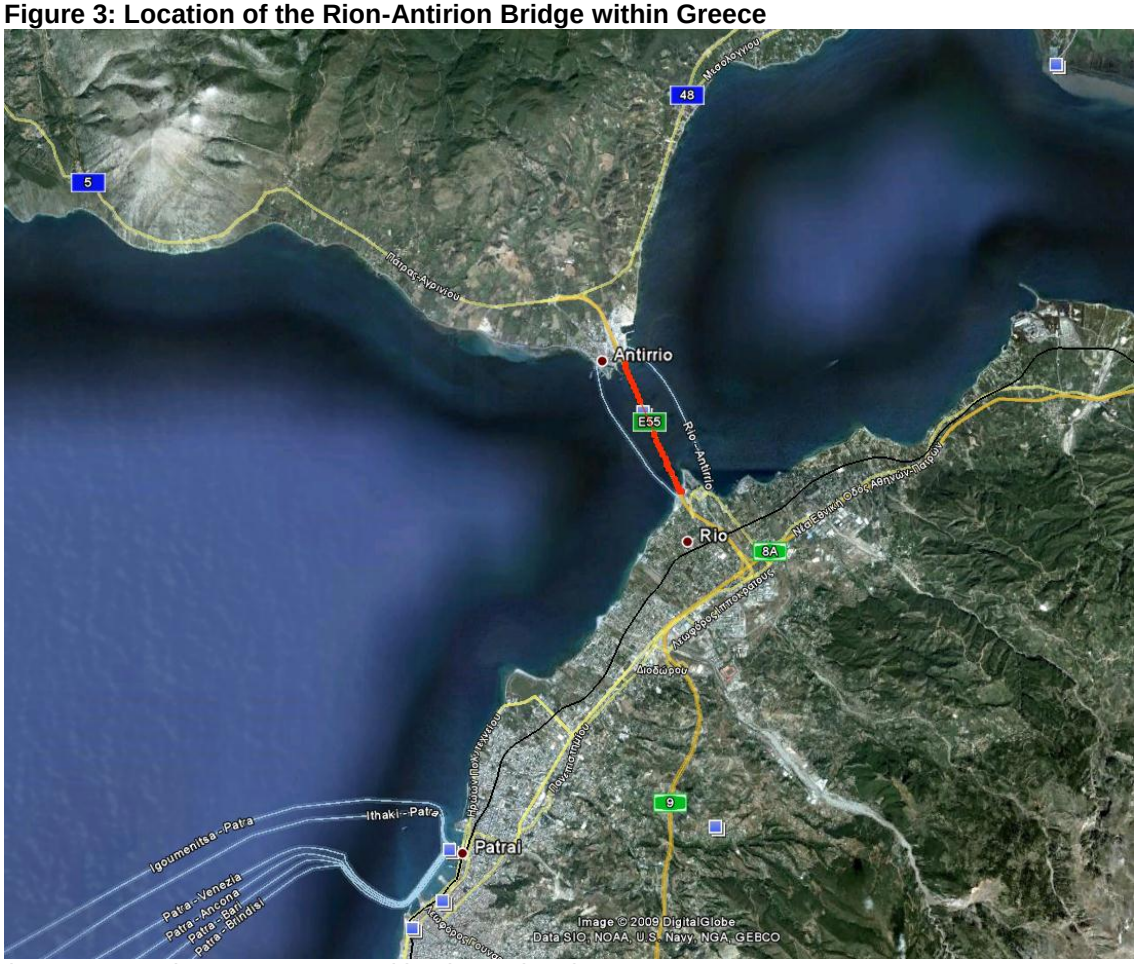
(Source: Hytiris, N., Kominos, A. 2001)

Country / Location

The Rion-Antirion Bridge is located in the Region of Western Greece and crosses the Gulf of Corinth connecting the Peloponnese with mainland Greece. The Bridge links the towns of Rion at the outskirts of the city of Patras (Prefecture of Achaia, south coast) and Antirion (Prefecture of Aitoloakarnania, north coast) (see figure 3). The Bridge links two major road axes of national importance, notably the *Ionian* axis (green line in figure 4), crossing the western part of the country and the segment of PATHE axis (Patras - Athens - Thessaloniki – Evzonoi [FYR Macedonia border]) on the north coast of Peloponnese (Law 2395/1996) (red line in figure 4). The *Ionian* axis, thus, besides providing better access to the isolated Region of Epirus, also constitutes the link between Egnatia Odos and PATHE integrating the road network on a national level (Law 2395/1996).

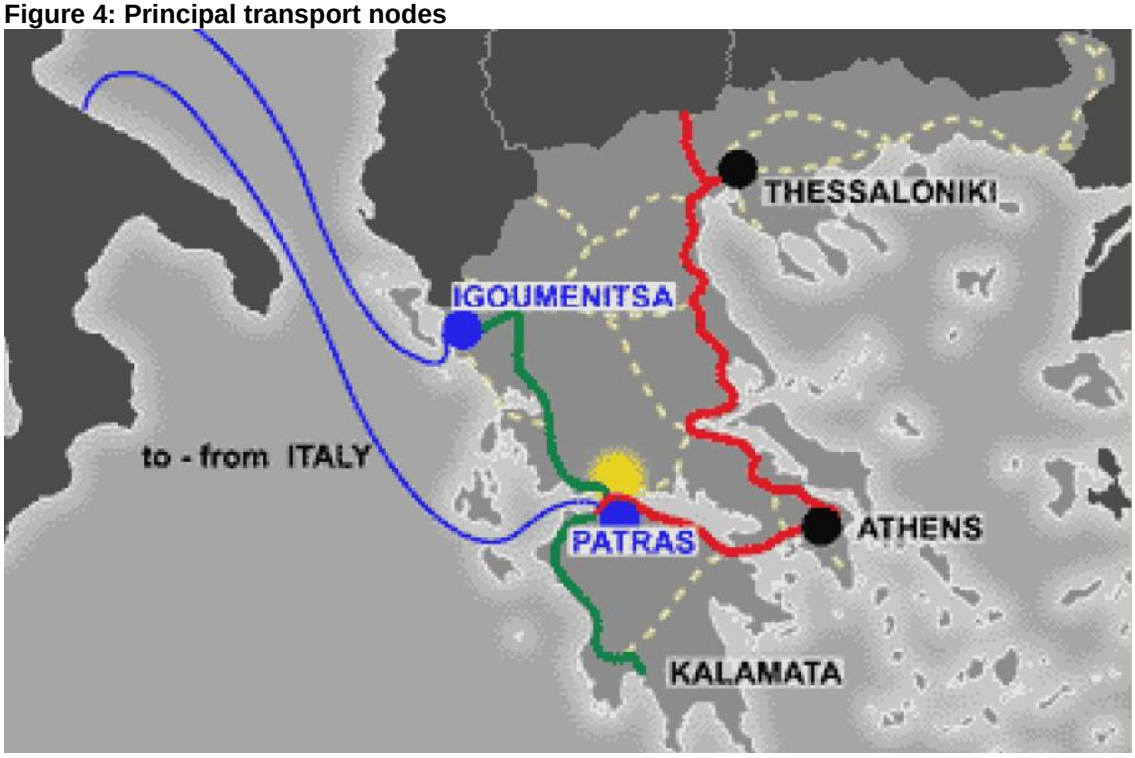
The Bridge's role is enhanced by its proximity to the port of Patras which, together with the port of Igoumenitsa (northern on the western axis), are the main sea gateways of Greece to Western Europe through Italy (Law 2395/1996, Pılissi du Rausas, 2006).

Figure 3: Location of the Rion-Antirion Bridge within Greece



(source: Google maps processed by the authors)

Figure 4: Principal transport nodes



(source: Pılassieı du Rausas, 2006)

Current status

This project began in 1998 and was completed in 2004; since then it has been in full operation. The seven year construction period consisted of a two year design and preparatory works period and a five year pure bridge construction period (Gefyra SA).

At the time the Rion–Antirion Bridge was planned, constructed and delivered the road network linked with the bridge was in poor condition and not up to motorway standards. All roads, Egnatia Road, the Peloponnese part of PATHE and the Ionian Axis were of quite poor standards or had major segments still under construction. Gradually, since that time, these road links have been significantly upgraded and it is anticipated that by 2014 the remaining road links will be upgraded to motorway standards (the remaining parts to be upgraded/built are denoted in red and dotted-green colours in figure 5) (Ministry of Transport Infrastructure and Networks. www.yme.gr, accessed on 12/12/2009).

Figure 5: Current status of national road transport network

(Source: TEN-T EA web-site (http://tentea.ec.europa.eu/ and processed by the authors)

Figure 6: Ongoing concessioned motorway projects linked with the Rion-Antirion Bridge

(Source: Gefyra SA, 2007)

Note: the east side *Ionia Odos* starting from Athens and heading north denotes the name of the concessionaire, which is the same as *Ionia Odos* on the west side (both segments were concessioned as one PPP). Patras-Athens-Thessaloniki is the major part of the PATHE motorway.

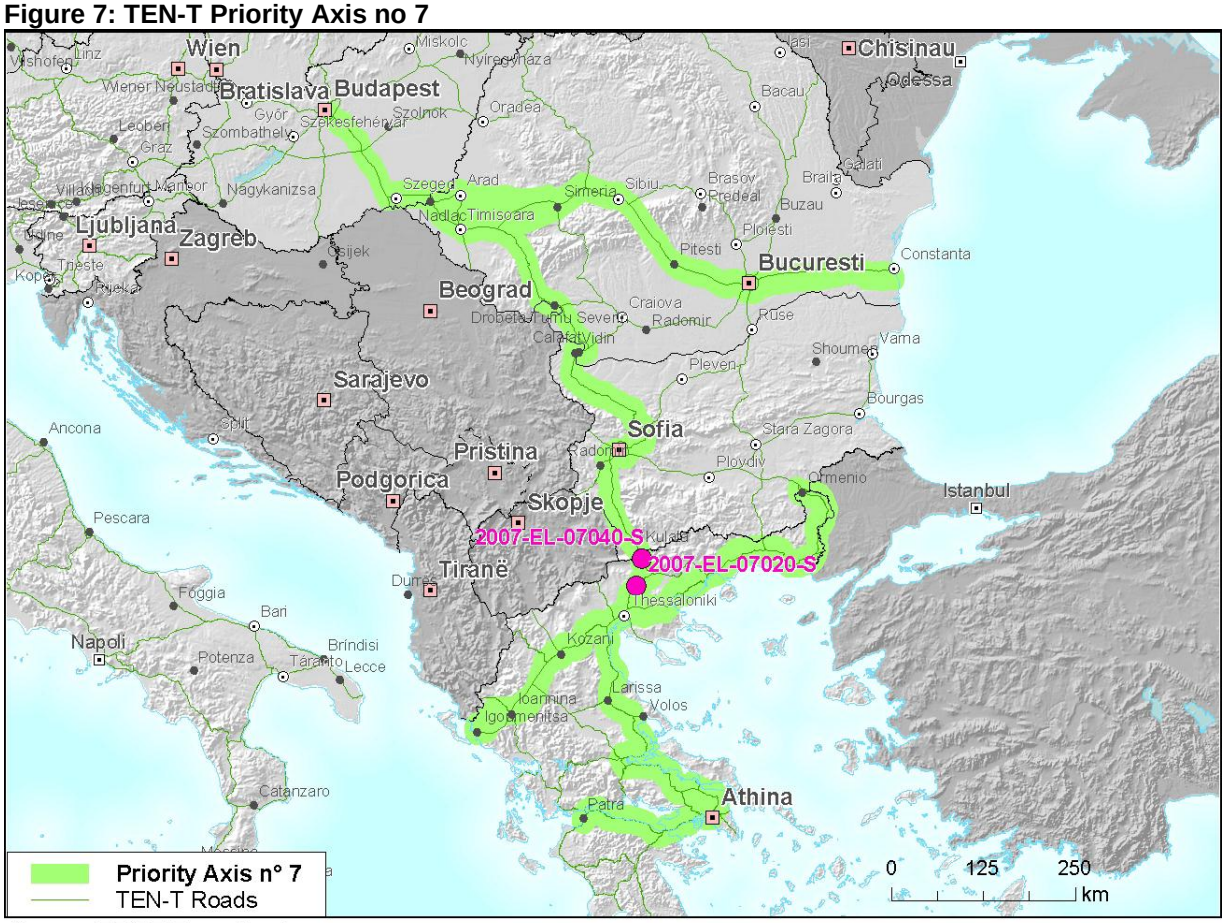
B PROJECT BACKGROUND

Principal project objectives

The introductory report of Law 2396/1995 for the ratification of the concession contract states the project objectives by describing the importance and necessity of the project. More specifically, the report states that:

- The connection between Rion and Antirion is undertaken by ferry-boats and the average crossing time is 45 minutes;
- The bridge will drastically decrease travel time, providing fast and safe movement of people and goods and new prospects for the development of the regions of Peloponnese and Western Greece;
- The bridge will provide a segment of PATHE TEN-T (priority axis 7);
- The bridge will contribute to the economic and cultural development of the geographical areas of Peloponnese, Western Sterea Ellada and Epirus;
- The bridge, as a part of the Western Road Axis from the Albanian border to Kalamata (on the south-west of Peloponnese), will connect PATHE with Egnatia Road, which were the two TEN-T priority axes at that time, enhancing the country's connection to Italy and the rest of Western Europe through the ports of Patras and Igoumenitsa;
- The bridge will decrease crossing travel time per car by about 40 minutes, and will consequently decrease the total cost of crossing the straits;
- It will improve the comfort, reliability and quality of service and ensure the continuation of service regardless of weather conditions;
- It will diminish the pollution and general unrest caused by the car and truck congestion in the ports of Rion and Antirion, which will be free of congestion;
- The project will provide a basis for the housing development and the production restructuring of the wider area around the bridge. For this purpose, special plans would be conducted and applied for the Gulf of Corinth, the municipality of Rion and the prefectures of Achaia and Aitoloakarnania, as well as restoration works for the Byzantine castles of Rion and Antirion;
- It will enhance the competitiveness of businesses and lead to the establishment of new ones in the isolated areas of the northwestern parts of the country as well as the socio-economic and cultural development of these areas.

Figure 7: TEN-T Priority Axis no 7



Source: TEN-T Executive Agency

(Source: EC, TEN-T EA web-site)

Key enabling mechanisms and decision to proceed

The first conception of the Rion-Antirion Bridge was as a rail link project by Harilaos Trikoupis back in 1889. For many years, the bridge had been a project that Greece 'had' to build. However, it took almost a century before the Greek State managed to invite tenders for building a fixed link between Northwest Peloponnese and the mainland.

In 1980, the Greek State decided to invite tenders for building the fixed Rion-Antirion Bridge. Unfortunately, this first invitation did not proceed beyond the first phase, which included expressions of interest and general suggestions, because there was no interest from the construction companies. As a result the tender was cancelled (Law 2395/1996, Gefyra SA, 2005, INT6).

In 1987, a new international tender call for the design, construction and financing of the project (as a public works procurement) began. In the auction on 28 March 1988 five consortia participated (INT6, INT24), although two were excluded before the opening of the financial bids because of violation of terms, while the other offers had serious technical problems (Law 2395/1996).

In December 1990 the second competition was cancelled (Law 2395/1996, Gefyra SA, 2005, INT6).

In 1991, the Greek State decided for the third time to invite tenders for the design, construction, self-financing and operation of the project, this time as a concession contract.

The contract stated that the project would be financed by the contractor and this would be paid off via income from the tolls. There was also the possibility of the participation of the Greek State in the financing. There were seven interested groups, among them the Gefyra group which consisted of the companies GTM International, GTM BTM, Dyckerhoff und Widmann, TEB, Elliniki Technodomiki, Ioannou & Paraskevaidis (J&P), Proodeutiki and K.J. Sarantopoulos (INT6).

The contest, after repeated postponements, was carried out on 1 December 1993. During the progress of the contest, two groups withdrew and only two submitted an offer: the Rion-Antirion group and the Gefyra group. The Rion-Antirion group was excluded for both essential and formal reasons and only the offer of the Gefyra group was considered. This was an issue that caused legal disputes with EU directives regarding the tender competitions which however were eventually resolved. The Gefyra group was then nominated as the concessionaire (Gefyra SA, 2005, INT6).

On 3 January 1996 the concession contract for the project was signed between the Greek State and Gefyra SA (INT6). The concession contract was ratified by the Parliament by Law 2395/1996 (F.E.K. 71^{A} / 24 April 1996).

In December 1996, the European Investment Bank (EIB) approved a loan of EUR 370m and, soon after, negotiations began between Gefyra SA, the state and the consortium of commercial banks for the finalisation of the financing terms and the signing of the loan conventions (Gefyra SA, 2005, INT6).

On 25 July 1997 the Master Facility Agreement was signed between Gefyra SA and EIB, while on 17 December 1997 the final contracts were signed and the financing of the project was defined and ensured. The effective date of the Concession Agreement was 24 December 1997 (Gefyra SA, 2005).

The project embodied the Design–Build–Finance-Operate (DBFO) method, with Gefyra SA as concessionaire. Gefyra SA is responsible for the design, construction, financing, maintenance and operation of the bridge during the 42-year concession period (Law 2395/1996, Gefyra SA, 2005, INT6).

The seven year construction period comprised:

- a two year preparatory period (1998-1999), in which the main works consisted of completing the final design for the bridge and installing the construction site with the main task of building the dry dock;

- a five year building period (2000-2004) when the bridge was actually built.

The construction was completed in August 2004 (almost five months before the deadline). On 13 August 2004 the Harilaos Trikoupis Bridge opened to the public (Gefyra SA, 2005).

Main organisations involved

Government

The Greek Parliament: The parliament has the legislative duties of the Greek state. The concession contract and the EIA have been ratified by the parliament as Laws of the Greek state.

The Ministry of Environment, Planning and Public Works (MEPPW): Responsible for the analysis and studies, preparation, tendering and awarding of the project. All responsibilities were assigned to a unit within the Ministry called Special Services for Public Works: Projects Rion–Antirion Bridge and Attiki Odos. The Ministry also signed the concession contract. The Minister had been working in very close collaboration with external advisors and consultants, who played a central role in the planning and implementation of the bridge.

The Ministry of Economy and Finance (MEF): The Ministry allocates parts of the national budget to MEPPW and conducts, in collaboration with MEPPW (and other ministries), the National Development Plan submitted to the EU for co-financing through Structural Funds (MEPPW, 2002).

European Union: The European Union has subsidised the project through the Structural Funds during both the 1994-1999 and 2000-2006 programming periods. Moreover, the EU has played a crucial role in 'promoting' the use of PPPs for the development of transport infrastructure and TENs (Trova and Koutras 2001, p.37). The EU grants played a catalytic role in the realisation of the project since the spending capacity of the country was limited. During the early 1990s, the General Government Budget deficit was very high and, in addition, deficit targets that had to be achieved in order for the country to enter the European Monetary Union imposed a low spending policy for the subsequent years (PWC 2006). The fact that the bridge was designed to be part of the PATHE TEN-T axis in the Essen European Council (EC) Summit (1994) has been catalytic for an additional reason: although EIB had been extremely reluctant to provide long-term financing for the construction of the bridge, it had to revise its position regarding the funding of the bridge, due to Community interest in the transport development priorities defined at the EC summit (INT24). A final contribution of the EU concerns the structural funds rules that obliged the Ministry to prepare monitoring reports on the spending and allocation of funds for the projects but also to conduct ex-post evaluation exercises on the impacts of projects.

<u>The private partner/concessionaire</u>

Gefyra SA: Gefyra SA was formed in 1995 by the French company GTM (acquired by Vinci in 2001), which is the largest shareholder, and six smaller Greek companies, to build the Rion–Antirion Bridge. The concession contract signed between the Greek Government and Gefyra SA involved the design, construction, financing, maintenance and operation of the bridge during the 42-year concession period (Gefyra SA, 2005). The shareholders of Gefyra SA are as follows (www.gefyra.gr, accessed on 10/07/2009):

VINCI CONCESSIONS	57.45%
AKTOR CONCESSIONS (Elliniki Technodomiki TEB,	22.02%
J & P	12.14%
ATHENA	8.39%
Total	100.00%

GEFYRA LITOURGIA SA: Gefyra SA is responsible for the management of the bridge, more specifically for the tolls, routine maintenance and traffic. Shareholders of this company are the same as in Gefyra SA with exactly the same shareholdings (www.gefyra.gr).

KINOPRAXIA GEFYRA: It is the Construction Joint Venture, which under the Design & Construction contract with Gefyra SA and a tripartite agreement with both the Greek State and Gefyra SA undertook the design and construction of the bridge, within a seven year design and construction period. The design period lasted from December 1997 to December 1999 while the construction period started in December 1999 and ended in

August 2004, approximately five months earlier than the programmed end of construction according to the concession contract (seven years after financial close) (Gefyra SA, 2005, INT24).

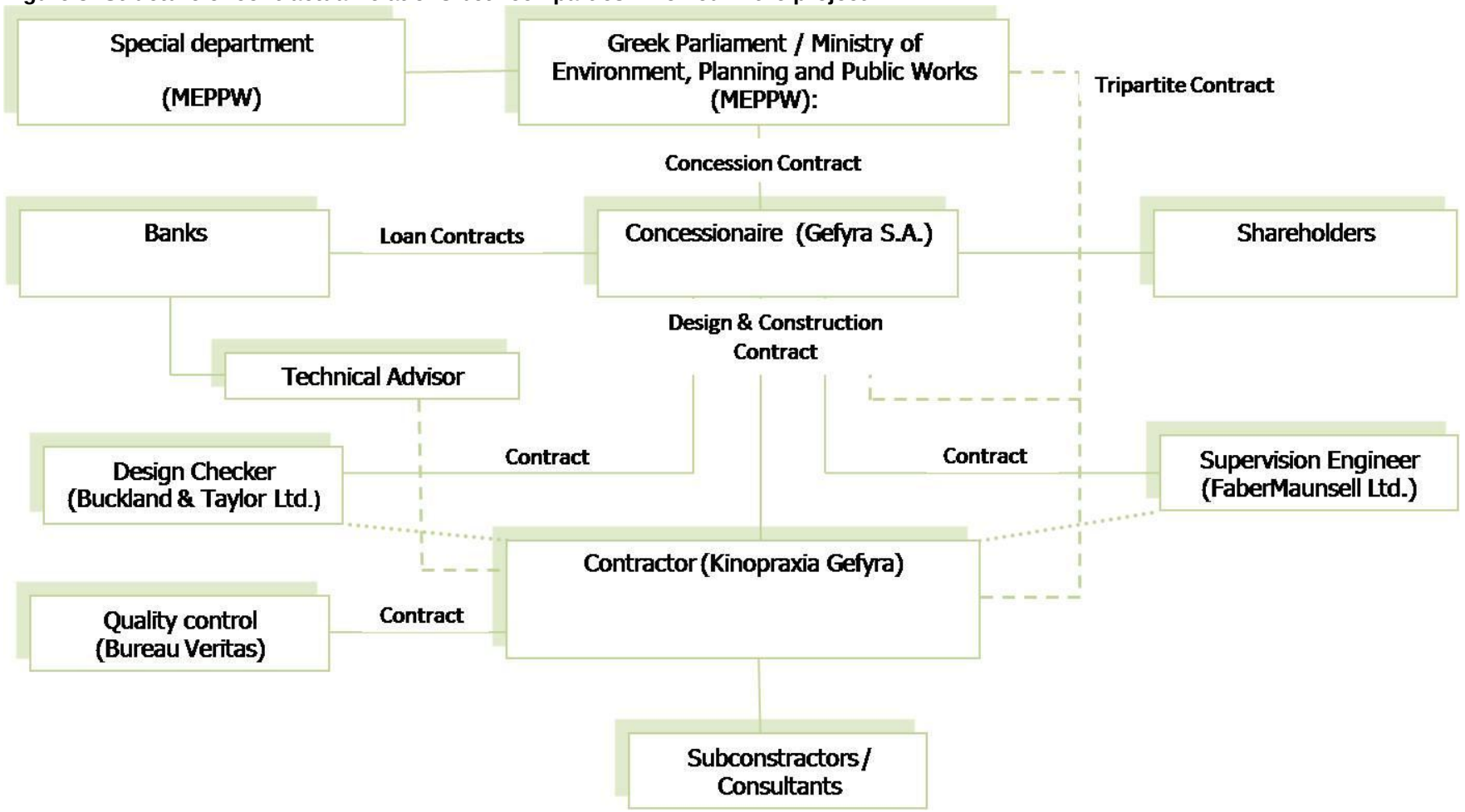
The construction companies that formed Kinopraxia Gefyra and their shareholding percentages in the company are as follows (www.gefyra.gr):

VINCI Construction Grands Projets	53.00%
AKTOR A.T.E.	15.48%
J & P - AVAX SA	11.20%
ATHENA SA	7.74%
PROODEYTIKI SA	7.74%
PANTECHNIKI SA	4.84%

External engineers and advisors

Figure 8 illustrates, besides the basic parties, some additional entities involved in the project with supervisory and advisory roles.

Figure 8: Structure of contractual relations between parties involved in the project



(source: Papanikolas, 2004)

Banks

European Investment Bank: The EIB was the sole lender to Gefyra SA, providing 45% of the long term finance for the development of Rio-Antirion Bridge. EIB provided a sum of available credit lines amounting to EUR 370m (GRD 115bn or ECU 370m in 1997 values when the lending agreement was signed) in three tranches of EUR 120m (tranche signature: 31 October 2000), EUR 120m (tranche signature 03 December 2001) and EUR 130m (tranche signature 08 May 2003) (EIB 1997, www.eib.org).

Consortium of Guaranteeing Commercial Banks: During the completion of the funding, nine commercial banks were contractors and then formed a group including the following banks (source: Sarantaki, 2007):

- Lead arrangers
  - Bank of Tokyo-Mitsubishi;
  - Bank of America.

- First tier participants
  - Bayerische Landesbank Girozentrale;
  - Credit Agricole Indosuez;
  - Societe Generale;
  - Landesbank Girozentrale;
  - Credit Agricole Indosuez;
  - Societe Generale;
  - European Investment Fund;
  - Commercial Bank of Greece;
  - National Bank of Greece.

- Participants
  - Abbey National Treasury Services;
  - Alpha Bank;
  - Bank of Scotland;
  - ING Bank;
  - KBC Bank;
  - Landesbank Hessen Thüringen;
  - Lioydstsb Bank;
  - Royal Bank of Scotland;
  - CIC Banques;
  - ETEBA;
  - Bank of Ireland;
  - De National Investeringbank;
  - Τράπεζα Εργασίας;
  - Depfa Group;
  - Allied Irish Banks;
  - Natexis Banques Populaires;
  - Mizuho;
  - Bank of Ireland;
  - EFG Eurobank;
  - NIB Capital Bank.

Intercreditor Agent: The Bank of Tokyo-Mitsubishi was the Intecreditor Agent of the banks, acting on their behalf according to the intercreditor agreement, representing them in various decisions and being responsible for communication with the other parties in the PPP. The

Intercreditor Agent approves and checks the legitimacy of any additional works and all processes involving the banks. The Bank of Tokyo-Mitsubishi was also a lead arranger, together with the Bank of America, in the commercial banks syndication.

Planning regime

In the first contest of 1988, the tender analysed the characteristics and design criteria of the bridge. This analysis was similar to other contests, with some modifications and additions to meet the specific needs of the bridge. The crucial planning criteria were not described in detail. They defined the basic features, while allowing bidders to contribute and to find the best technical and cost-effective solution within the prescribed requirements (Efpalinos Techniki, 1992).

The Government had accepted two types of links, the fixed and the floating bridge. These were the constraints that existed, although there was no mention of whether the fixed link should be hanging or cable-stayed (Efpalinos Techniki, 1992).

It is important to mention that at the beginning the potential for a rail link was examined, as this was the vision of Harilaos Trikoupis (Efpalinos Techniki, 1992). But such a solution would be extremely expensive; the creation of a separate bridge for the rail network would be more economically efficient (INT24).

Outline of planning legislation

The most important legislation relevant to the Rion–Antirion Bridge is listed below:

- Law 1418/84 and the Presidential Decree 609/85 covering the legislation on public works contracting;

- Law 2395/1996: Ratification as a Law of: i) the Concession Contract (Design, Construction, Financing and Operation) between Gefyra Consortium and the Greek state, ii) the Tripartite Agreement between Gefyra Consortium, the Greek state and the Construction Joint Venture (KINOPRAXIA Gefyra), iii) the Environmental Impact Term of the Project;

- Presidential Decree 387/1997 of the amendment of the Concession Contract and the Tripartite Agreement.

Other important contracts within the PPP contractual framework

- The contract of the design – construction

Parties: Concessionaire, Construction Joint Venture (Kinopraxia Gefyra), public sector

According to this contract the consortium undertook the preparation of a detailed study and the completion of construction within seven years.

- The contracts before the effective date

Parties: Greek State, Gefyra Consortium and Kinopraxia Gefyra (the construction Joint venture)

These contracts, executed during 1996-1997 (between the signing of the Concession Contact and financial close), allowed the implementation of geotechnical surveys in the subsoil of the seabed. These works were necessary for the development of the final design and were paid for by the state. In the case of financial close being achieved, the money paid by the state would be deducted from the state's subsidy, and otherwise Gefyra SA would just deliver the full survey outcomes to the Ministry (INT16).

- The contract of the Checker of the design

Parties: Gefyra SA and the Buckland & Taylor Ltd.

This contract provided for monitoring and checking of the design study by the checker. The checker's selection was based on the agreement between the state and Gefyra SA to employ a very competent and specialised company. The idea was introduced and demanded by the concessionaire (Gefyra SA) and, despite the initial reservations of the state, was finally adopted.

- The contract of the Supervision Engineer

Parties: Gefyra SA and the FaberMaunsell Ltd.

FaberMaunsell Ltd supervised the work of the Construction Joint Venture and particularly monitored its progress in accordance with the design drawings, the quality standards, safety and environmental protection. They also submitted relevant reports in order to certify monthly payments as well as the delivery milestones of the project.

- State Contribution Financial Contract

Parties: Greek State and the Gefyra SA

This contract was signed by the Greek State and the Gefyra SA and described in detail the financial obligations of the Greek State.

- Shareholders Agreement

Parties: The shareholders of Gefyra SA (concessionaire)

This contract was signed between all the shareholders within the special purpose vehicle (Gefyra SA) and arranges their equity contribution. The shareholders had also, according to the Shareholders Agreement, to issue bank letters of credit for the full equity amount unpaid at the Effective Date and pledge all their shares into the Concessionaire to the benefit of the lenders.

- The contract for the technical panel of experts and the contract for the Financial panel of Experts

Parties: The State, Gefyra SA, the three members of the technical panel, the three members of the financial panel.

The concession contract and the construction contract provide for a dispute resolution procedure of international standards with two three-member panels as arbitrators. These panels are empowered with the ability to quickly settle potential disputes between the participants, each participant having accepted that a unanimous decision of a panel be final and binding with immediate effect.

- The Master facility Agreement of the EIB

Parties: Gefyra SA and the European Investment Bank

EIB provides Gefyra SA with a loan of EUR 370m to be withdrawn during the construction period and to be repaid in 25 years after the last withdrawal. A condition precedent to the first drawdown under the EIB loan was the approval by the Checker of the final design for the Rion-Antirion Bridge.

During the construction period, the prior issuance of bank letters of credit to the benefit of EIB should have guaranteed each drawdown. In 2006, Gefyra SA converted a part of the total loan (EUR 100m) to a fixed interest rate, within the framework of its policy to compensate the interest rate risks.

- The Guarantee Agreement (Letter of Credit Facility Agreement)

Parties: Gefyra SA, the Consortium of Commercial Banks, and the European Investment Bank.

This agreement guarantees the provision by the consortium of commercial banks to the Concessionaire of letters of credit to guarantee each drawdown under the EIB loan. The letters of credit were securities that could be called upon in case of specific defaults of the Concessionaire under the financing documentation. Should the EIB called, the commercial banks would have been vested with all the lenders' rights vis-a-vis the Concessionaire. The letters of credit expired in August 2004, at the completion of the works for the Rion-Antirion Bridge.

In certain restricted circumstances, the letter of credit facility agreement also provided for the possibility of cash advances from the commercial banks to the Concessionaire.

- The Common Terms Agreement

Parties: Gefyra SA, the EIB and the consortium of commercial banks

The common terms agreement was a framework agreement for the EIB master facility agreement and the letter of credit facility agreement. It detailed the undertakings of the concessionaire towards the lenders and defined the events of default of the Concessionaire, which may have led to a demand for immediate repayment of the debt.

(Source: Domain, 2007, www.gefyra.gr)

Environmental statements

During 1988 Efpalinos Techniki SA conducted the Environmental Impact Assessment (EIA) Study of the Rion–Antirion project and during 1992 the University of Patras complemented it. This study determined the major potential negative environmental impacts of the bridge. According to the study, the impacts during construction were noise, air pollution, the location of the worksite and the impacts due to its operation and the potential impact upon marine life of the antifouling product used on the part of the structures permanently under sea level. During operation the impacts were noise and air pollution from traffic, aesthetic problems due to the integration of the bridge with historical sites (the castles of Rion and Antirion) and the surrounding environment in general and a possible change of land use in the vicinity of the bridge on both sides (NAMA, 1995).

The EIA study was conducted according to the demands of Law 1650/86 for the protection of the environment and the Common Ministerial Decisions 69269/5387/90 and 75308/5512/90, which incorporated the EU 337/85 Directive for the EIA of projects into Greek environmental legislation.

The EIA was submitted to the Ministry of EPPW in 1993 (NAMA, 1995). The Ministry made the study available to the Prefectural Councils concerned (Achaia and Aitoloakarnania) on 3 August 1993. The procedures of announcement of the study and public consultation were conducted by the responsible authorities, the Prefectural Councils of Achaia and Aitoloakarnania, and their feedback from public consultation was sent to the Ministry of EPPW on 6 September 1993 and 1 September 1993 respectively.

The Ministry of EPPW issued Decision no 78263/4045/9.7.1993 concerning 'Preapproval of the sitting of the Rion-Antirion Bridge project at the Prefectures Aitoloakarnania and Achaia' and Decision no 67731/15.9.1993 for the 'Approval of the Environmental Terms for the Rion-Antirion Bridge Project'.

In 1994 the EU received a recourse concerning the consultation procedures and asked for clarifications from the Greek Government about the Environmental Impact Assessment (EIA) publication procedure and the bridge layout selected (see annexed letters in NAMA 1995: letter of EC DG XI to the Ambassador of Greece in Brussels on 23 February 95 and reply letter of the MEPPW to EC DG XI). The people who had made the recourse were insisting that they were not informed about the EIA consultation, since this was only announced to their mayor. Also they were claiming that out of the seven alternative solutions for the location of the bridge between Rion and Antirion, the one that was selected was the most harmful to the aesthetics of the Byzantine castles and the human environment because it meant that people would have to be relocated. The Ministry replied to the EC by giving evidence that the procedures for publication and hearings were carefully followed in accordance with existing legislation. The Ministry also provided documentation on why the selected layout was adopted. This feedback clarified the issue.

There were also at least three appeals to the SAC against the ministerial decisions for the location and the environmental terms, from citizens of Rion and NGOs opposed to the location of the south end of the bridge at Rion and some other aspects of the bridge (INT24). For one of those appeals, a preliminary injunction decision was made against the appeal, but the verdict by SAC was still due in 2009 (INT24). However, this has not caused problems for the progress of the project since the Environmental Impact terms were (despite the pending appeal) incorporated into Law 2395/1996, which ratified the concession contract. The ratification of the Environmental Impact terms as a Law of the state (by the parliament) is only possible for projects of such great importance to the national economy that their concession or construction contracts have also been ratified as Law of the state. This legal provision was made by Law 2338/1995, which ratified the Environmental Impacts for the Athens International Airport and Attiki Odos. It is important to note that this provision (which has been also used for important projects related to the 2004 Olympics) has generated a very serious discourse in the juridical community of the country. The SAC, after appeals against this provision, has articulated a rather vague verdict stating that the Environmental Terms can be ratified in a Law by the parliament, so that the risk of cancellation can be avoided in the case of projects of national interest. However, the jury also has stated that this entails a contradiction of the constitution, especially when there is a pending legal appeal against the lawfulness of the Environmental Terms, the location and the building permission (see WWF 2005 and SAC Decisions nr. 6068/1996, nr. 6066/1996, nr. 3824/1997 for relevant legal appeals to the SAC and the respective decisions).

Land acquisition

The Rion–Antirion Bridge is a project the major part of which is located over the sea, which belongs to the Greek State. However, there is one part on the Rion side and another on the Antirion side which had to be expropriated. According to the concession contract, the Greek State had the responsibility for the expropriations (Law 2395/1996).

C PRINCIPAL PROJECT CHARACTERISTICS

Route description

(See section A).

Project costs

Actual costs

The total cost of the project, including financial expenses incurred during the construction period, was about EUR 800m (see also table 4).

Table 1: Actual cash outflows in the construction period

Uses of funds	EUR m	%
Construction cost	664.1	82.7
Fees of the checker offices and supervisors	16.0	2
Operating costs	50.2	6.3
Financial costs	72.4	9
Total	802.7	100

(source: www.gefyra.gr)

Predicted Costs

According to the Concession Contract (Law 2395/1996), the sources and uses of funds were initially agreed as:

Uses of funds

Guaranteed construction cost in accordance with the offer of the concessionaire (values 1 July 1993)	ECU 449m
Update (from 1 July 1993 to completion of construction)	ECU 112m
Interest during the construction period and financing costs	ECU 104m
Running costs of the SA until the start of the project, including the fees of the independent checker offices and supervisors	ECU 26m
Total	ECU 691m

Sources

Concessionaire's own equity	ECU 65m
State Contribution (State and EU subsidy)	ECU 306m
EIB Loan	ECU 320m
Total	ECU 691m

The concessionaire's equity (ECU 46.5m, prices 1 July 1993) would be adjusted annually on the curve rate of ECU bonds. As such in 1996 prices it was estimated to be ECU 65m.

Law 2395/1996 mentions that the financial contribution of the State would amount to ECU 200m in 1 July 1993 prices, according to the concessionaire's financial offer. The release of this amount would be in seven years, during the design and construction of the bridge. Specifically, the distribution amount per year would be as follows:

1996	1997	1998	1999	2000	2001	2002	2003
34.6	7.8	17.4	50.6	41.2	25.0	16.6	6.8

The total amount of the financial contribution was estimated to rise (assuming the contract took effect on 1 July 1996) to ECU 306m at 1996 prices. This was expected to be comprised of the following amounts (Law 2395/1996):

- ECU 150m from the existing commitment from the European Regional Development Fund (ERDF);
- ECU 50m as a loan (part of it already approved) from the European Coal and Steel Community (ECSC) to the Greek state;
- ECU 56m from the Public Investment Program during the seven years of the construction period.

The loan of ECU 320m with a maturity of 25 years was estimated to be provided by the European Investment Bank. For the first eight years it was estimated that only interest would be paid (Law 2395/1996).

Actual versus predicted costs

It is rather difficult to accurately estimate if there is a difference between the actual and the predicted costs because the actual costs are not discounted in 1996 ECU prices. According to our communication with the finance department of Gefyra SA, the above figures correspond to the lump sum price of the concessioned object which did not deviate from what was agreed in the concession contract. However, the project budget had a provision for extra works needed for the realisation of the project. These works were outside the lump sum price of the concessioned object and it was stated (according to the Concession Contract) that their cost cannot exceed 5% of the lump sum price. According to our communication with the finance department of Gefyra SA and INT24, these extra works exceeded 5% by about 1% to 2% (around EUR 15m). Moreover, Kinopraxia Gefyra (the CJV of the concessionaire) was awarded other related projects that were under the responsibility of the state and had to be financed by the state (the most important of which were the construction of access roads to the bridge and the moving of the power cables from the straits between Rion and Antirion). Finally, another cost component was derived from the bonuses for speedy delivery provided by the state to the concessionaire in 2004, in order for the bridge to be delivered in early August 2004, before the 2004 Olympics. According to the concession contract, the delivery was agreed to be in December 2004. However, the state decided to organise and publicise the celebration of the Olympic flame passing over the bridge just before arriving to Athens for the initiation of the Games (INT24). In this sense, we can conclude in general that the project has been implemented without serious overruns.

According to the above data, we conclude that in general, there were not any significant budget deviations.

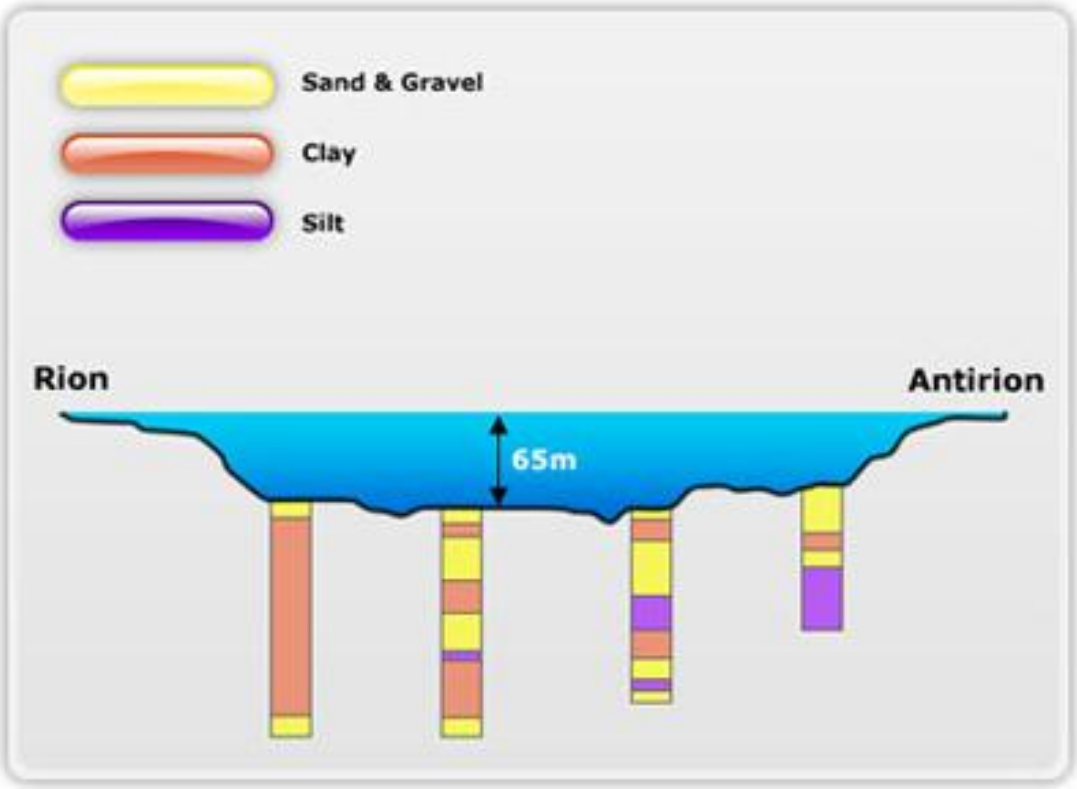
Main engineering features

Physical data

The physical features of the straits present an exceptional combination of adverse conditions, which makes this project unique: water depth up to 65 metres; absence of stiff seabed subsoil; strong seismic activity and tectonic movements *(*Gefyra SA, 2005). The seabed profile presents steep slopes on each side and a long horizontal plateau about 60m

below sea level. No bedrock was encountered during investigations down to a depth of 100m below the seabed. Based on earlier geological studies, it is believed that the thickness of sediments made of thick layers of clay mixed in some areas with fine sand and silt is greater than 500m (Gefyra SA, 2005).

Figure 9: The seabed of the Bridge



(source: www.gefyra.gr accessed on 10/07/2009)

The main construction characteristics

The upper soil layers are reinforced with inclusions, which are two metre diameter hollow steel pipes 25 to 30 metres long driven at a regular spacing of seven metres. About 200 pipes are driven within each pier. A three metre thick properly levelled gravel layer tops them. Foundations are 90 metre diameter reinforced concrete caissons resting on the gravel layer. A cone whose diameter ranges from 38 metres to 26 metres forms the lower part of the pier.

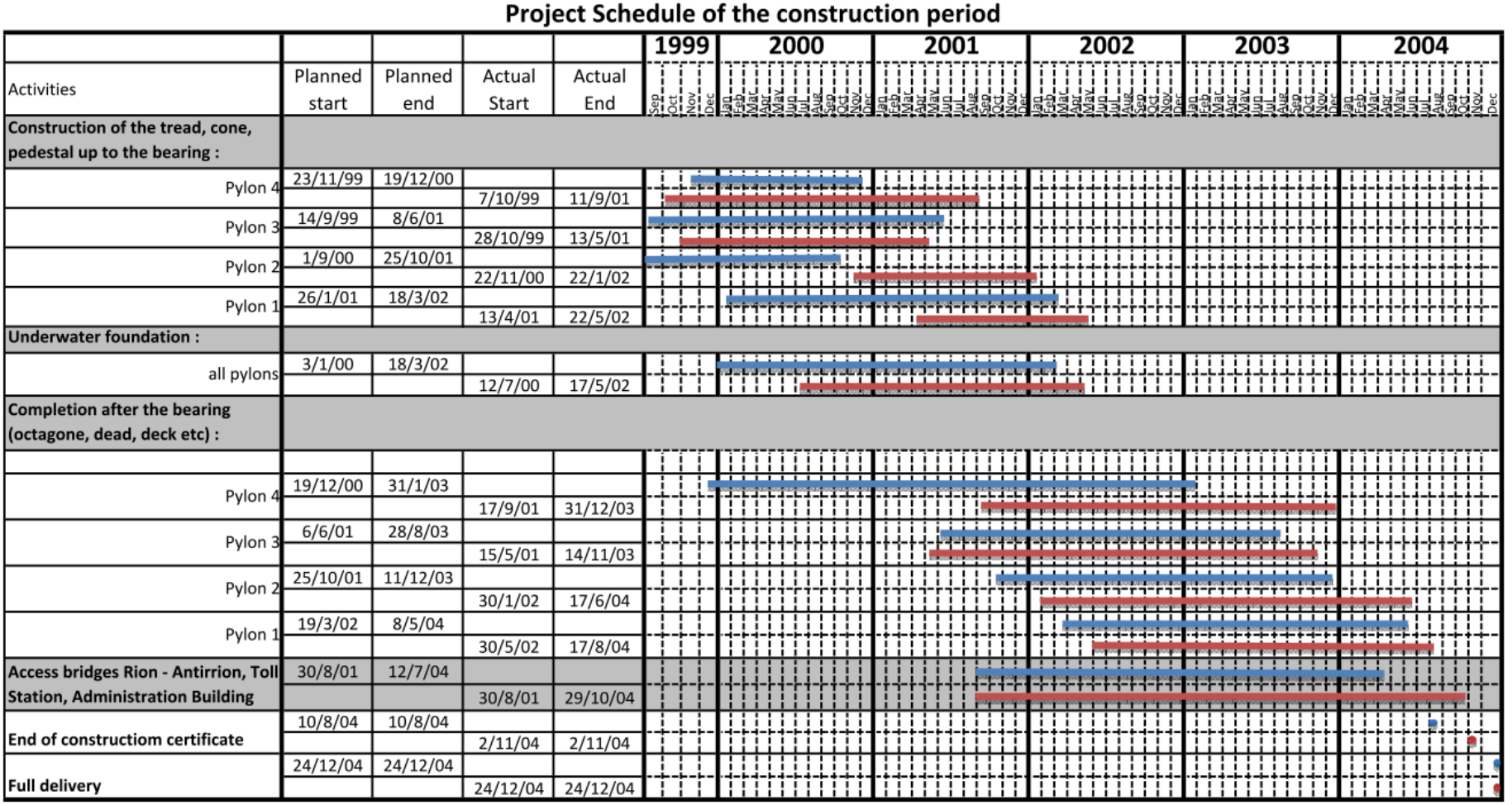
The upper pier shaft bears a reverse pyramid with a height of about 15 metres and a square base 38 metres in length. Each pylon is composed of four reinforced concrete legs with a section of four by four metres, embedded in the pylon head to form a monolithic structure. The stay cables are in inclined arrangements, with their lower anchorage on deck sides and their upper anchorage in the 35 metre high pylon head. They are made of parallel galvanized strands. The thickest cable is formed of seventy 15mm strands.

The deck is 27.2 metres wide with two traffic lanes plus a safety lane and a pedestrian walkway in each direction. It is a composite structure with a steel frame made of two longitudinal 2.2 metre high plate girders on each side and transverse plate girders spaced every four metres. The top slab is made of precast concrete panels. The deck is continuous and fully suspended for its total length. Four damping devices connect the deck to the top of

each pier and limit the pendulum movement of the deck during an earthquake. The dynamic relative movement during the seismic event is in the order of ± 1.30 metres, while velocities may exceed 1 metre per second.

On both sides, a large transition pier links together the deck of the cable-stayed bridge with the deck of the approach viaducts.

Figure 10: Project schedule



Activities	Planned start	Planned end	Actual Start	Actual End
Construction of the tread, cone, pedestal up to the bearing :				
Pylon 4	23/11/99	19/12/00		
			7/10/99	11/9/01
Pylon 3	14/9/99	8/6/01		
			28/10/99	13/5/01
Pylon 2	1/9/00	25/10/01		
			22/11/00	22/1/02
Pylon 1	26/1/01	18/3/02		
			13/4/01	22/5/02
Underwater foundation :				
all pylons	3/1/00	18/3/02		
			12/7/00	17/5/02
Completion after the bearing (octagone, dead, deck etc) :				
Pylon 4	19/12/00	31/1/03		
			17/9/01	31/12/03
Pylon 3	6/6/01	28/8/03		
			15/5/01	14/11/03
Pylon 2	25/10/01	11/12/03		
			30/1/02	17/6/04
Pylon 1	19/3/02	8/5/04		
			30/5/02	17/8/04
Access bridges Rion - Antirrion, Toll Station, Administration Building	30/8/01	12/7/04		
			30/8/01	29/10/04
End of constructiom certificate	10/8/04	10/8/04		
			2/11/04	2/11/04
Full delivery	24/12/04	24/12/04		
			24/12/04	24/12/04

(source: Dimoglou, 2003)

The marine equipment

A tension-leg barge has been custom-made to perform the various marine works including seabed dredging and the driving of inclusions. It is a world 'premiere' to have applied this principle on movable equipment (named LISA A). The concept is based on active vertical anchorage to dead weights resting on the seabed. When in place, the tension in these vertical anchor lines is adjusted in order to give the required stability to the barge in function of the sea waves and the loads handled on board. Moving to another location is achieved by increasing the tension in the anchor lines, the buoyancy of the barge allowing the dead weights to be lifted from the seabed.

(source: Gefyra SA, 2005)

Figure 11: Placement of the first two fundamental bases

(source: Dimoglou, 2003)

The pylons

A typical structure is 220 metres high from sea bottom to pylon head. The piers lie in about 60 metres of water. The pylon bottoms range from 25 metres to 45 metres (for the two central pylons) above sea level, leaving a shipping clearance below the deck of 52 metres in the middle of the strait. Pylons rise by 115 metres to a maximum height of 160 metres above sea level.

(Source: Gefyra SA, 2005)

Figure 12: A pylon view

(Gefyra SA, 2005)

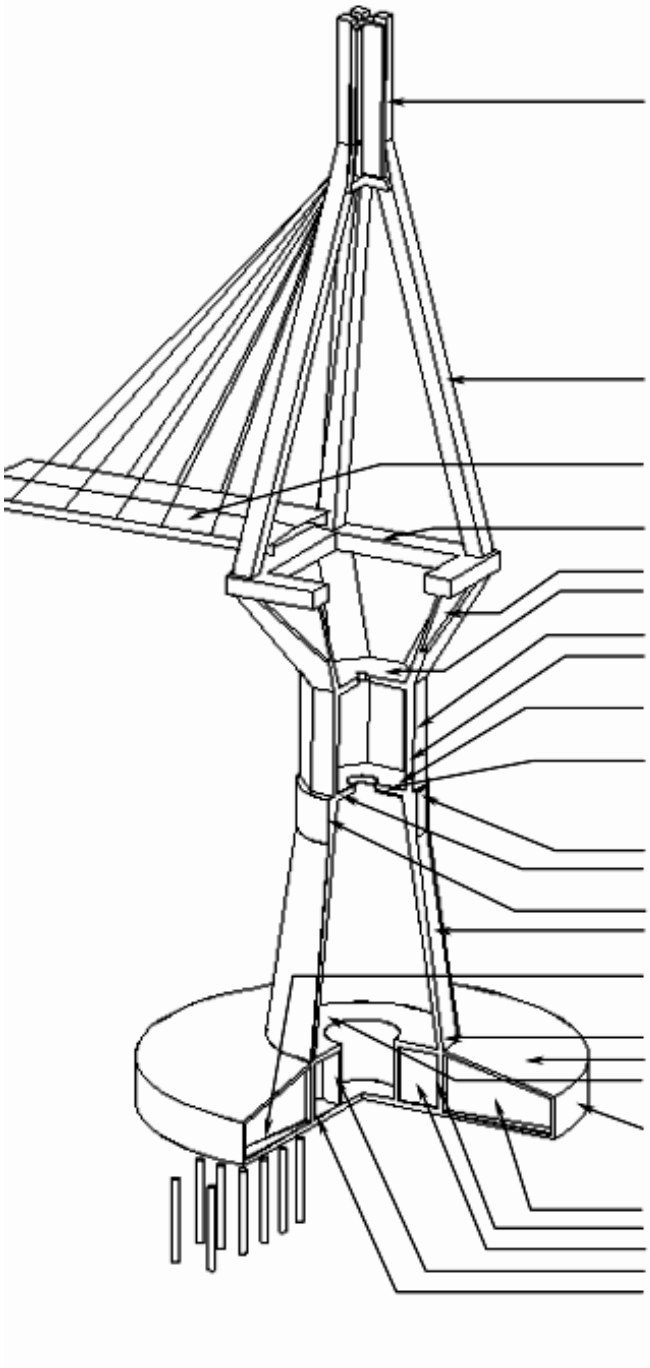
Figure 13: Deck installation

(Source: Gefyra SA, 2005)

Materials used

Materials included 250,000 cubic metres of concrete for the entire bridge (including 210,000 cubic metres for the main bridge) and 70,000 tonnes of steel reinforcement (Papanikolas, 2008; www.vinci-construction-projects.com). Figure 14 gives the quantities of concrete, and the type and quantities of cement used for the main bridge (source: Papanikolas, 2008; www.vinci-construction-projects.com).

Figure 14: Segments and materials of the pylons



Concrete Location	Concrete Type	Theoretical Quantities (m3)
Pylon Head	C60/75	4.000
Pylon legs	C60/75	13.464
Viaduct Deck	C60/75	16.870
Pylon Base	C50/60	11.380
Pier Head	C45/55	14.568
Pier Head Slab	C45/55	2.060
Octogon (except splash zone)	C45/55	6.504
Octogon (splash zone)	C45/55	2.944
Octogon connection M4	C50/60	616
Octogon connection (M1, M2, M3)	C60/75	1.848
Pier Shaft Slab	C45/55	280
Shaft slab wall (splash zone)	C45/55	332
Pier Shaft Slab (including precast)	C45/55	964
Cone climbings (splash zone)	C45/55	3.460
Cone climbings (except splash zone)	C45/55	23.556
Ballasting concrete		7.620
Cone	C45/55	2.565
Footing Top Slabs	C45/55	15.350
Ring Slabs	C45/55	4.896
External Wall	C45/55	11.244
Temp. Cofferdams	C45/55	1.828
Walls for trim tanks	C45/55	645
Radial Beams	C45/55	24.080
External Ring Wall	C45/55	9.004
Diaphragm Walls	C45/55	2.459
Internal Ring Wall	C45/55	2.701
Raft	C45/55	25.417
TOTAL MAIN VIADUCT ONLY		**210.655**

(source: Papanikolas, 2008)

D. PROJECT TIMELINE

Entry Number	MONTH	YEAR	EVENT
1	**March**	**1889**	Harilaos Trikoupis, Greek Prime Minister, publishes a governmental program for the expansion of the railway network of West Peloponnese and West Sterea Ellada. However, the expansion of the rail link Krioneri to Antirion and its connection to the grid of the Peloponnese is not initiated (Law 2395/1996).
2		**1964**	A technical commission was established to conduct geotechnical surveys in the strait between Rion and Antirion but the effort did not show any significant progress (Kaiafa, 2003).
3		**1975-1974**	The Technical Chamber of Greece organises two conferences (one in late 1975 and another in early 1975) for potential solutions for a link between Rion and Antirion (Gefyra SA, 2005).
4		**1977**	An international conference is organised in Patras to investigate the potential implementation of a link in Rion-Antirion, where distinguished scientists are invited from all over the world, and a serious scientific discourse is initiated (Gefyra SA, 2005, Kouloumbis, 1978).
5		**1980**	The first international call for proposals for the construction of the Rion–Antirion Bridge as a public work is launched. All types of links would be accepted in the technical offer (tunnel, floating bridge, suspension or cable-stayed bridge) but the tender does not progress beyond the first phase involving expression of interest and proposals, since construction companies did not express adequate interest (Gefyra SA, 2005, Law 2395/1996).
6		**1981**	The centre-left wing political party PASOK won the national elections and excluded the bridge from its initial agenda (Gefyra SA, 2005). In general, the period from 1981 to 1985 is considered as anti-mega project, given the weaknesses of the state budgets and the prioritization of policies regarding social services and wages enhancement.
7		**1986**	In view of the potentially large amount of EU funding that Greece was about to obtain, the government (PASOK) envisions an ambitious program to modernise transport infrastructure and the Rion-Antirion bridge re-appears on the agenda. The powerful new Ministry (MEPPW)[1] is making contacts with invited teams from GTM and other large experienced constructors from abroad to explore the feasibility of potential large transport projects located mainly in Athens (Gefyra SA, 2005). Along with those projects in Athens, the Ministry includes the bridge in the relevant discussions, asking for informal feedback from GTM representatives who had shown a special interest in the project although they were not sure that the project was technically feasible given the very high seismic activity of the area (Gefyra SA, 2005). Meanwhile, the Ministry had already announced a call for a technical advisor/consultant to prepare the tender for the project (Gefyra SA, 2005).
8		**1987**	The feedback from GTM in early 1987 was that a link could be a cable stayed bridge, despite the great deal of

[1] In 1986 the government established the Ministry of Environment Planning and Public Works by merging two former ministries (Planning, Housing and Environment - Public Works) under a new Minister, who was aiming to procure large projects and eliminate the former delays deriving from the disintegration between the two Ministries (Lialios, 2007)

Entry Number	MONTH	YEAR	EVENT
			unknown physical and environmental conditions in the strait (Gefyra SA 2005, INT24). The Ministry by mid-1987 had hired the Greek engineering company Efpalinos Techniki and the British Rendel Palmer & Tritton to prepare the tender documentation, and had commissioned geotechnical surveys (through drillings under the seabed). The technical advisors had to prepare the tender documents to reflect the design and construction criteria imposed by the adverse physical and environmental conditions in the strait. In this effort, a number of engineering experts, from Greece and abroad, were hired to support the technical advisors' work (Gefyra SA, 2005). The surveys proved that the subsoil was extremely unstable, so the idea of an underwater tunnel was abandoned (Gefyra SA, 2005). Before the end of 1987, the Ministry announced an international call for tender for the design, construction and financing of the bridge (not on a concession basis but on the basis of offset provisions) (Law 2395/1996).
9	**March**	**1988**	At the end of March 1988 five consortia submit proposals (Gefyra SA, 2005, Law 2395/1996). Two of them are disqualified before the opening of the financial bids, because they are not compatible with the tender requirements, while the remaining three offers had serious technical issues that required further investigation (Gefyra SA, 2005, Law 2395/1996). The three approved offers were submitted from the French company GTM[2] and the German Krupp-Thyssen (both proposing the construction of a cable-stayed bridge), and a Greek-Italian group of companies proposing a suspended bridge (Gefyra SA, 2005, Law 2395/1996). The evaluation of technical offers put the German group at the top, but after the opening of the financial offers and a prolonged round of evaluation, in which both the technical advisors and the ministerial committees participated, the French group eventually gained ground (Gefyra SA, 2005). However, the state still had doubts on some aspects of the technical offers and moreover had serious worries about how much the actual final cost of such a technically complex project would be and how this cost would be financed (INT16). According to Tzanavara (1996) the ministries asked the three bidders to further improve their offers and some more studying of the project took place in the following period.
10	**June**	**1989**	In early 1989, while PASOK was still the governing party, GTM initiated a discussion with the state about the benefits of a potential PPP arrangement for the procurement of the project (INT16). However, serious political unrest[3], from June 1989 onwards, resulted in the suspension of procedures due to the reluctance of the transitional governments to make a decision for such a big project (Gefyra SA, 2005).
11	**April**	**1990**	The project is back on the spotlight, but in a new framework: the project will be tendered as a PPP concession and

[2] The proposed bridge of GTM was greatly based on the studies conducted for the 20km cable stayed Channel Tunnel Bridge that was studied for the Channel Tunnel bid, three years before.

[3] In a climate of political unrest and serious legal appeals targeting the PASOK government, elections were announced in June 1989. These did not lead to a new government of a single political party, so three parties agreed to establish a government. This fell because of the withdrawal of one party and in November 1998 another election was announced. The new election, again, did not produce a parliamentary majority and, consequently, a new coalition government was needed. After protracted negotiations, the three major parties agreed to participate in an *ecoumeniki* (universal) all-party government under the widely respected ex-governor of the Bank of Greece (X.Zolotas), with the main task of stabilising the economy and running a new election. Finally, in the April 1990 election, a marginal parliamentary majority by the Conservative Party was achieved (www.minpress.gr: Lyrintzis and Nikolakopoulos, 2009)**.**

Entry Number	MONTH	YEAR	EVENT
			negotiations between the consortium led by GTM (acquired by Vinci in 2001) and the state started with the confidence that a concession was the best way to proceed to ensure the total cost did not burden the state budgets and also to transfer construction risk to the constructor (Gefyra SA, 2005, INT16).
12	**December**	**1990**	The second competition (launched in 1987) is canceled (Gefyra SA, 2005, Law 2395/1996).
13		**After 1990**	Transportation between Greece and Western Europe through Yugoslavia has almost ceased because of the war. Now, the main non-air accessibility to western Europe is through the Adriatic Sea and the ports of Igoumenitsa and Patras (Figure 5). So port traffic is increasing and the bridge together with the upgrade of the western road axis and its integration with the national road network becomes of critical importance.
14	**January**	**1991**	The Ministry of EPPW launches a new tender process, the third in sequence, for a concession-PPP for the design, construction, financing and operation of the project (Gefyra SA, 2005, Law 2395/1996). The new tender is based on the feasibility studies and tender documents prepared by the co-operating companies Efpalinos and Rendel Palmer & Tritton. In particular, the financial advisers Kouri Capital and Kidder Peabody are involved in the drafting of tender documentation (Law 2395/1996). Seven groups express interest in this competition and six of them are pre-selected (Law 2395/1996).
15		**Summer 1992**	New drillings to investigate and appraise the sea bottom, required for the design of the bridge, were undertaken (Gefyra SA, 2005).
16		**Autumn 1992**	The new tender is released, but the risk-sharing proposed by the tender call is seen as inappropriate by both private parties and the banking sector. The group GEFYRA makes a series of comments and suggestions, several of which were accepted (Gefyra SA, 2005, INT24).
17		**1993**	The tender process is officially launched based on the results of investigations that have taken place and the proposals of bidders that were accepted (Gefyra SA, 2005). The Rion-Antirion Bridge is appraised in the framework of a national transport study called GREECE 2010 that also provided an input for the 1994–2000 and the 2000-2006 EU Community Support Frameworks. The study produces a critical input for the accurate appraisal of the traffic of the bridge since it considers the impact to traffic on the bridge of the gradual realisation of an upgraded national highway network linked with the bridge. The study refers to the Rion–Antirion bridge as a vital link of a national transportation network development plan that aims (Transport Research and Development International, 1995): • to minimise the disadvantages of the country due to its peripherality, as compared to the other member states of the European Union; • to emphasise its strategic location as a gate of the Balkan peninsula to the countries of the Mediterranean. On a national level, the objectives of the national transportation network are (Transport Research and Development International, 1995): • to upgrade the transportation connections within the country of the north-south and west-east axes; • to increase accessibility to various peripheral districts of the country;

Entry Number	MONTH	YEAR	EVENT
			• to provide an integrated network, equal opportunities, and reduce the inadequacies of western regions and the Peloponnese.
18	**1 December**	**1993**	After a number of postponements requested by the bidders, 1 December was set as the deadline for submission of bids. The submission date, according to INT24, was pushed forward by the Gefyra consortium (which was by far the most active consortium in keeping in communication with the Ministry, making remarks to the Ministry regarding the bid, but also very well prepared in terms of financial and technical analyses for the project). Again, according to INT24, Gefyra wanted the submission date to be postponed to after the 10 October 1993 elections, because they believed that if bid offers were submitted before the elections there would be a serious risk that the government of that time would abandon the tender (the conservative government of that time had generated serious social unrest due to anti-social, neoliberal policies but also due to the foreign policy choices related to conflicts with FYR Macedonia. A series of MPs in the conservative government started quitting the party and the prospect of an election was very likely) while the prospect of a change to a PASOK government would be favorable for the project. So, the bids were submitted to the new PASOK government which thereafter showed great zeal in proceeding with the project. Only two bids were submitted, the consortium Rion Antirion (Greek–Dutch led by Boskalis and Parnon) and the GTM (acquired by Vinci in 2001) led consortium (French–Greek) GEFYRA (Law 2395/1996, INT6). The Competition Commission rejected the former as inconsistent with the terms of the tender because they proposed a tunnel while the tender requirements were for either a high or a floating bridge. So Gefyra became the preferred bidder (Gefyra SA, 2005, INT24).
19	**December**	**1994**	The EC Essen summit identifies 14 priority transport projects (TEN-T). These included the PATHE motorway (see figure 7) while the Rion–Antirion bridge was incorporated into PATHE (Gefyra SA, 2005, INT24). This was regarded as an absolutely critical milestone for the realization of the project. The state and Gefyra maintained active communication (the key persons from both sides had built a constructive relationship), and were working for a shared aim to find long term lending for the project besides their own contribution (INT24). They realised that the bridge had to be incorporated in the TEN-T priority projects; otherwise the EIB would not be willing to provide long term lending and it would be rather impossible to find another lender, other than EIB, to provide a 20-25 years maturity loan on a project like this in Greece. EIB already knew the project from the previous Design–Build tender in 1988 when the state had submitted to EIB a socio-economic analysis to ask for funding. According to INT24 and INT16, this analysis had a poor cost-benefit ratio and was also very poor in terms of quality. Based on that, and their general perception, EIB had a negative view of the need for and the benefits of such a technically complex project. The state, just a few months before the EC Summit in Corfu (where the Christophersen Group would put forward the priority projects), prepared together with Gefyra the required documentation to be handed to the Greek representative in the Christophersen Group. The Corfu EC Summit considered seriously the request for the Rion–Antirion Bridge to be incorporated into the PATHE axis (as a vertical connection to PATHE before Patras) and the next EC Summit in Essen officially confirmed that the bridge belongs to the PATHE Priority project. Extremely critical, as INT24 states, had been the role of the Prime Minister

Entry Number	MONTH	YEAR	EVENT
			Papandreou in promoting the project in the EC summits. After that decision, EIB had to revise its position regarding the funding of the bridge, according to the Community's interest in terms of the transport development priorities defined at the EC summit (INT24, EC 1994).
20	**March**	**1995**	The European Commission examined the lawfulness of the tender, after the appeals of competitors on the grounds of the tender procedures and the financial offer of Gefyra, which contradicted the tender requirements (and also that the technical offer was not based on a previous application and did not have a definite and finalised approach to various technical matters). A crucial issue of dispute was that the financial offer of Gefyra had significant inconsistencies[4] with the demands of the tender call along with the fact that competition in the bidding was poor (INT24, INT16). However, Gefyra had informed the state at a very early stage that the tender call was not appropriate for a proper concession risk-sharing and that the offer that would be submitted would deviate at various issues that later would have to be legally fixed (INT24, INT16). The European Commission finally rejected the appeals. According to INT24 and INT16, Gefyra and the state claimed that the other competitor had never objected on the questions-and-answers documents exchanged between Gefyra and the Ministry (MEPPW) that were always officially circulated among all competitors before the bid submissions. The remaining issues of deviations between the tender call and the financial offer were left to be settled in the concession contract that would be ratified as a law by the parliament so as to be immunised from appeals (Gefyra SA, 2005, INT24, INT16).
21	**3 January**	**1996**	The concession contract was signed by the Greek Government and Gefyra SA (Gefyra SA, 2005, Trova and Koutras, 2001, Himoniti, 2003). In general, there were many issues that needed to be properly contractualised in order for the project to be bankable and for both Gefyra and the state to feel partners in a fair deal. Those issues had principally to do with the risk allocation balance and mechanisms such as risk allocation of force majeure, which had to be clarified, well defined and allocated properly (INT16). Another major issue was the control of the design and progress of work that had to be assigned to an independent checker and an independent supervisor since the state was not capable of carrying out such a job for such an innovative and technically complex project, despite the fact that the Ministry initially did not want to out-source and neutralise the control (INT16). A critical decision made just after signing the concession contract was the agreement between the state and the concessionaire to sign the so-called 'Contracts before the effective date'. These contracts, which were executed in the period between the signing of the Concession Contact and the financial close, allowed the implementation of geotechnical surveys in the subsoil of the seabed. These works were necessary for the confirmation of the construction design assumption and the progress of the final design and were paid for exclusively by the state. In the case that financial close was achieved, the money paid by the state would be deducted from the state's

[4] The tender call stated that the Government could not guarantee the loan during construction. However, the financial offer of Gefyra mentioned that the long term lending had to be guaranteed during construction (having in mind that EIB, the only bank that could provide long term lending, would demand a guarantee during construction for such a technically complex project). In general the financial offer of Gefyra had significant inconsistencies with the demands of the tender call (INT16)

Entry Number	MONTH	YEAR	EVENT
			subsidy; otherwise Gefyra SA would just deliver the full survey outcomes to the Ministry (INT16). These surveys were very costly but absolutely necessary because they played a very important role in the negotiation with the EIB, by demonstrating a maturity of design for the risky construction.
22	**24 April**	**1996**	The concession is ratified by the parliament (Gefyra SA, 2005).
23	**December**	**1996**	The Executive Committee of EIB approved the provision of the long term loan to Gefyra SA. EIB was initially not comfortable about providing the long term loan, but they had (since the bridge was a TEN-T priority project) to appraise the project's CBA again and moreover their credit risk. This time, a signed concession contract was in place, which according to EIB's initial view addressed risk–sharing in a secure way (INT16). Moreover, a new more advanced CBA had been conducted showing the socio-economic benefit of the project (INT16). However, EIB was still expressing a strong stance against assuming any amount of credit risk. EIB was unquestionably requesting guarantees for the repayment of the loan during the operation period. The provision of loan guarantees to the concessionaire during the operation period was something that the Greek Government couldn't do, according to the PPP tender that awarded the project to the concessionaire. At the same time, EIB could not provide the long term lending without guarantees. In order to solve this problem, the Greek Government guaranteed a stand-by loan of ECU 75m to the concessionaire, which could only be used in case the concessionaire could not fulfill his financial obligations to EIB (interest and loan repayment) during the operation of the project. If the concessionaire was unable to pay for his obligations to the EIB, the amount to be paid could be drawn from the stand-by loan facility (INT25, INT11). If the total amount drawn from the concessionaire from this stand-by loan exceeded ECU 70m the Greek Government would take over the operation of the bridge.
24	**25 July**	**1997**	The Master Facility Agreement of EUR 370m and 25 years repayment period is signed between Gefyra SA and European Investment Bank (EIB) (Gefyra SA, 2005, INT16, 2004).
25	**11 December**	**1997**	Financial Close and commencement of concession (Gefyra SA, 2005). The main factor delaying financial close during the previous year was the request by EIB for guarantees during construction (INT16, INT24). This was achieved by the syndication of a number of commercial banks (led by the Bank of America and the Bank of Tokyo–Mitsubishi) which organised a consortium to guarantee the EIB loan to Gefyra S.A during construction. The major issue in the negotiations of the four parties (Gefyra, the state, EIB and the consortium of commercial banks) was that the commercial banks did not want to assume any kind of risk that would derive from the state's responsibilities during construction. EIB initially wanted a full guarantee without caring whose fault it might be (INT16). After a year of negotiations, default events were defined (along with primary causes of the events that would be decided with the assistance of a panel), according to which EIB could call the letter of credit. In this sense, EIB agreed to take a substantial share of the state's risk.
26	**17 December**	**1997**	The Ratification Act of the concession contract states that, if any amendments were needed for the bankability of the project, they could be made by Presidential Decree, without going to the Parliament (Law 2395/96). This proved critical, since the concession contract had to be amended (by Presidential Decree 387/1997 in December 1997) for specific issues to be clarified and well defined according to the demands of the banks. Also, the

Entry Number	MONTH	YEAR	EVENT
			amendment allowed for some financial and technical aspects to be articulated more concretely. It is appropriate here to mention that the practice of amending a law with a Presidential Decree could cause serious legal concerns with regard to the power and significance of a Law. However, it should be recognized as a confirmation of the importance of the role of banks and sponsors and their power over the original parties (Trova and Koutras, 2001).
27	**24 December**	**1997**	The concession of 42 years came into effect just after financial close. Thus, the project started operating, seven years after the beginning of the concession, on 24 December 2004 (Gefyra SA).
	23 September	**2000**	The first base for the bridge was constructed (Gefyra SA, 2005).
28	**13 May**	**2001**	The first foundation was completed and ready to leave the dry dock to take its final position (Gefyra SA, 2005).
29	**24 May**	**2004**	The Constructor placed the final plate of the bridge. The two shores of the Corinthian Gulf were connected (Gefyra SA, 2005).
30	**8 August**	**2004**	The Olympic Flame passed over the bridge with its final destination the Athens Olympic Games beginning in five days' time (Gefyra SA, 2005).
31	**12 August**	**2004**	The bridge was opened to traffic (Gefyra SA, 2005).
32	**27 January**	**2005**	One of the cables caught fire, possibly after being hit by lightning. The bridge was closed to traffic.
33	**2 February**	**2005**	The bridge re-opened to traffic (initially a limited re-opening, with full re-opening after the repair of the cable stay) and extra anti lighting-hit protection systems were installed. The issue of the lighting hit led to worries about the quality of materials and the measures taken by Gefyra SA. After more than a year, the results of a study of the case by an experts' committee appointed by the Ministry (MEPPW) suggested a more detailed inspection of various technical aspects of the cable-stays but no other legal measures were taken (Kathimerini 2006, INT25). The issue ended after a recent study commissioned from an independent engineer from abroad (INT24).
34	**December**	**2039**	The end of concession (the control and operation of the bridge is to be handed over to the Greek state) is set to 2039. However, the concession will end earlier if the concessionaire achieves a predetermined Return on Equity as defined in the Concession contract (11.5%) (Law 2395/96).

E PROJECT FUNDING/FINANCING

Background to funding/financing

The Rion–Antirion Bridge along with Attiki Odos and the Athens International Airport were the three first projects to be procured as PPPs in Greece with the instrumental support of Structural Funds and EIB's long-term lending.

Traffic forecasts and financing / funding response

The role of traffic forecasts becomes absolutely decisive in a PPP deal, with the major source of revenues being the tolls. The traffic forecasts are used, in conjunction with the toll level and the time of concession, to estimate the revenues that the project can yield, revenues that are used to pay for the operation and maintenance of the bridge, to repay loans, and to repay investors' equity with a return on that equity throughout the concession period. Traffic forecasts are instrumental for the public sector in order to prepare the tender and the bid. For this reason, in the case of the Rion–Antirion Bridge both parties mandated traffic studies which showed significant demand and growth bud did not capture the actual very high levels of traffic that the bridge has experienced from the beginning of its operation (Bastos, 1999, Kaparos, 2008).

Prior to the tendering process for the project, the Greek State commissioned a Feasibility Study from the companies Efpalinos Techniki and Rendel Palmer & Tritton. This study also examined the traffic forecast (Table 2) for the Rion-Antirion Bridge for the years 1992-2030.

Table 2: Traffic forecast for the years 1992 - 2030

	CARS		TRUCKS		BUSES		MOTORCYCLES		PASSENGERS	
YEAR	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1992	1603489	1659849	490454	505042	94533	96390	72311	73269	6061528	6454911
1993	1673162	1763064	502761	520419	98341	99161	74565	83362	6873246	7120709
1994	1720534	1861671	516459	535193	99503	99770	76891	80680	7030299	7389536
1995	1796219	1952186	530157	550210	96070	102192	79249	80324	7438975	7396235
1996	1846755	2040955	543855	565129	104404	104724	81621	83050	7366015	7615909
1997	1923753	2132753	557553	580088	104455	106010	84000	86269	7818184	7844626
1998	1975159	2228194	571251	595030	106577	108103	86381	88876	7826304	8073727
1999	2052353	2326028	584949	609979	109341	110431	88764	90573	8290938	8302844
2000	2104081	2425331	598647	624926	108235	112073	91147	94611	8280077	8531963
2001	2181208	2525993	612345	639873	113606	114047	93530	96921	8734495	8761081
2002	2233127	2628261	626043	654820	114498	116229	95913	98566	8726495	8990199
2003	2310124	2732313	639741	669768	116112	118050	98297	100684	9184193	9219317
2004	2362200	2838170	653439	684715	119144	119992	100680	103213	9176990	9448435
2005	2439055	2945781	667137	699662	119320	122081	103064	105797	9633401	9677553
2006	2491280	3055113	680835	714609	123054	123989	105447	107962	9626146	9906672
2007	2567990	3166162	694533	729556	124552	125929	107831	110574	10082327	10135790
2008	2620361	3278938	708231	744504	126084	127964	110214	113117	10075602	10364908
2009	2696927	3393448	721929	759451	128950	129911	112597	115424	10531431	10594026
2010	2749441	3509692	735627	774398	129886	131859	114981	117705	10525026	10823144
2011	2825865	3627668	749325	789345	132743	133863	117364	120079	10980474	11052262
2012	2878521	3747375	763023	804292	134583	135826	119748	122538	10974440	11281381
2013	2954804	3868813	776721	819240	136178	137783	122131	124895	11429531	11510499
2014	3007600	3991982	790419	834187	138796	139770	124515	127298	11423861	11739617
2015	3083744	4116883	804117	849134	140191	141740	126898	129735	11878587	11968735
2016	3136678	4243515	817815	864081	142591	143702	129282	132138	11873279	12197853
2017	3212685	4371878	831513	879028	144593	145681	131665	134511	12327643	12426972
2018	3265755	4501973	845211	893976	146287	147653	134049	136888	12322697	12656090
2019	3341626	4633799	858909	908923	148691	149619	136432	139295	12776699	12885208
2020	3394831	4767357	872607	923870	150360	151594	138816	141688	12772115	13114326
2021	3470568	4902646	886305	938817	152531	153567	141199	144079	13225756	13343444
2022	3523907	5039666	900003	953764	154593	155535	143582	146480	13221532	13572562
2023	3599511	5178418	913701	968711	156380	157508	145966	148881	13674813	13801681
2024	3652981	5318901	927399	983659	158629	159480	148349	151276	13670950	14030799
2025	3728455	5461116	941097	998606	160458	161450	150733	153665	14123870	14259917
2026	3782055	5605062	954795	1013553	162520	163422	153116	156061	14120367	14489035
2027	3857400	5750739	968493	1028500	164592	165394	155500	158457	14572928	14718153
2028	3911128	5898148	982191	1043447	166452	167365	157883	160851	14569783	14947272
2029	3986345	6047288	995889	1058395	168599	169337	160267	163247	15021986	15176390
2030	4040201	6198159	1009587	1073342	170517	171309	162650	165643	15019200	15405508

(source: “Efpalinos Techniki”, 1992)

Traffic forecast methodology

The above traffic predictions were calculated by time-series analysis using the Box-Jenkins method (Autoregressive Integrated Moving Average model). ARIMA models are flexible and suitable for time-series analysis. The methods used by ARIMA models combine three types of analysis: auto regression-AR, integration and the moving average-MA. All three types of

analysis are based on the random variation that appears in between two observations of a series and affect its level.

In the auto regression process, each measurement of a series represents a linear function coalition of one or more measurements. For the auto regression of n-series, n-1 measurements are used. As an example:

Measurement t = Variation + $\Phi \times$ Measurement t-1

The Φ parameter is called first coefficient of correlation. It is calculated by the observed series and shows the degree of dependence of a measurement on its previous one. The auto regression coefficient between Measurement t and Measurement t-1 can also be calculated by step delay 1. The auto regression analysis is a process that uses memory, meaning that each measurement correlates with all previous ones. This way, each variation of the system has a declining effect with all next time periods.

(source: Transport Research and Development International, 1995)

Tolling assumptions

The concession contract stipulated that the toll rates cannot exceed a maximum level. The maximum toll fare levels were set in 1992 and are adjusted every year to take account of inflation as reflected by the Consumer Price Index in ECU. Toll rates may be re-adjusted by the concessionaire once more in each calendar year if the annual inflation rate rises more than 5% in a period of twelve months (Law 2395/96).

According to Law 2395/96, passengers, pedestrians, and non-motorised vehicles, motor vehicles of the Greek Government, the Greek Police vehicles, fire trucks, vehicles of the Greek Army Forces and ambulances do not pay any tolls.

Table 3: Increase in toll fare

Year	Toll fare (EUR)
2004	9.7
2005	10
2006	10.5
2007	10.9
2008	11.2
2009	11.7
2010	11.8

(source: Stavris, 2008)

Funding sources

The sources of funds for the project, as published on the official site of the concessionaire and other sources, are illustrated below:

Table 4: Sources of funds

	source: www.gefyra.gr	source: INT16 and Maublanc (2004)	source: ELTECH (2006)
Sources of funds	EUR m		
Concessionaire's own equity	**68.6**	69	65
State contribution (EU and state subsidy)	**385.1**	335	400
Loan EIB	**349.0**	362	370
Financial earnings		6	4
Total	**802.7**	**772**	**839**

(Source: multiple)

F OPERATIONS

Traffic volume

According to the study of the Efpalinos Techniki company (1992), 'The traffic forecast of the Rion–Antirion Bridge' (Table 2), the maximum traffic volume for the year 2005 was 3,873,321 vehicles. However, according to Gefyra SA, the actual traffic volume reached 4,339,742. It seems that the forecasted traffic has already been exceeded by nearly 500,000 vehicles or 12% from the first year of the bridge's operation (Tables 6 & 7). The actual data correspond to the period 2005-2008. Throughout this period the actual traffic is higher than the traffic forecast.

Table 5: Yearly volumes and average daily traffic for the following years of operation

Year	Vehicle traffic	Average daily vehicle traffic	Change (%)
2005	4,339,742	11,890	0 (Base Year)
2006	4,514,327	12,368	4.02%
2007	4,823,125	13,214	6.84%
2008	4,978,600	13,640	3.22%

(source: Stavris 2008, Gefyra SA 2007)

Figure 15: Yearly volumes and average daily traffic for the following years of operation

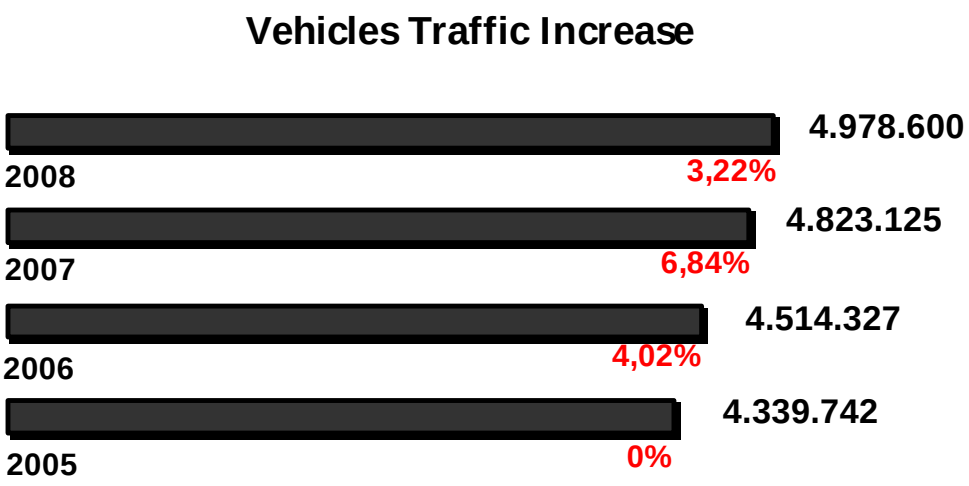
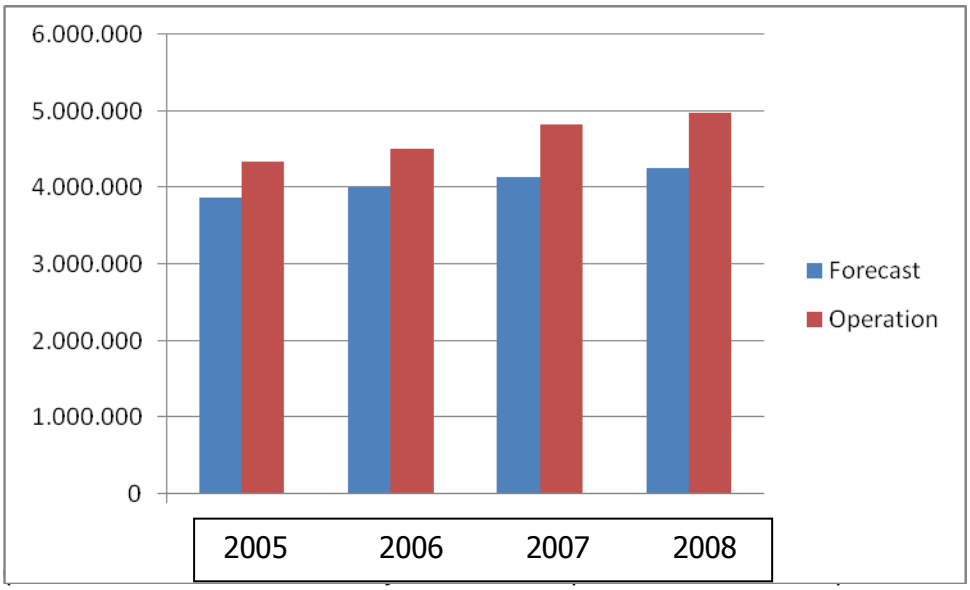


Table 6: Yearly volumes and average daily traffic against traffic forecast

Year	Vehicles traffic forecast	Average daily vehicles traffic forecast	Change (%)
2005	3,873,321	10,612	0 (Base Year)
2006	4,001,673	10,963	3.31%
2007	4,132,221	11,321	3.26%
2008	4,264,523	11,684	3.20%

(source: Efpalinos Techniki, 1992)

Figure 16: Traffic forecast against actual traffic for the period 2005-2008



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H GLOSSARY

AIA: Athens International Airport

ARR: Athens Ring Road

CBA: Cost/Benefit Analysis

CC: Concession Contract

CFO: Chief Financial Officer

CJV: Construction Joint Venture

CPI: Consumer Price Index

CSF: Community Support Framework

EC: European Commission

ECU: European Currency Unit

EIA: Environmental Impact Assessment

EIB: European Investment Bank

EIF: European Investment Fund

EMU: Economic and Monetary Union

ERDF: European Regional Development Fund

EU: European Union

GRD: Greek Drachma

I/C: Interchange

IRR: Internal Rate of Return

MEP: Member of Parliament

MEPPW: Ministry of Environment, Planning and Public Works

NPV: Net Present Value

PATHE: Patras-Athens-Thessaloniki-Evzoni

PPP: Public Private Partnership

ROE: Return on Equity

SAC: Supreme Administrative Court

TEN-T: Trans-European Networks/Transport

VAT: Value Added Tax