Road Safety, a high priority for Greek Motorway Concessions:

“The cases of Olympia Odos, Aegean Motorway and Moreas.”

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Motorway Concessions Overview

<table>
<thead>
<tr>
<th>Description</th>
<th>OO</th>
<th>Moreas</th>
<th>AMSA</th>
<th>E65</th>
<th>Nea Odos</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Sections</td>
<td>82 km</td>
<td>82 km</td>
<td>200 km</td>
<td>173 km</td>
<td>537 km</td>
<td></td>
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<tr>
<td>State New Sections</td>
<td>23 km</td>
<td></td>
<td></td>
<td>57 km</td>
<td>11 km</td>
<td>91 km</td>
</tr>
<tr>
<td>New Sections</td>
<td>283 km</td>
<td>100 km</td>
<td>30 km</td>
<td>174 km</td>
<td>196 km</td>
<td>783 km</td>
</tr>
<tr>
<td></td>
<td>365 km</td>
<td>205 km</td>
<td>230 km</td>
<td>231 km</td>
<td>380 km</td>
<td>1411 km</td>
</tr>
</tbody>
</table>
## Fields of Activities

<table>
<thead>
<tr>
<th>Design and Construction</th>
<th>Operation and Maintenance</th>
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</thead>
<tbody>
<tr>
<td><strong>Existing Sections</strong></td>
<td><strong>Traffic Management &amp; Safety (24/24h)</strong></td>
</tr>
<tr>
<td></td>
<td>- Traffic Management Centers</td>
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<tr>
<td></td>
<td>- Emergency Dial Number</td>
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<tr>
<td></td>
<td>- Patrons &amp; Intervention Teams</td>
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<tr>
<td></td>
<td>- Agreements with Emergency Services</td>
</tr>
<tr>
<td></td>
<td>(est. common operational plans/ support and provision of premises &amp; equipment to ES)</td>
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<tr>
<td></td>
<td>- Recovery Unit Services</td>
</tr>
<tr>
<td><strong>New Sections</strong></td>
<td><strong>Inspection &amp; Maintenance</strong></td>
</tr>
<tr>
<td></td>
<td>- Corrective &amp; Preventive maintenance</td>
</tr>
<tr>
<td></td>
<td>- Safety audit &amp; Improvement proposals</td>
</tr>
<tr>
<td></td>
<td><strong>Interface with Construction activities</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Toll Collection</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Customer Service</strong></td>
</tr>
<tr>
<td></td>
<td>- Communication Service</td>
</tr>
<tr>
<td></td>
<td>(Phone calls, handling of complaints, info to users,..)</td>
</tr>
<tr>
<td></td>
<td>- Subscribers Service for ETC</td>
</tr>
</tbody>
</table>

- **Safety Audit** targeting to 1st priority measures for safety upgrade
- **Implementation of first safety measures**
- Gradual **Refurbishment / Upgrade** according to contractual schedule/ specs

- **Design** according to modern specs
- **Safety Audits** in multiple stages
- **Construction per Section** with high standards, either:
  - in green field areas
  - widening of existing sections
### Traffic Management & Safety Mechanism: “Before & After CCD”

<table>
<thead>
<tr>
<th>TMC Activities</th>
<th>Incident Management</th>
<th>Monitoring of Road Network</th>
<th>Support to drivers</th>
<th>General Activities on the Road</th>
<th>Traffic Flow Monitoring</th>
<th>Other Services</th>
<th>Planning</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Dealing with routine incidents</td>
<td>CCTV use for Incident Management</td>
<td>Provision of Information to the media</td>
<td>Routine Incidents Managements</td>
<td>Removal of broken down vehicles</td>
<td>Escort to special vehicles</td>
<td>Elaborating Protocols and Emergency Plans</td>
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<tr>
<td></td>
<td>Dealing with accidents and serious incidents</td>
<td>CCTV use to monitor traffic and detect incidents</td>
<td>Placing Signs for deviations</td>
<td>Dealing with accidents and serious incidents</td>
<td>Abandoned Vehicles</td>
<td>Monitoring Road Works</td>
<td>Planning of standard Traffic Management Means</td>
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<td>Handling Emergency Calls</td>
<td>Real Time Traffic Management</td>
<td>Planning Strategic Signing</td>
<td>Imposing the law on Infractions</td>
<td>Provision of temporary signage</td>
<td>Special Events / Crises</td>
<td>Planning of Works on the Road</td>
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<td></td>
<td>Placing signage to incidents</td>
<td>Collaboration with other involved parties</td>
<td></td>
<td></td>
<td>Cleaning debris, oil, animals etc.</td>
<td>Training users of the road (information leaflets)</td>
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<td>Dealing with routine incidents</td>
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**Services not provided or provided only fragmentary**

- **Traffic Police**
- **Company**
- **Jointly**

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Special characteristics affecting Operation - OLYMPIA ODOS

Road Sections with totally different character

✓ "Elefsina - Korinthos" Motorway section:
  o 64 km length (3 lanes & 1 EL / direction)
  o Including Kakia Skala complex of tunnels (~4.5km)
  o 2 big toll plazas (Elefsina and Isthmos)
  o AADT of 30,000 veh/day per direction (70,000 in peaks)
  o Adjacent to Athens serving mainly interurban traffic

✓ Patra Bypass:
  o 18.3 km length per direction (2 lanes & 1 EL / direction)
  o Including Patras By-Pass tunnels (~4.7km)
  o AADT of 8,000 veh/day per direction (15,000 in peaks)
  o Half section (eastern section) serving interurban traffic

✓ Korinthos - Patra NNR:
  o 120.0 km of National Road (1 lane & 1 EL / direction)
  o Mostly undivided, with poor geometry, high accident rate,..
  o AADT of 10,000 veh/day per direction (30,000 in peaks)

and generally:

✓ High traffic fluctuations during the year
  increased traffic during weekends, holidays & summer

✓ Smooth terrain – Limited winter maintenance needs

✓ Mentality and habits of Users connected to old operation framework
  (e.g. throwing garbage, stopping in dangerous locations, walking, illegal exits/entrances etc.)

✓ Extended construction activities inside or adjacent
  all above sections [see before and next slides]
Design and Construction Works - OLYMPIA ODOS – existing sections

“Korinthos-Patra” NNR: 1st year safety works after safety audit

- **Signing:**
  - marking works (240 km), “cat eyes” at the edge of the road (25 km)
  - cleaning/replacement of damaged signs (1000 pcs.) and
  - barriers reflectors (17,700 pcs)
- **Safety Barriers:**
  - replacement and improvement (74 km)
- **Pavement:**
  - improvement of anti-skid features / shot-blasting (66 km)
  - local pavement repairs (50,000 m²)
- **Road lighting:**
  - repairs of existing infrastructure (38 km)
- **Vegetation:**
  - cleaning/trimming bushes & trees at the side of road (176 km)
- **Hydraulics:**
  - cleaning of shoulders from plants, dirt, waste and gutters for rainwater drainage (242 km)
- **Parking areas:**
  - signing upgrade and shape re-arrangement

“Elefsina-Korinthos” and “Patra By-Pass” Refurbishment works

- **Pavement:**
  - asphalt repairs in specific locations and extended sections
- **Signing:**
  - all gantries replacement, new small side signs, speed limits, removal of hundreds of advertisement signs, etc
- **Safety Barriers:**
  - new, replacements (central reserve and structures), NJ profile
- **Fencing:**
  - repairs and/or relocation
- **Slope stability measures
- **Hydraulics:**
  - specific enhancements (side ditches) and cleaning
- **Parking areas:**
  - safety upgrade (median and barriers), new WC buildings
- **Structures:**
  - conditions inspections, inventory and massive repairs of joints
- **EEM Systems:**
  - SCADA, new Traffic Systems, Sub-Stations and lighting upgrade
- **Local interventions:**
  - Local widening before Tripolis I/C, new Pachi bridge, I/C
- **Anti noise:**
  - construction of zones with panels for first time
- **Vegetation:**
  - plantation and irrigation,
“Big Challenge”, Operation Under Construction - OLYMPIA ODOS

“Korinthos-Patra” Section

Difficulties and particularities:

- **Construction works along with traffic** in a very limited width
- **Construction activity simultaneously developed** along the entire length (120km)
- **Short time schedule** in combination with uncertainties / delays in land acquisition, due to expropriations, archaeology and P.U.,...
- **Many existing technical structures** (bridges, underpasses, culverts, hydraulics etc.) requiring expansion or demolition (>100)
- **Simultaneous construction of Railway Line** (ERGOSE) for long stretches in adjacent areas.

Large number/density of traffic arrangements:

- **Various types of cross sections** (1+1 or 1+2/2+1, 2+2):
  - Special design and approval procedures, involving several entities (designer, Constructor, CJV, Operator, IE, Service, Traffic Police,...)
  - **Uniformity** of signing and safety means used
  - **Special Operation/Intervention Plans**
  - **Emergency parking areas & access – evacuation points**
  - **Specific emergency 4-digit phone number**
  - Close collaboration with the Emergency Services and local authorities
  - **Intensification of patrolling / recovery units**
  - Quick incident response

Currently approx. 42 km (35% of KOPA length)
First years operational results/performance - OLYMPIA ODOS

**Incident Management**
- 57 incidents / day
- 87% immobilized vehicles and obstacles while the rest 13% are accidents, problems with users, traffic congestion etc.
- Quick Response

**Accidents Statistics**
- along Existing Sections (ELKO & PbP)
  - accidents with injuries reduced by 24%
  - fatal accidents reduced by 50%
- along KOPA
  - accidents with injuries in KOPA reduced by 42%
  - fatal accidents in KOPA reduced by 68%

**Maintenance interventions/repairs**
- 151 Road infrastructure damages per month:
  - 58% signing, 22% fencing & barriers and the rest 20% pavement, tunnels, sewage & draining, etc.
- 143 EEM damages/failures per month:
  - 27% toll system, 25% MMS, 28% EEM in open sections, 18% EEM in tunnels and the rest 2% other damages.
- 70% within the same day
- 90-95% repaired within the current month

**Communication**
- 46 calls per day and 62 written requests per month
- average response time within 1 week
- Continuous information to the Users related to traffic conditions, works along the road, etc.

400 employees permanent staff 24hours per day + subcontractors
Special characteristics affecting Operation- AEGEAN MOTORWAY

- Different carriageway patterns
  - 135 km of two lane motorway
  - 30 km of National Road with undivided carriageway
  - 65 km of three lane motorway with one C&C in urban environment
- National Road section characteristics
  - Very poor geometrical characteristics (min. total width 6,80m)
  - Extreme seasonality of traffic
  - Frequent rockfall phenomena
- Simultaneous snow falls possible along the entire stretch of 230km
Design & Construction Works – AEGEAN MOTORWAY

Infrastructure Interventions in Existing Sections:

• Paving (2,062,000 m² anti skid layer, 1,860,000 m² other layers) and marking (100% of the project)
• Repair and enhancement of guard rails (according to safety audit)
• Improvement of Park and Rest Areas & installation of toilets
• Construction of 2 OMCs, 2 MSS, 3 FTP, 3 RTP, 3 Police and 2 Fire Brigade buildings
• Cleaning of hydraulic works
• Installation of CCTV system and Emergency Telephones
• Rockfall protection works in Tempi Valley
• Everything completed 2.5 months ahead of schedule

New Section:

• Construction of 30 km motorway section including 11.5 km of tunnels (6 km + 3 km + 2.5 km).
• All construction traffic uses the existing national road section
“Special Case” of Operation Under Construction - AEGEAN MOTORWAY

- Operation for five months under extreme conditions “Tempi Rockfall”
- Project “cut in two” (transport of personnel, distribution of winter maintenance equipment)
- On top of that, occupation by farmers for three weeks
- Support of the State for the establishment of alternative routes (signage, supply of equipment to Police and Fire Brigade)
- Operation “outside the Project” (legal issues, insurance, signage, communication, responsibilities)
- Increased demand for driver information (call center, leaflets)
- Increased demand for equipment
- Standstill of Toll plaza operation (personnel issues)
First years operational results/performance - AE GEAN MOTORWAY

- AADT 22.500 along the busiest section (Katerini - Kleidi)
- 39 incidents per day [excluding toll violations]
- Response time of 50 minutes (no contractual obligation)
- Response time of subcontractors & authorities is 40 minutes
- 76 incoming calls per day
- 50 incoming written requests per month
- Response time to written requests 2 weeks maximum

Aegean Motorway accidents with injuries comparison

Fatal accidents
Accidents with injuries

400 employees permanent staff 24 hours per day
Design and Construction Works - MOREAS

- **Safety audit** (a contractual requirement) on the pre-existing Korinthos-Tripoli section (82 km), resulted in introduction of further improvements (in addition to those already stipulated)

- **Low-cost measures** taken immediately on operation commencement (March 2008): guardrails, marking, signing, drainage cleaning, pruning etc.

- **Refurbishment / heavy maintenance** of the Korinthos-Tripoli section (completed in 2010), including full resurfacing, provision of hard shoulder, partial realignment and construction of 2 new tunnels and 2\(^\text{nd}\) bore of existing Artemisio tunnel, plus Traffic & Toll System installation

- **Construction of new sections** towards Kalamata and Sparti. Already 31 km of new motorway are in operation.
Special characteristics affecting Operation - MOREAS

- Motorist habits developed over 16 years prior to concession (such as parking, walking, waiting for bus on the motorway)
- Seasonality of traffic (summer, weekends, Easter)
- Largely interurban (Athens-related) traffic; low trip frequency (few intra-regional commuters)
- On completion of project, a second (satellite) Operation and Maintenance Centre will serve as a base for the southern half of the motorway, to rationalize use of resources
- Extended area with altitude >500m relatively susceptible to winter weather
Operation Under Construction - MOREAS

- This phase lasted during the first two years of the concession period (2008 to 2010) and affected the pre-existing Korinthos-to-Tripoli section.
- Moreas was fortunate in having already a dual carriageway cross-section. Works were typically performed across one-half of each carriageway.
- Queuing incidents proliferated during the “operation-under-construction” phase, but there was no adverse safety impact.
- Special arrangements were made for the Artemisio tunnel, where the new bore was completed first and temporarily served two-way traffic during refurbishment of the old bore (late 2009).
First years operational results/performance - MOREAS

- AADT 10.500 per direction along the busiest section (Korinthos to Spathovouni)
- 20 incidents per day [excluding toll violations]
  - 80% immobilized vehicles & obstacles, the rest (20%) are accidents, traffic congestion, incidents in tunnel, etc.
- Average response time (2008 to date) at 16 minutes
- Average response time of subcontractors & authorities (2008 to date) at 27 minutes
- Maintenance:
  - 41 road infrastructure damages per month (22% signing, 47% barriers and fencing)
  - 73 EEM damages/failures per month (53.7% toll system, 18.4% EEM in tunnels, 9.5% EEM in open sections)
  - 91% of all damages repaired within a month - 41% during the same day
- 4 incoming calls per day (not including the emergency response number 1866)
- 13 incoming written requests per month
- Response time to written requests: 3 days

Average response time (min)

- AMBULANCE: 21
- FIRE BRIGADE: 21
- TRAFFIC POLICE: 21
- HV RECOVERY UNIT: 16
- EXRPESS SERVICE: 25
- MOREAS: 45

MOREAS accidents with injuries comparison

- Fatal accidents
- Accidents with heavy injuries
- Accidents with light injuries

180 employees permanent staff 24 hours per day
Conclusions

The cooperation of private and public sector in managing road infrastructure projects contributes to improving road safety and specifically:

on the level of construction by:

• Implementing Road Safety Audits in all stages
• Systematic efforts to improve the worksite arrangements
• Maintain/ secure the necessary equilibrium between LOS (traffic flow, safety) & constructability
• Utilizing the operation experience in design/construction issues

on the level of operation by:

• Enhanced monitoring of the road network (24h a day, 365 days a year)
• Quicker detection and response to incidents and problems
• Improving coordination among the involved parties
• Immediate dealing with many “routine” incidents so they don’t escalate to serious accidents – reduction of secondary accidents
• Ensuring the means and saving resources for the state services, in order to concentrate on their duties (Policing and Fire Fighting)
• Exploitation and extensive use of new technologies and systems
• Provision of new services to the drivers (road assistance, information etc.)
• Contribution to providing a safer road environment
• Setting up and monitoring specific LOS standards and operational criteria (KPI’s)