Prof. Dr. GERNOT BEER

Personal Details

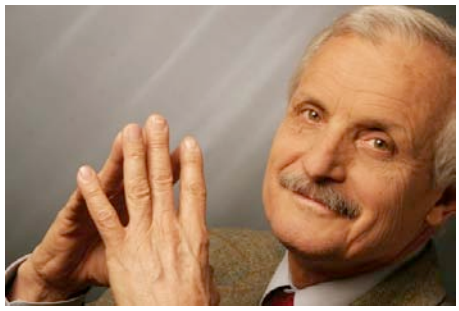
Address: 2/12 Magnus Street
Nelson Bay, NSW 2315

Telephones: Mobile: +61 (0)447921182

E-Mail: gernot.beer@tugraz.at

Date of birth: August 14, 1944

Nationality: Austrian, Australian permanent resident



Education

1976	Graz University of Technology	Dr.techn.
1973-76	University of Queensland, Australia	PhD in Civil Engineering
1971-72	Lehigh University, U.S.A.	Master of Science, Civil Engineering
1964-69	Graz University of Technology	Diplom Ingenieur (Dipl.Ing.), Civil Engineering

Awards

1971-72 Fulbright Fellowship

1996 European Academic Software Award for the development of RuckZuck teachware

2009 "European Champion of Research" award from the Austrian ministry of science.

2010 European Commission nominates project TUNCONSTRUCT for the best project award given for the best projects in the 7th framework program (spanning 5 years).

2012 Selected as one of 16 persons that influenced sustainable development at the Graz University of Technology over a period of 6 years. (Book "Initiators of sustainable development at the TU Graz" published)

2015 Distinguished lecturer award from the University of Queensland.

Employment History

2012- Emeritus Professor, Graz University of Technology, Austria

2011-2017 Conjoint Professor, University of Newcastle, Australia

1993-2012 Professor of Structural Analysis, Faculty of Civil Engineering, Graz University of Technology

1993-2012 Head of Institute, Institute of Structural Analysis, Graz University of Technology

1985-93 Senior Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Division of Geomechanics, Australia

1978-85 Senior Research Fellow, Department of Civil Engineering, University of Queensland, Australia

1975-78 Associate, Technische Datenverarbeitung (TDV), Graz, Austria

1972-75 Lecturer in Civil Engineering, Queensland Institute of Technology, Australia

1971-72 Research Assistant, Department of Civil Engineering, Lehigh University, USA

Languages

German, English, Spanish

Summary of achievements

Professor Beer is an internationally recognised expert in numerical simulation, rock mechanics and underground excavation. He continues to be involved in research and is currently coordinating a project funded by the Austrian Science Fund. Since becoming emeritus Professor in 2012, his research output has increased significantly. In 2015, two papers authored and co-authored by him appeared in the journal *Computer Methods in Applied Mechanics and Engineering,* which has one of the highest impact factors (3.0) of engineering journals. A further paper is being prepared for this journal to be submitted in May 2015. He has also recently finished a book on "Advanced numerical simulation methods", which was commissioned by Taylor&Francis and is due to appear in August 2015.

His main contributions are in the advancement and application of simulation methods, starting with Finite and Boundary Element methods and most recently isogeometric methods. In 2013 he organised a short course on "Isogeometric methods for numerical simulation" at the International Centre for Mechanical Sciences (CISM) in Udine, Italy which was very well attended. He has recently become involved with the research group of Tom Hughes at the University of Texas, Austin and it is planned that one of his PhD students in Graz will spend some time as a postdoc at this institution after his graduation.

Throughout his career he has been extremely successful in acquiring and managing research projects, with a total budget of over 31 Million Euros (a list of project follows later). He was the technical coordinator of the EC project "Technology Innovation in Underground Construction" (TUNCONSTRUCT), one of the largest integrated projects of the European framework for research and development. The project involved 40 partners from 11 European countries. It integrated not only on-the-field engineering experience and technical know-how of the industry, but also research capabilities and conceptual innovation of the academic sector. The project received an excellent evaluation (see www.tunconstruct.org) and was shortlisted for the best project award.

He is the author or co-author of 5 books, editor of 4 books and has made 12 contributions to books, authored over 40 journal articles and 50 publications in conference proceedings. He has been invited to present 7 plenary and 7 keynote lectures. He has organised 4 mini-symposiums and given 3 short courses at international conferences. In 2007 he was a VIP speaker at a symposium organised by the Hyundai Engineering Corporation in South Korea and in 2010 he was the main speaker at a symposium organized by the British Tunnelling Society. He will be a keynote speaker at the Coupled conference in May 2015. In 2011 he was invited together with Prof G. Gioda to be the editor of a special issue of the ASCE Journal of Geomechanics.

He has acted as a reviewer for many research funds including:

- ARC
- University Grants Committee, Hong Kong
- German research fund (DFG)
- British Council, UK
- European Research Council (ERC)

In 2011 he was invited to be a member of an international panel to review the teaching and research at the Aalto University in Finland.
He has acted as reviewer for many journals including:

- International Journal for Numerical Methods in Engineering

- Computers and Geotechnics
- Engineering Analysis with Boundary Elements
- Engineering Structures
- Computational Mechanics
- Computer Methods in Applied Mechanics and Engineering

and reviewed book proposals for the following publishers:
- J. Wiley (12 proposals)
- CRC press (3 proposals)
- Cambridge University Press (1 proposal)

He has consulted with the many companies including:
- Geoconsult, Austria
- Lahmeyer International, Germany
- Hyundai Engineering, Korea
- Golder Associates, Canada
- Golder/Grundteknik, Sweden
- Chamber of Mines, South Africa
- Nepal Electricity Authority

He has been involved as an adviser in numerical modelling at a number of projects around the world including:
- Caverns for the Large Hadron Collider at CERN, Switzerland
- Goldisberg Underground Power Station, Germany
- Semmering road tunnel, Austria
- Underground power stations in Nepal and Iran

In 2007, he was together with Prof. Ted Brown a member of an international panel to review excavation procedures at the Masjed-e-Soleiman Underground Hydroelectric Power Plant in Iran.

Funded Research Grants since 1997 (***** Coordinator)

Date	**Title and funding body**	**Amount awarded**
1997-2002	* *Joint Research Initiative "Numerical Simulation in Tunnelling*", Austrian National Science Fund (FWF).	€ 2 000 000
2001-2004	* *Virtual Real Time Fire Emergency Simulator (VIRTUAL FIRES*), European Commission, IST Programme.	€ 1 600 000
2001-2005	*Fire in Tunnels Thematic Network (FIT)*, European Commission, GROWTH Programme.	€ 23 000
2002-	*Safety in Tunnels (SafeT*), European Commission, GROWTH Programme.	€ 92 000
2002-2006	* *Numerical Simulation of Tunnel Advance with the Boundary Element Method*, Austrian National Science Fund (FWF).	€ 230 000
2003-2005	* *Europe-Latin American Boundary Element Network (ELBENet)*	€ 190 000
	European Commission, ALFA	
2005-2008	*Soil-structure interaction in the time domain using the BEM,*	
	Austrian National Science Fund (FWF).	€ 102 000
2005-2009	* *Technology Innovation in underground construction*	

	(TUNCONSTRUCT), Integrated Project, European	
	Commission, NMP Programme, Total budget:	€ 26 000 000
2006-2009	* *Modelling of ground support in tunnelling with the BEM*	€ 300 000
	Translational research project, Austrian National Science Fund (FWF).	
2009-2012	* *Adaptive method coupling*	
	Translational brainpower project, Austrian Science Fund (FWF)	€ 300 000
2009-2012	*Safety of European road network (SERON)*	
	Project, European Commission, ICT & Security Programme	€ 200 000
2010-2014	* *Numerical simulation in technical sciences (NUMSIM)*	
	Marie Curie grant, European Commission, IRSES Programme	€ 246 000
2012-2015	* *Fast isogeometric Boundary Element Methods*	€ 330 000
	Austrian National Science Fund (FWF)	

Career-best publications

1-4. Books:

Beer, G. Advanced numerical simulation methods - From CAD Data directly to simulation results. CRC Press, 2015.
I was commissioned by CRC Press to write this book, which will be published in June 2015. The book contains new developments in numerical simulation techniques and novel approaches to achieve a seamless integration of CAD and simulation.

Beer, G., Smith, I.M., Duenser, CH. The boundary element method with programming, Springer, Wien-New York, 2008.
Citations: 129
This is a second edition of my previous book (see below) containing many new developments, such as parallel processing, dynamics, handling of inclusions, non-linear material behaviour, and piezo-electricity. The emphasis is on explaining the theory and computer code is not presented for all topics.

Beer, G. Programming the boundary element method. John Wiley & Sons, Inc., 2000.
Citations: 222
This book gives an introduction to the Boundary Element Method with emphasis on programming. This book is ideal for any reader wishing to work in this field or use this method for the solution of engineering problems. From the beginning, the emphasis is on the implementation of the method into computer programs. The book covers two-and three-dimensional linear and non-linear analysis in potential flow (heat flow and seepage) and static elasticity. The book is very popular among students, engineers and scientists, since it includes several computer codes.

Beer, G., Watson, J.O. Introduction to finite and boundary element methods for engineers. Wiley, New York, 1992.
Citations: 285
This is my first book that discusses both the Finite Element Method and the Boundary element Method, which pays equal attention to both methods and gives the necessary theory behind each. The book is very popular among students, engineers and scientists since it uses simple engineering terms to describe which types of problems can best be solved with each method, combining the two and the applications for which this might be suitable.

5. Paper:

Beer, G., Marussig, B. and Zechner, J. A simple approach to numerical simulation with trimmed CAD surfaces. Computer Methods in Applied Mechanics and Engineering, **285**, 776-790, 2015.
*ERA 2010 Journal Ranking: A**
This paper appeared in a high impact journal (5 year impact factor: 3) and received very positive comments from reviewers. It deals with a novel method to convert trimmed surface information from CAD programs to analysis suitable information.

6. Paper:
Marussig, B., Zechner, J., **Beer, G**. and Fries, T.P. Fast isogeometric boundary element method based on independent field approximation. Computer Methods in Applied Mechanics and Engineering, **284**, 458-488, 2015.
Citations: 2
*ERA 2010 Journal Ranking: A**
This paper deals with the implementation of the isogeometric BEM using Hierarchical matrices, to achieve fast computation. The concept of geometry independent filed approximation was first introduced here. This is a result of an Austrian research project with one PhD and one Postdoc, that I am coordinating.

7. Paper
Pereira, A., **Beer, G.** Interface dynamic stiffness matrix approach for three-dimensional transient multi-region boundary element analysis. International Journal for Numerical Methods in Engineering 80, p. 1463 – 1495, 2009.
Citations: 9
*ERA 2010 Journal Ranking: A**
This paper contains approaches on coupling BEM regions in the time domain.

8.-11.- Papers on infinite elements

Beer, G. Mapped infinite patches for the NURBS based boundary element analysis in geomechanics. Computers and Geotechnics, 66:66–74, 2015.
Moser, W., Duenser, Ch. and **Beer, G.** Mapped infinite elements for three-Dimensional multi-region boundary element Analysis. International journal for numerical methods in engineering 61, p. 317-328, 2004.
Citations: 27
*ERA 2010 Journal Ranking: A**
Beer, G., Watson, J.O. Infinite boundary elements. International Journal for Numerical Methods in Engineering, 28, 1233-1247, 1989.
Citations: 65
*ERA 2010 Journal Ranking: A**
Beer, G., Meek, J. 'Infinite domain' elements. International Journal for Numerical Methods in Engineering, 17, 43-52, 1981.
Citations: 170
*ERA 2010 Journal Ranking: A**
The original paper on infinite finite elements published in 1981 was one of my most cited papers at the time. I developed the idea further for application to infinite boundary elements and most recently to isogeometric BEM.

Technology Innovation in Underground Construction

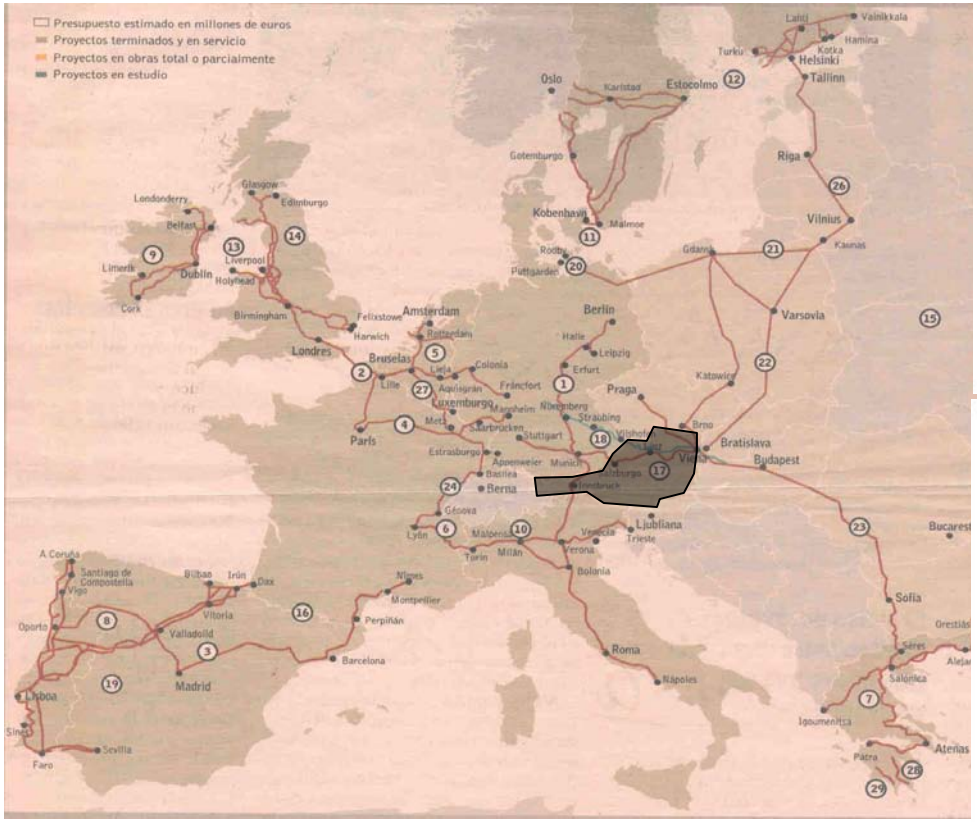
Gernot Beer ,

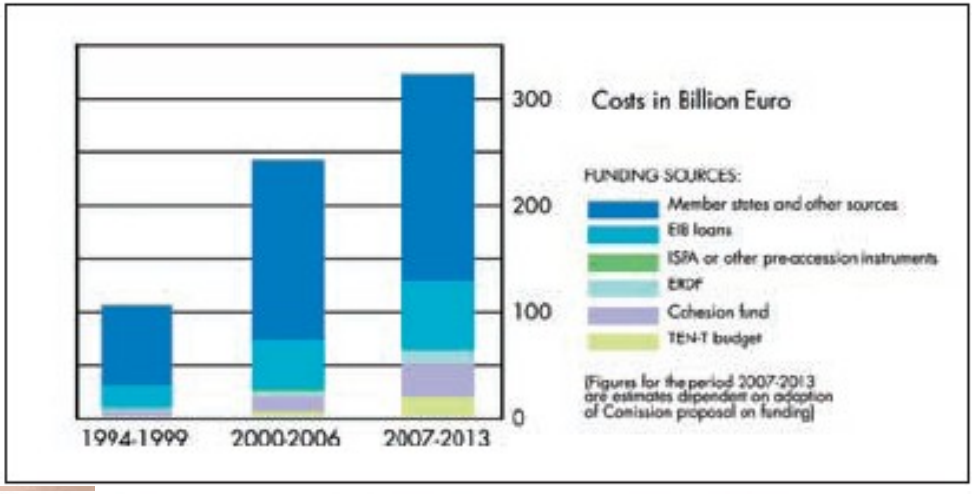
Institute for Structural Analysis, TU Graz, Austria

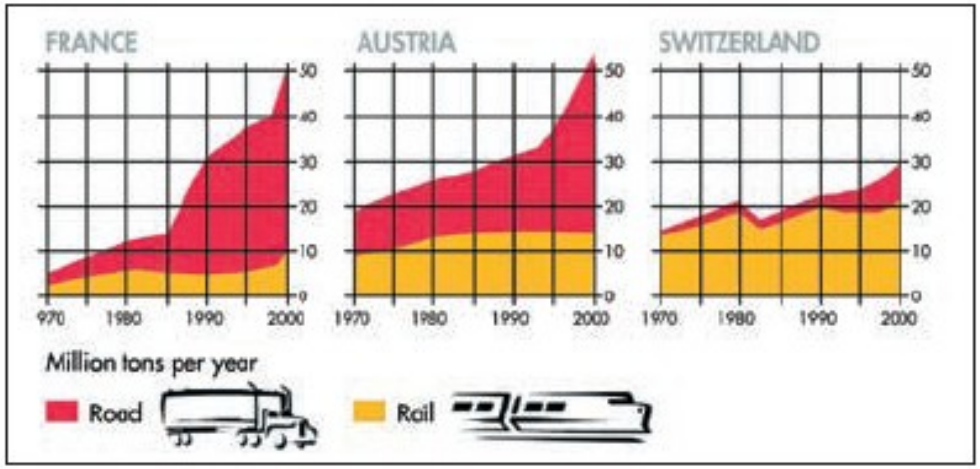
Motivation

Underground construction will increase significantly in the future

Trans European Network – Transportation (TEN-T)







Motivation

Major tunneling projects in Europe

Tunnel Project	Length[1]	Location	Construction		Construction Budget[2]
			Start	End	
Brenner basis	55	Austria, Italy	2010	2020	9.000
Koralm	33	Austria	2008	2016	4.000
Semmering	22	Austria	2009	2018	2.600
Lyon-Turin	52	France, Italy	2009	2019	7.600
Total	**162**				**23.200[2]**

[1] In Kilometres. [2] In Million €.

Source: Datanet.

Motivation

- Many cities suffer from pollution.

The acceptable levels of fine dust pollution (as specified by the EC) caused by traffic have been exceeded many times in Graz last winter. Fine dust has been identified as a cause for cancer and many respiratory diseases.

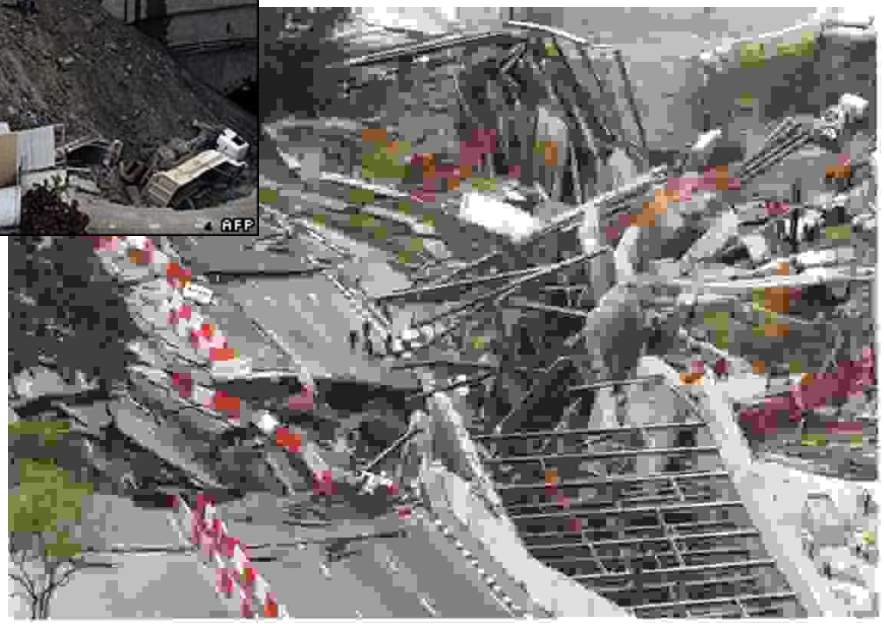
Imagine the city of tomorrow

Motivation

Underground construction is in many cases to expensive and risky

Sao Paulo

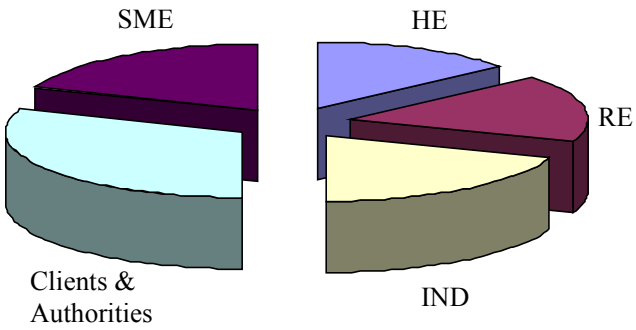
Taiwan

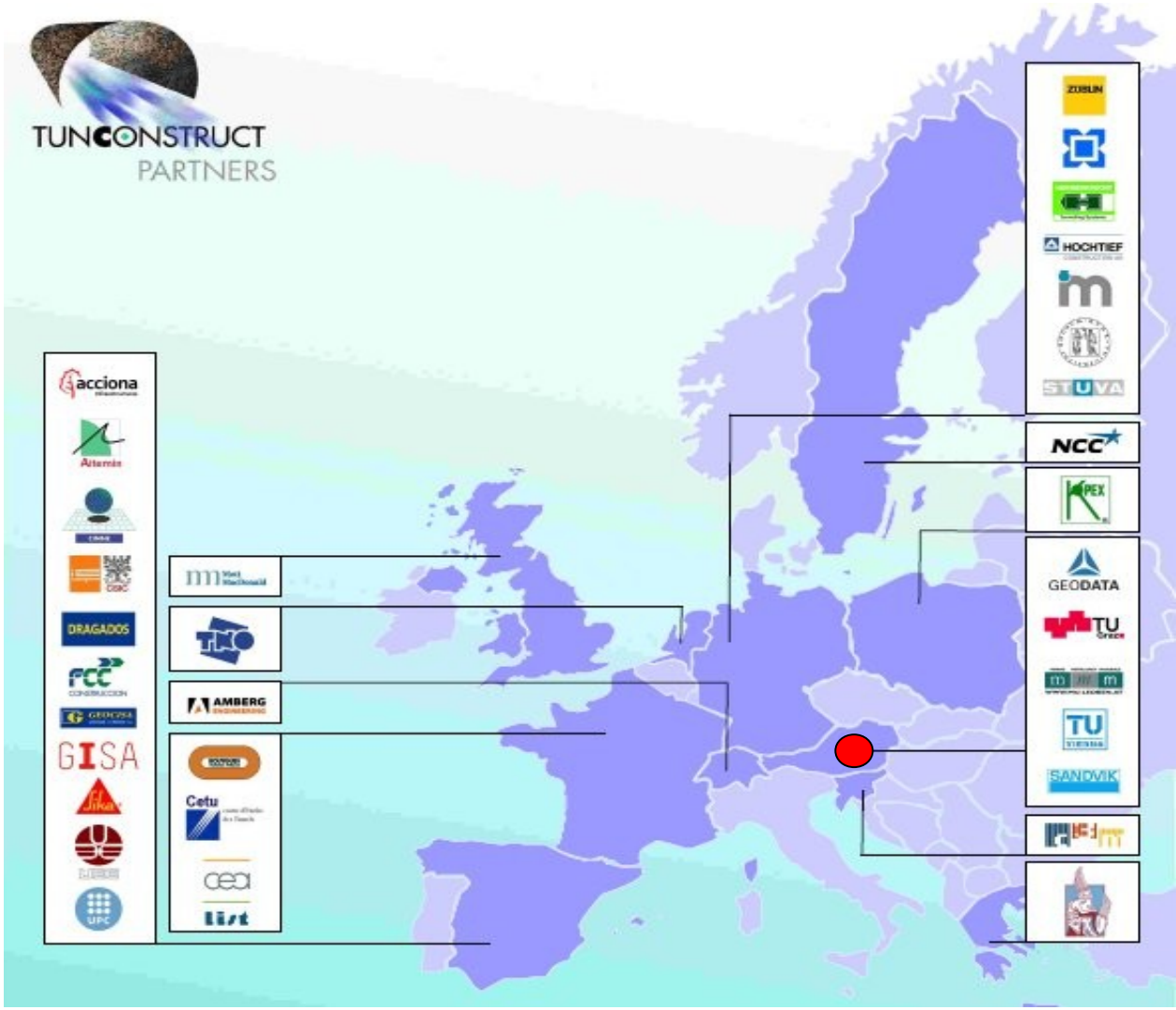


Singapore

TUNCONSTRUCT Consortium

33 Partners
+ 7 Clients





Budget (4 years):
26 M€ (14 M€ EC contribution)
Start: 1. Sept 2005
End: 30.August 2009

Technology Innovation in underground construction (TUNCONSTRUCT)

Mission statement:

„ Underground construction will be safer and considerably **more efficient** than today and the effect on the environment will be significantly reduced. **Risks will be better known and managed**. This will lead to an increased use of underground space to the benefit of the European society”

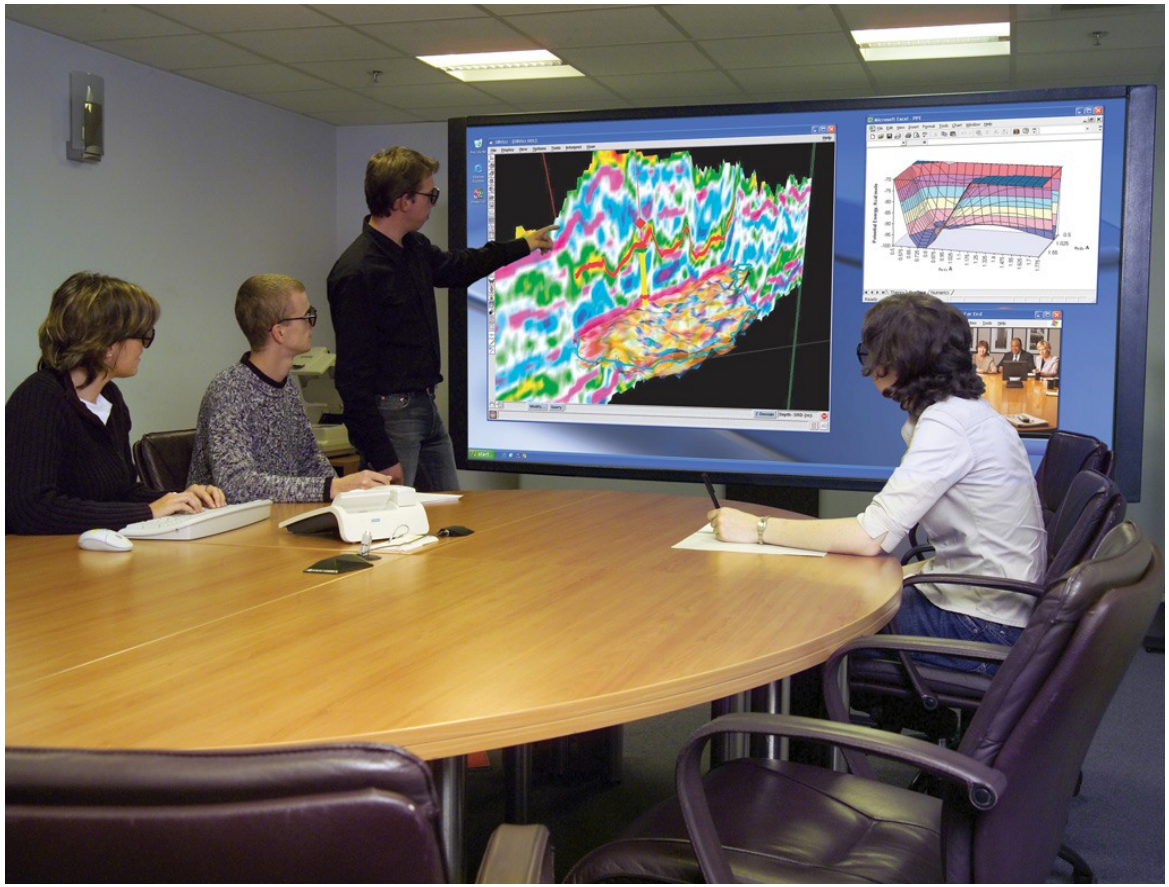
Efficiency

- Reduction of costs
- Consider all costs (exploration, design, construction, maintenance & repair)
- Reduce and mange risk

Through Innovation TUNCONSTRUCT will make radical improvements under the following main headings:

Design:

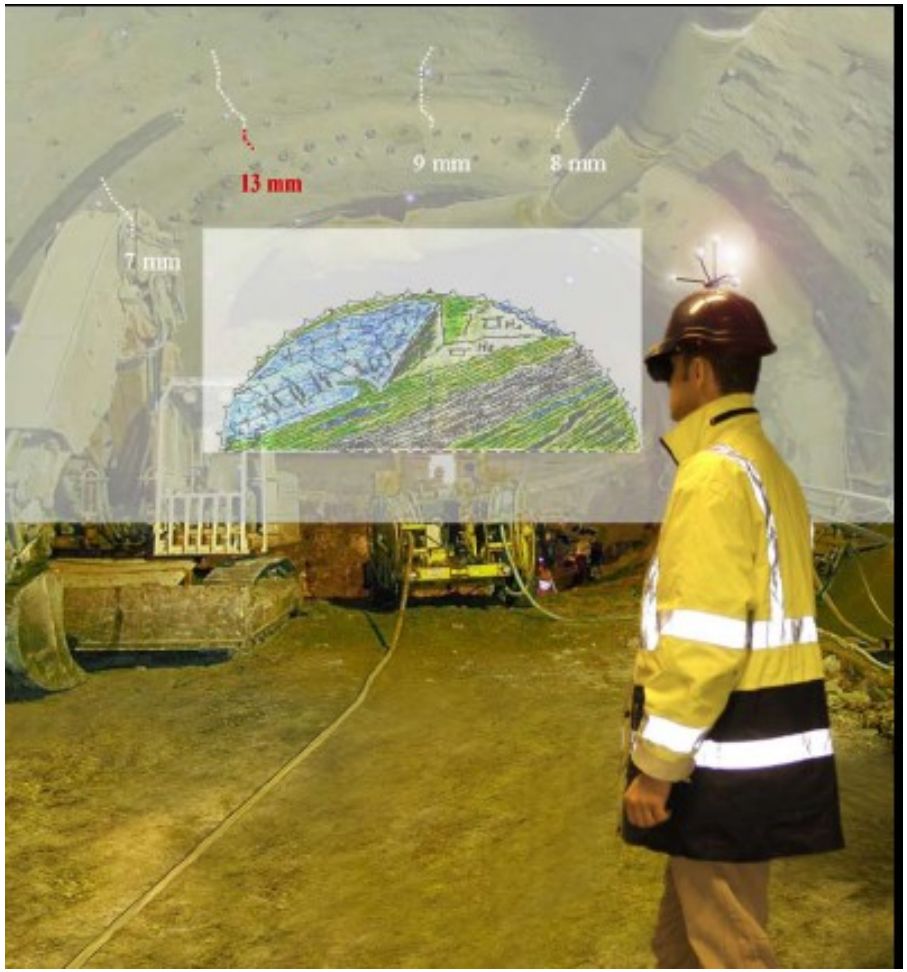
- Select alignment
- Select construction method
- Select construction sequence
- Select support measures



Through Innovation TUNCONSTRUCT will make radical improvements under the following main headings:

Construction Processes:

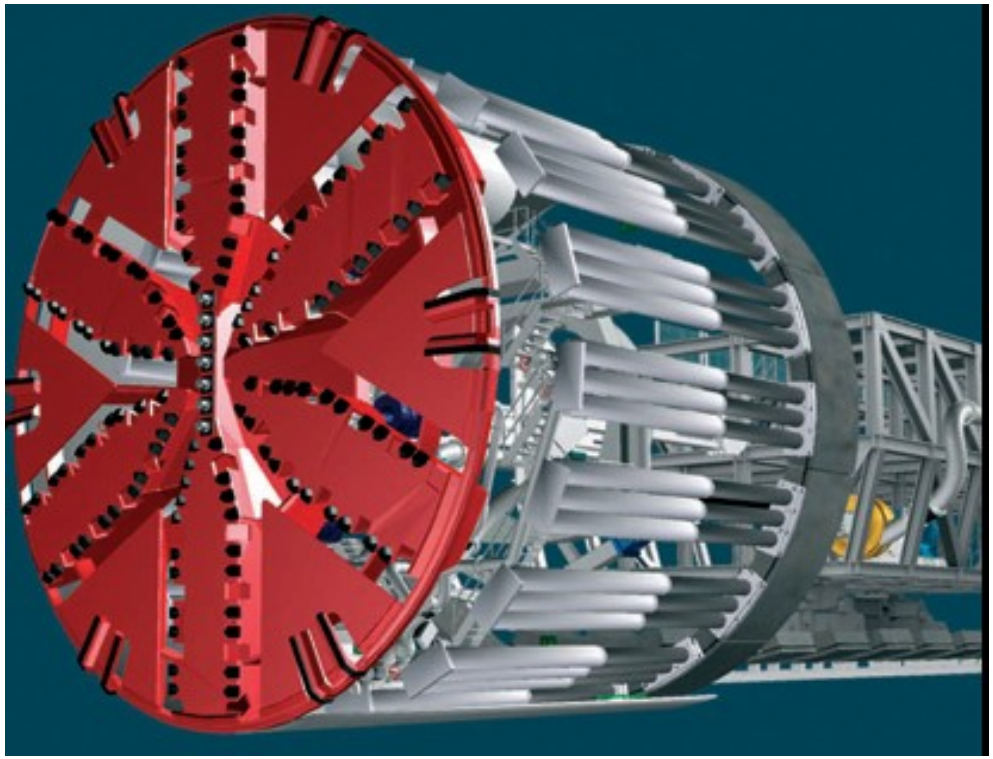
- Instant access to data
- Improve knowledge of geological conditions
- Monitoring
- Virtual training



Through Innovation TUNCONSTRUCT will make radical improvements under the following main headings:

Construction Technology

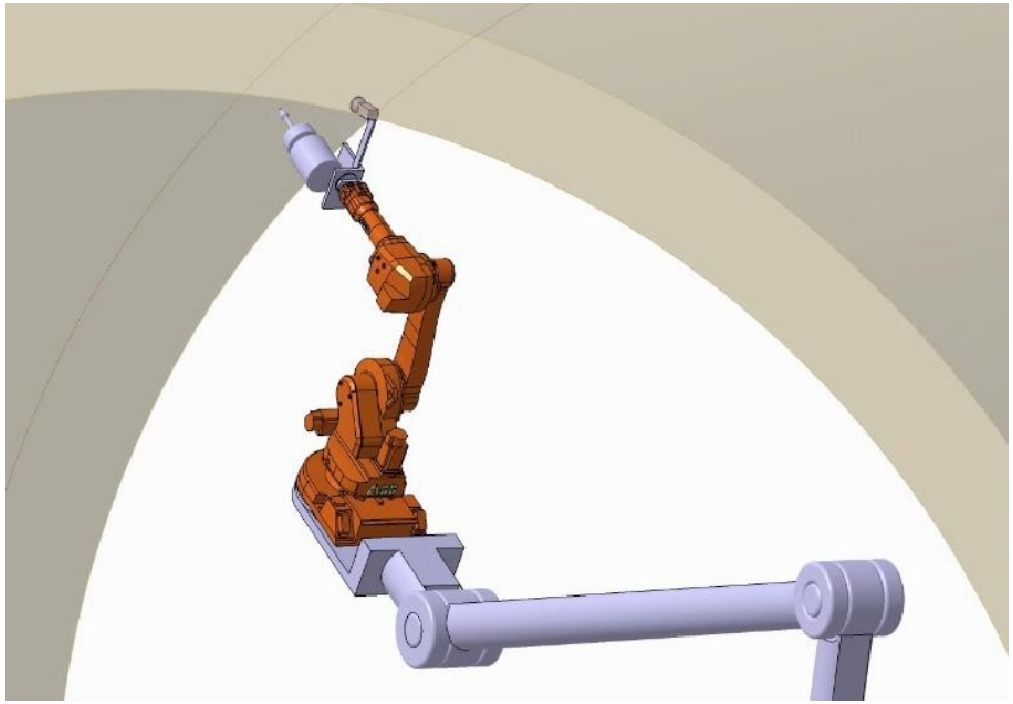
- Larger diameter TBM
- TBM for varying ground conditions
- Improvements in cutting technology
- Monitored disc cutters
- New shotcrete technology
- New materials for lining



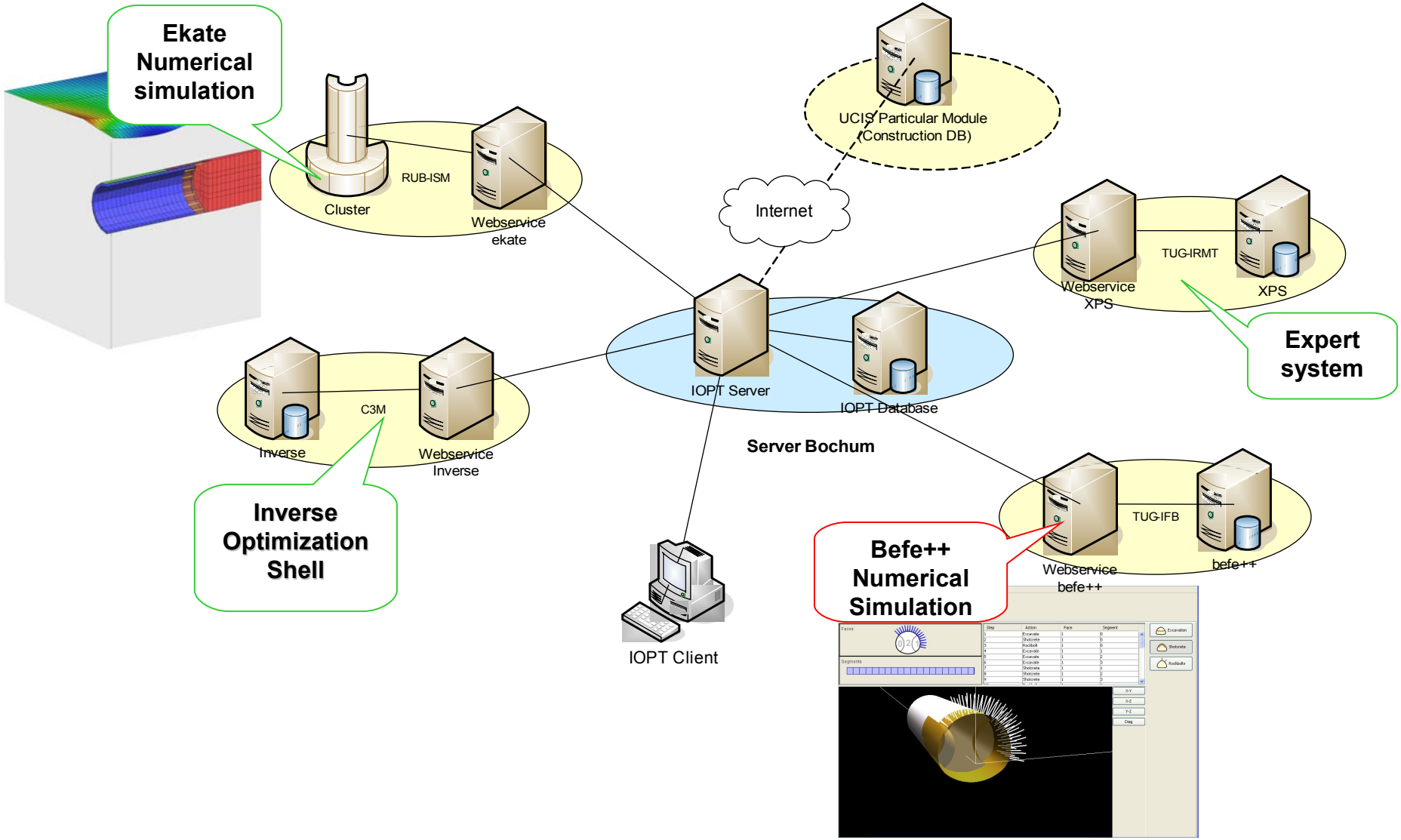
Through Innovation TUNCONSTRUCT will make radical improvements under the following main headings:

Maintenance and repair:

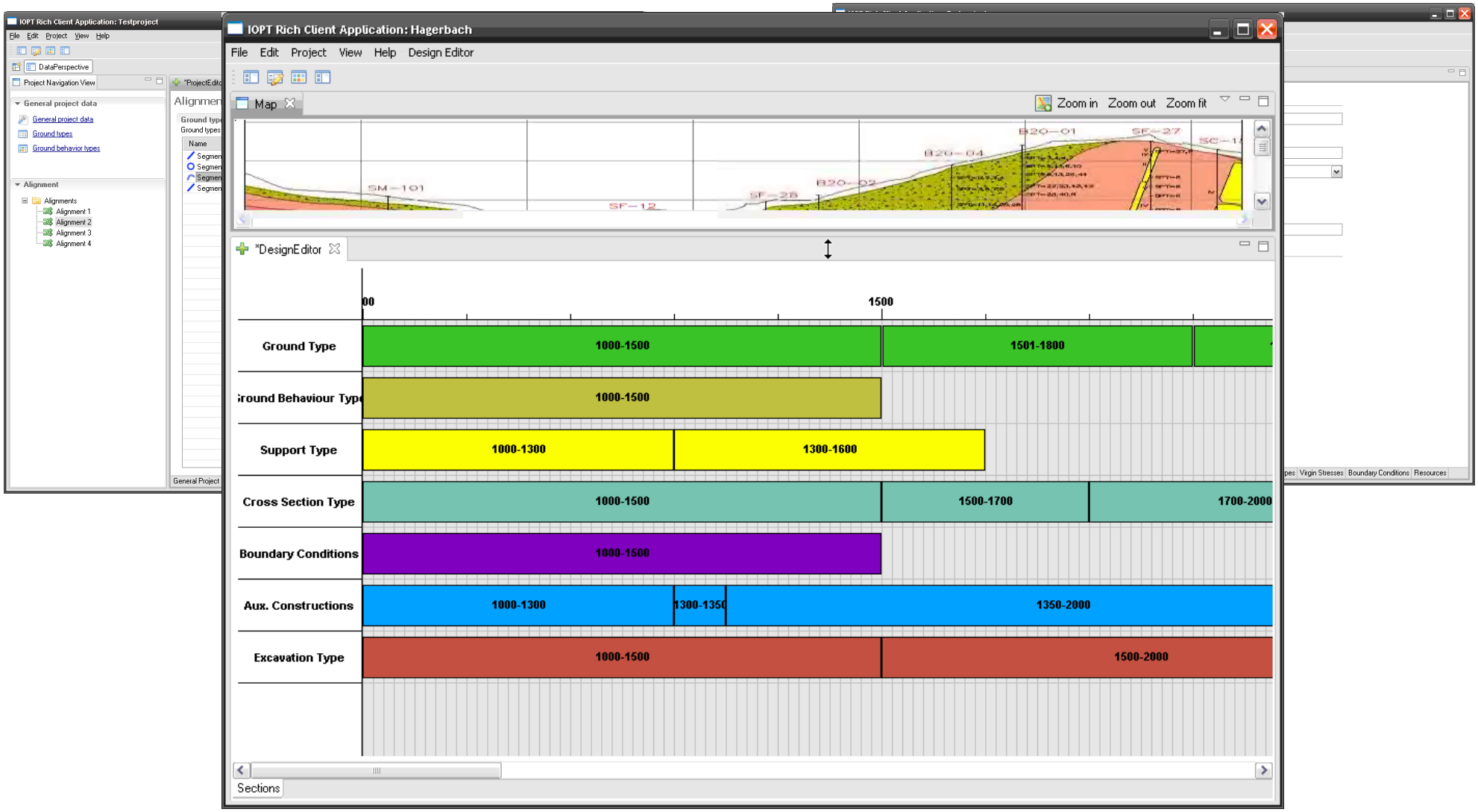
- Monitoring of structural state
- Life cycle analysis
- Repair with minimum disruption to traffic



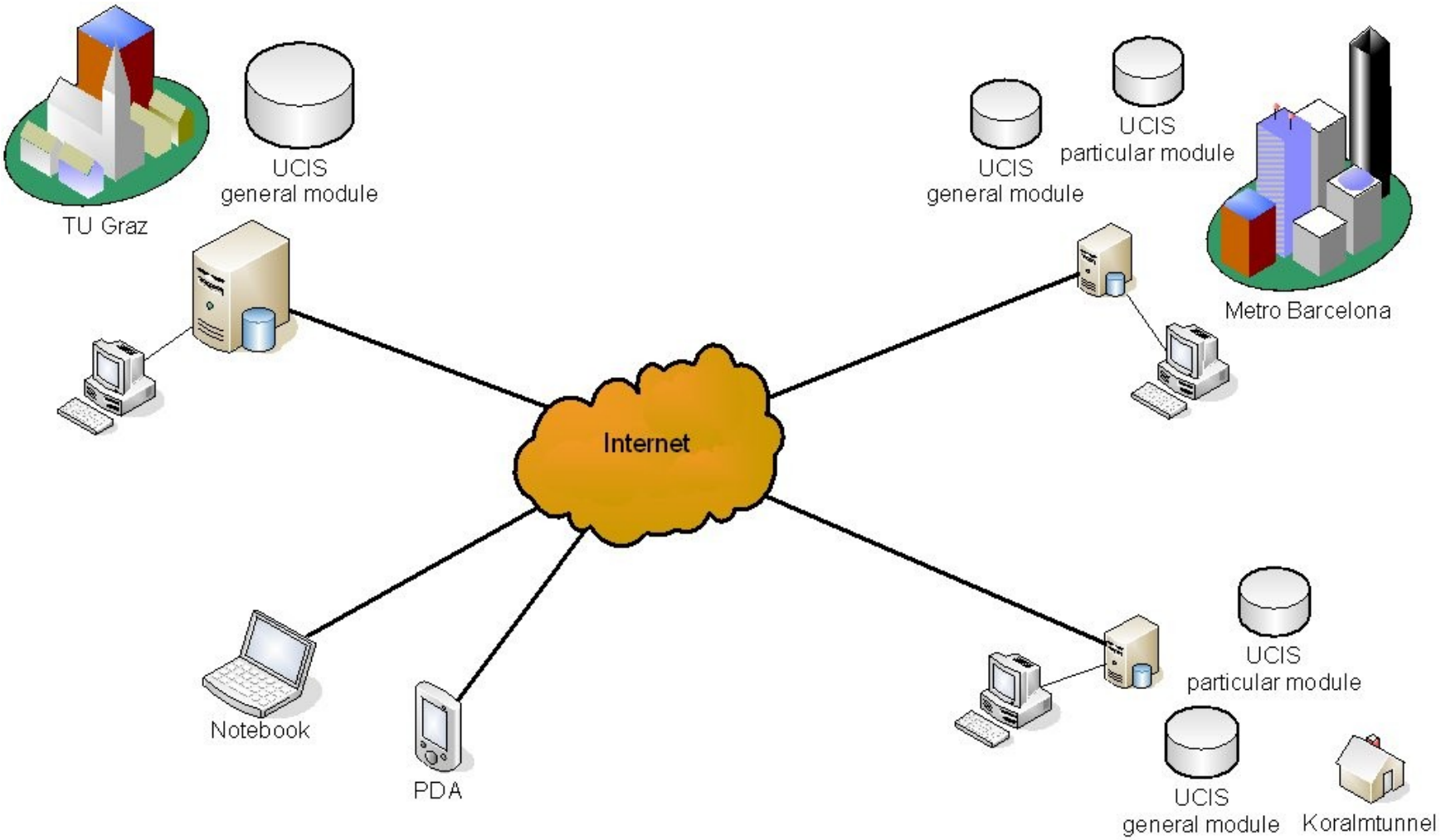
IOPT applies software integration via Web Services.



Development of the prototype IOPT client.

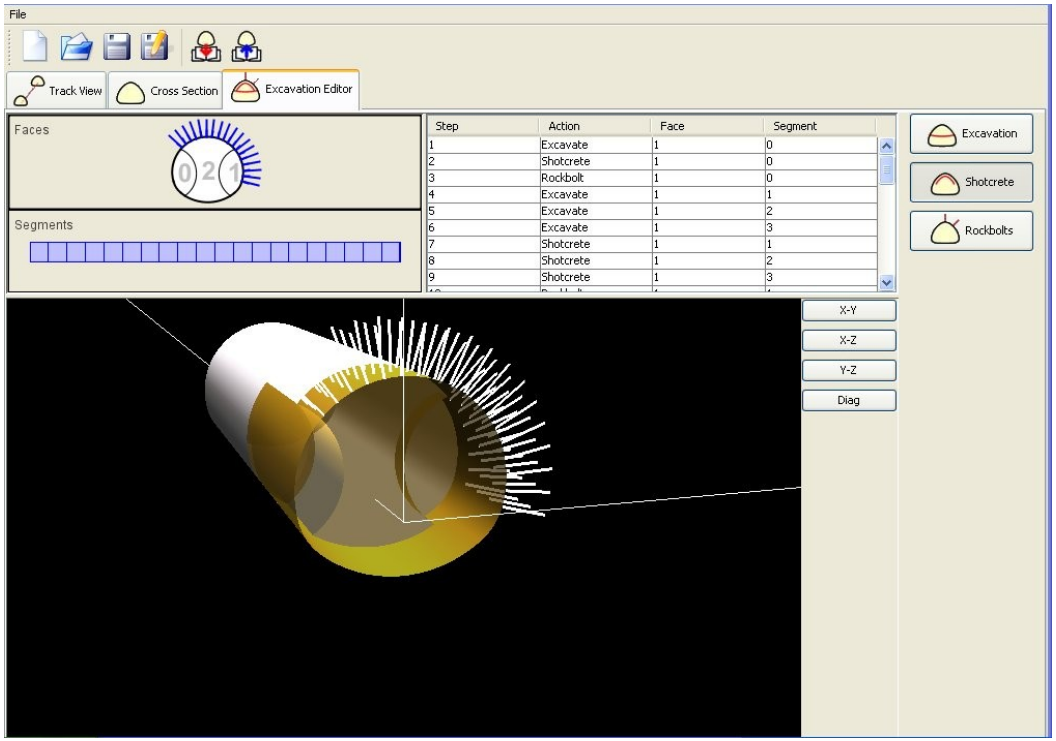


Underground Construction Information System (UCIS)



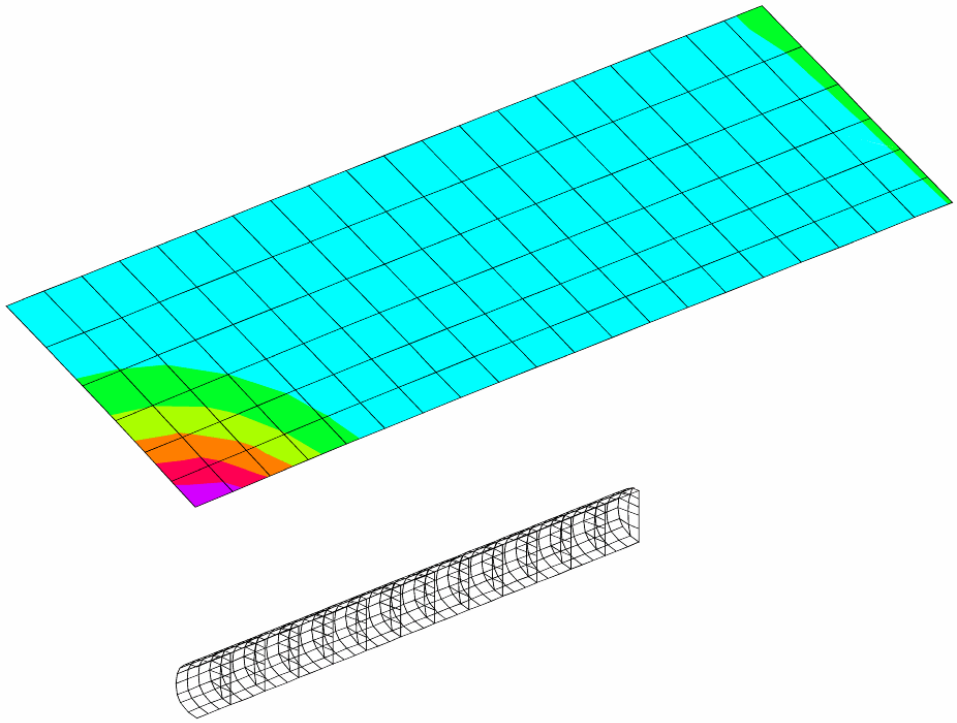
Simulation

Easier to use



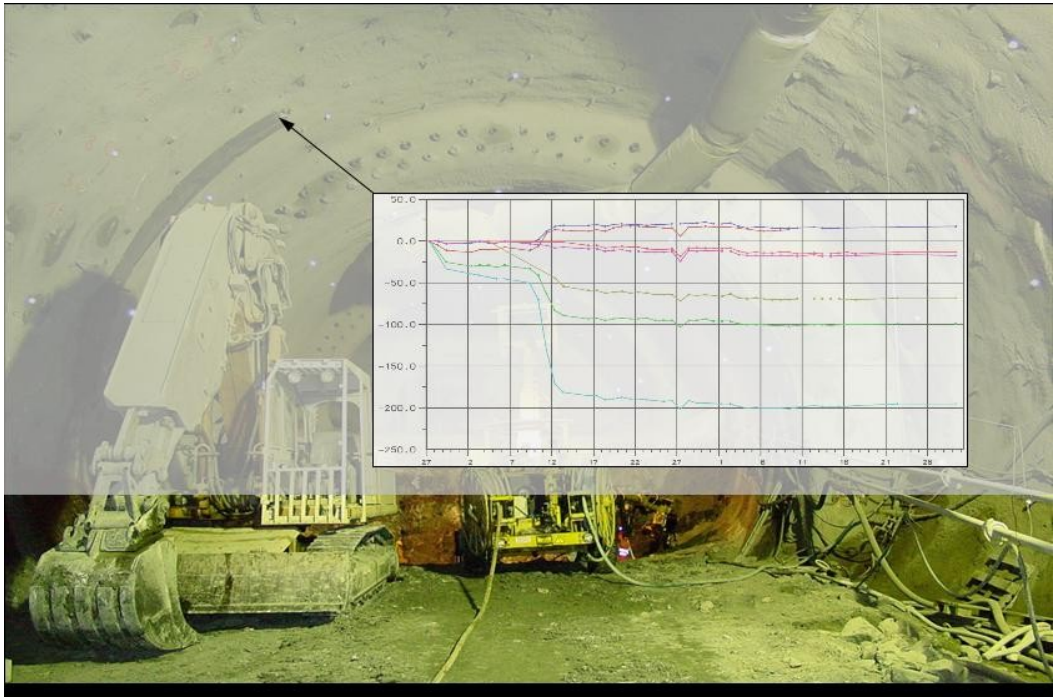
Simulation

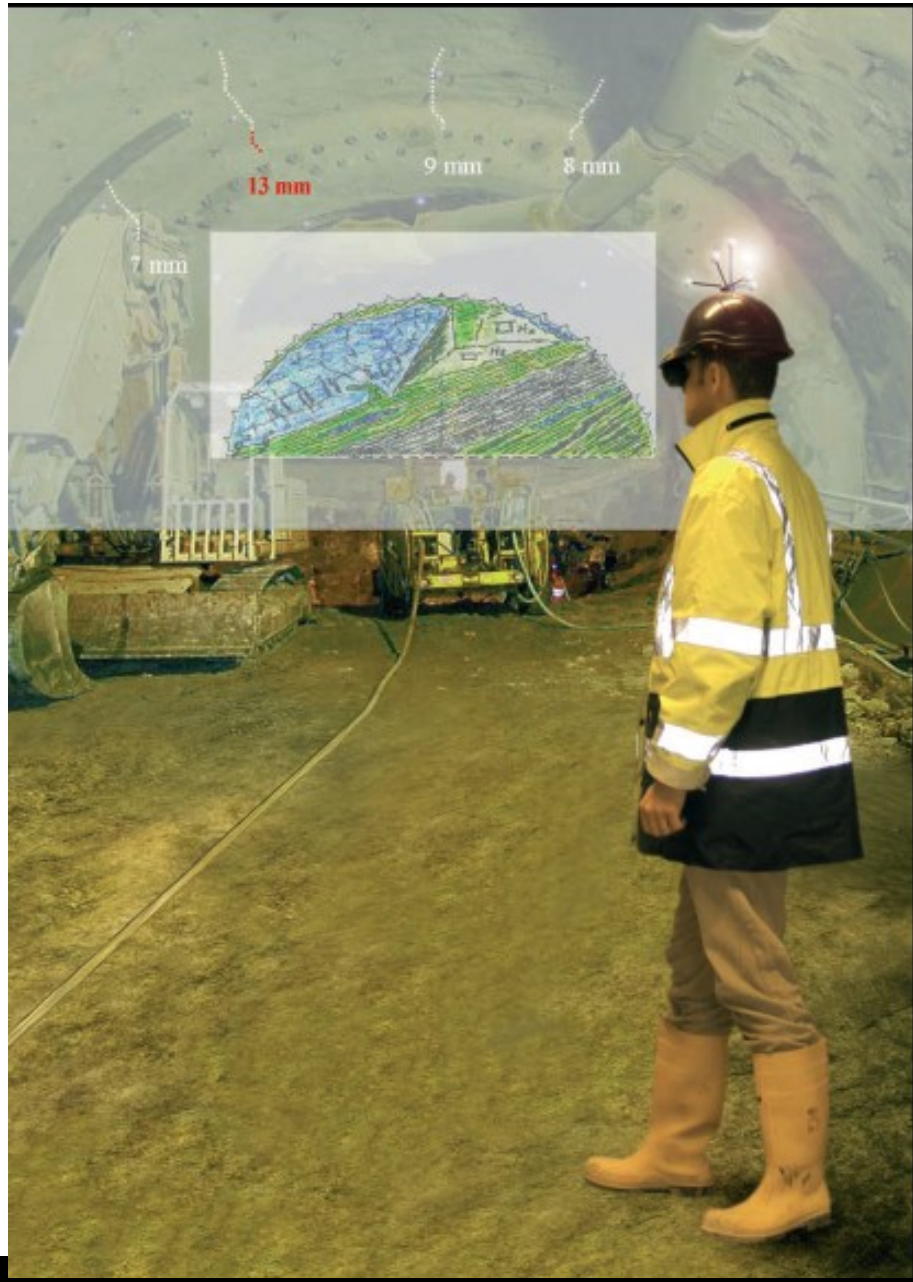
Faster: Towards realistic (3-D) real time simulation using the Boundary Element Method



Construction Processes

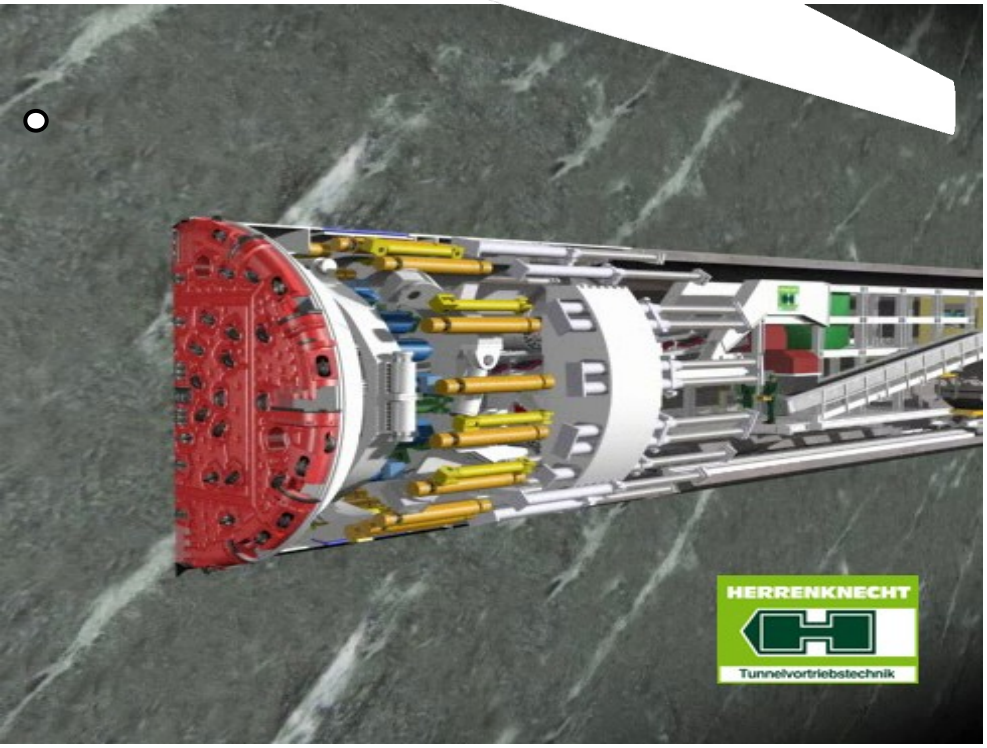
Instant access to all data via UCIS using augmented reality

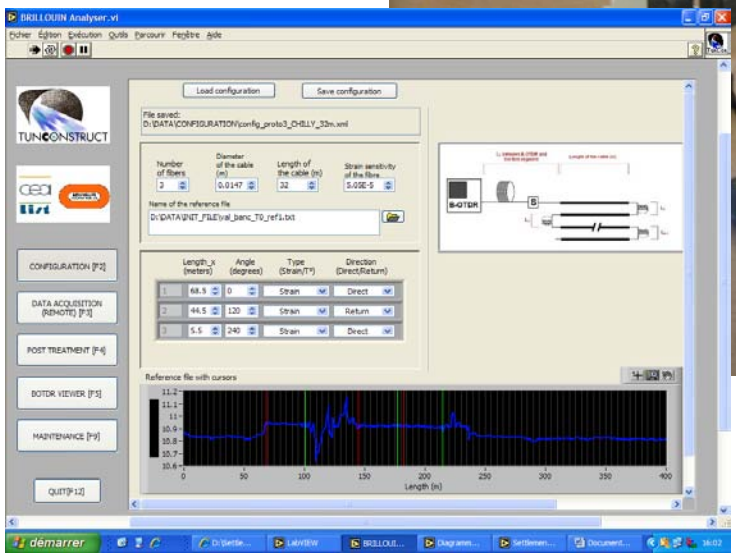




Construction Processes

- al time monitoring of ground
- ‘ via sensing cable





Construction Processes

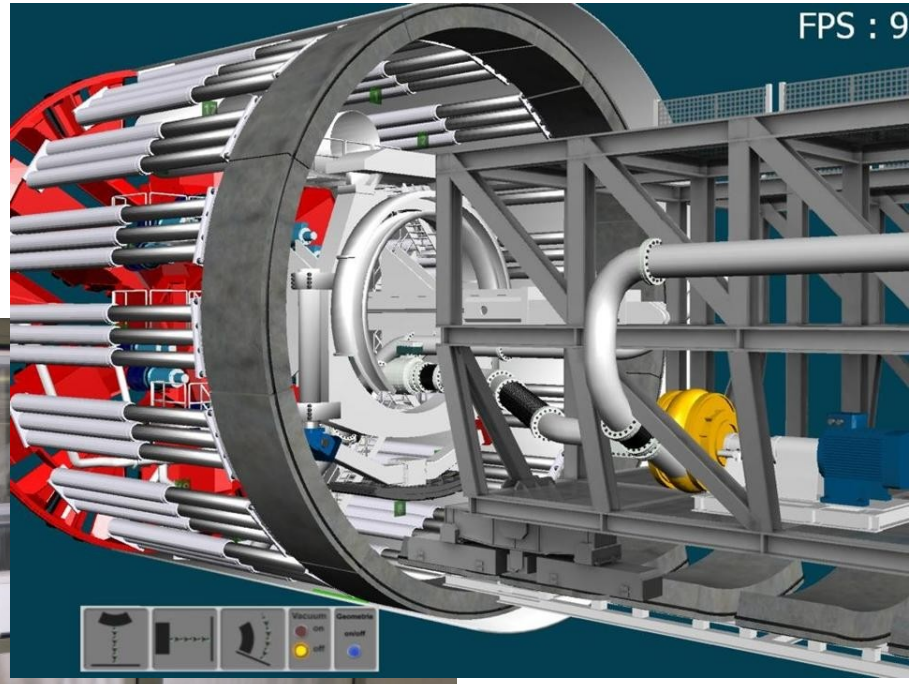
Use of horizontal drilling:

Sensing cable installation

Grouting

Construction Processes

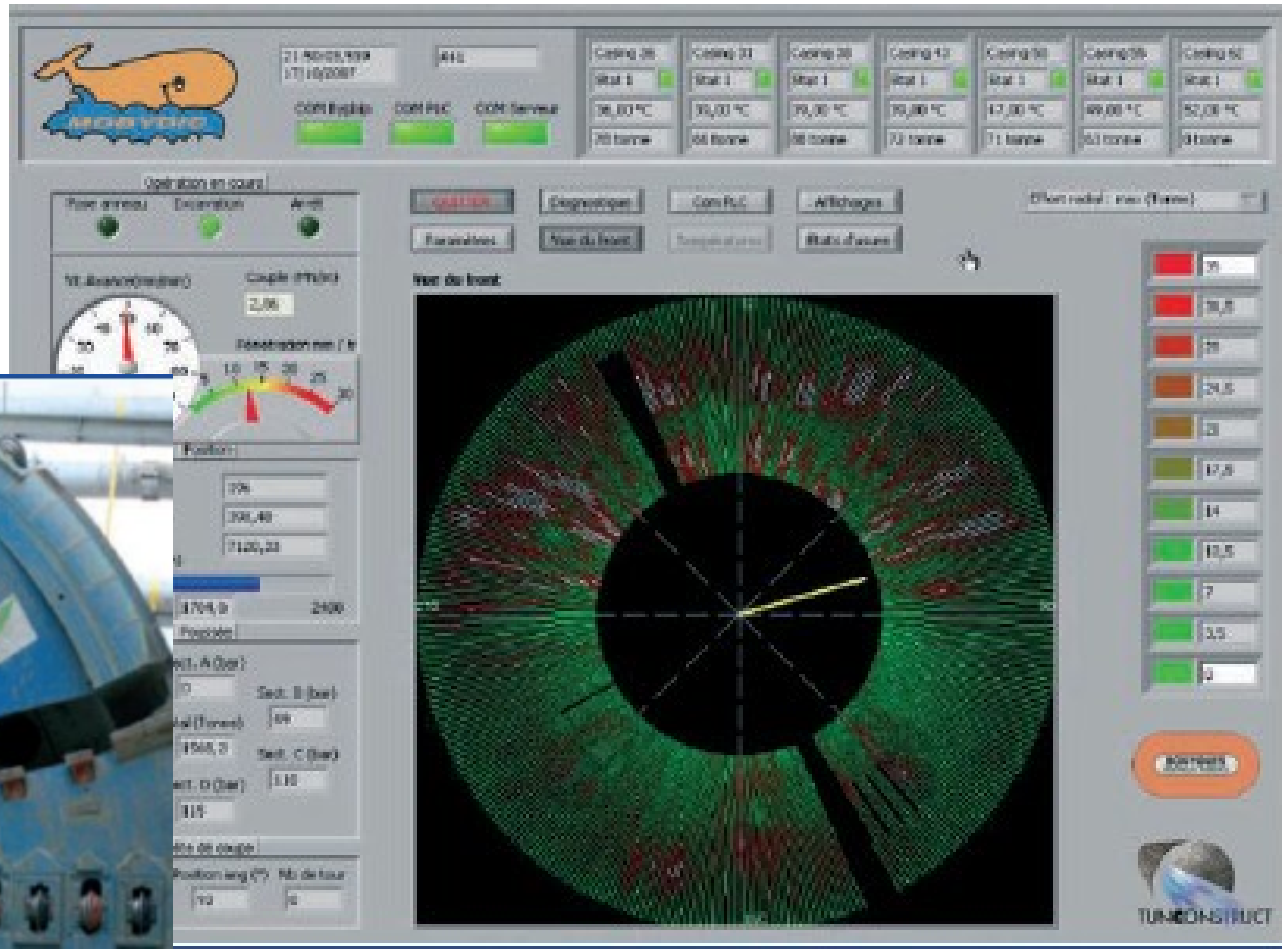
Training of personnel in the placing of segments



Construction Technology

Monitored disc cutters:

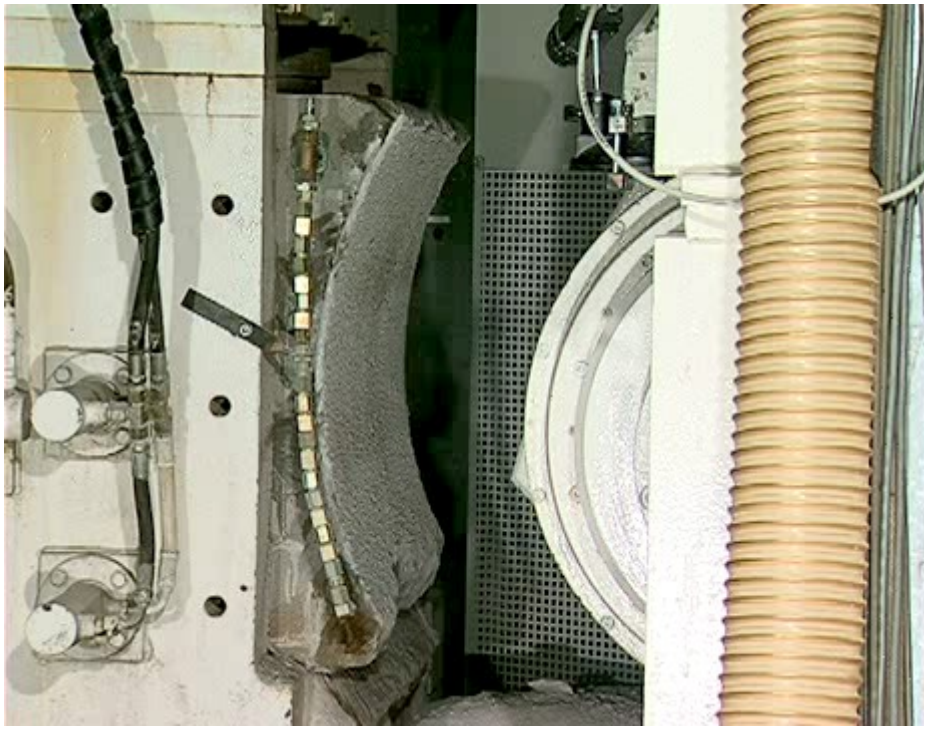
- Prevent damage
- Optimize tool change
- Use to “sense” geological conditions

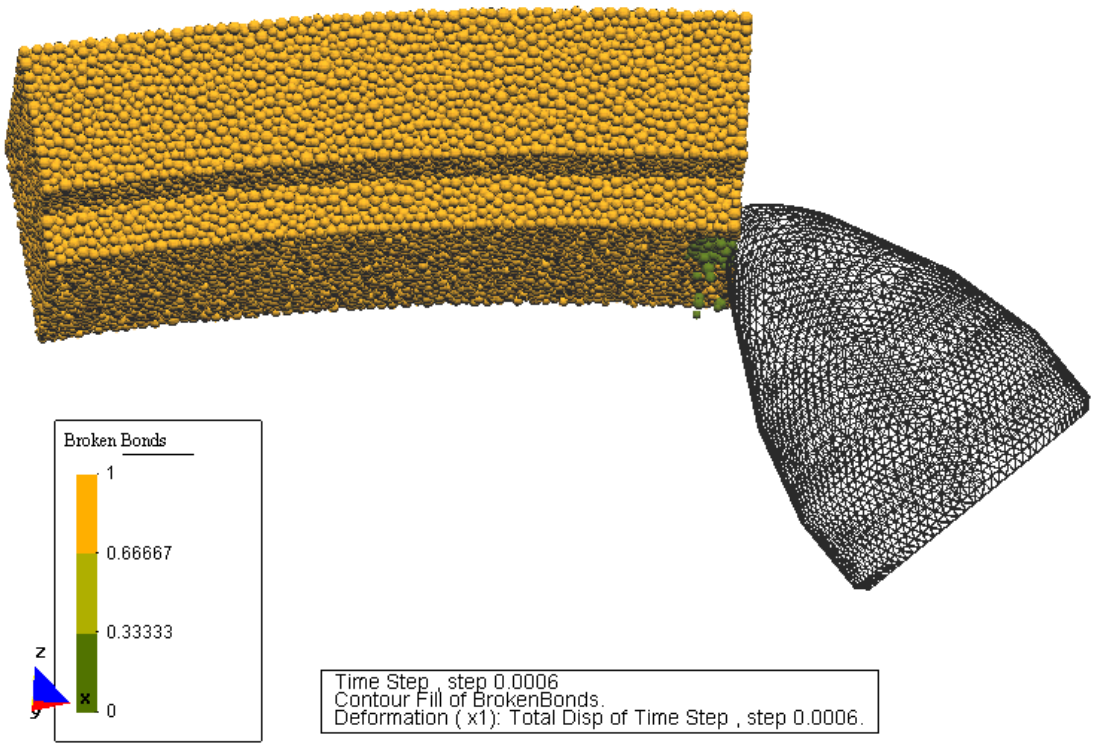


Construction Technology

Optimization of rock cutting through numerical simulation

- Decrease tool wear
- Optimize shape





Construction Technology

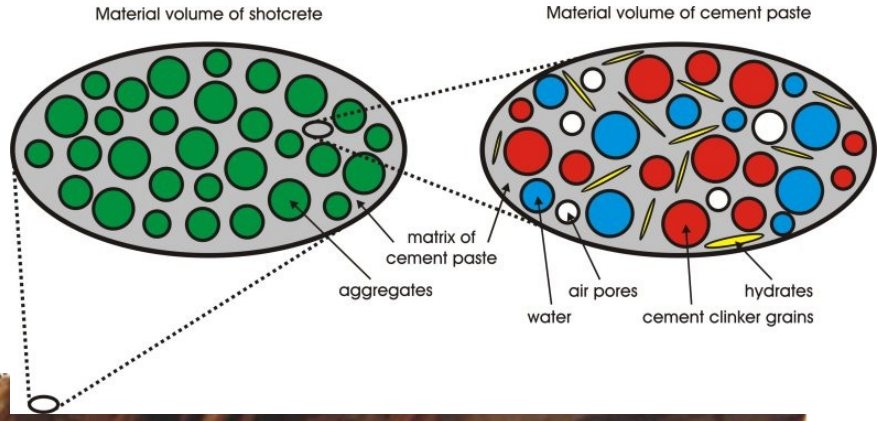
Innovative solutions for tunnel segments

- Increased strength
- Increased durability

Construction Technology

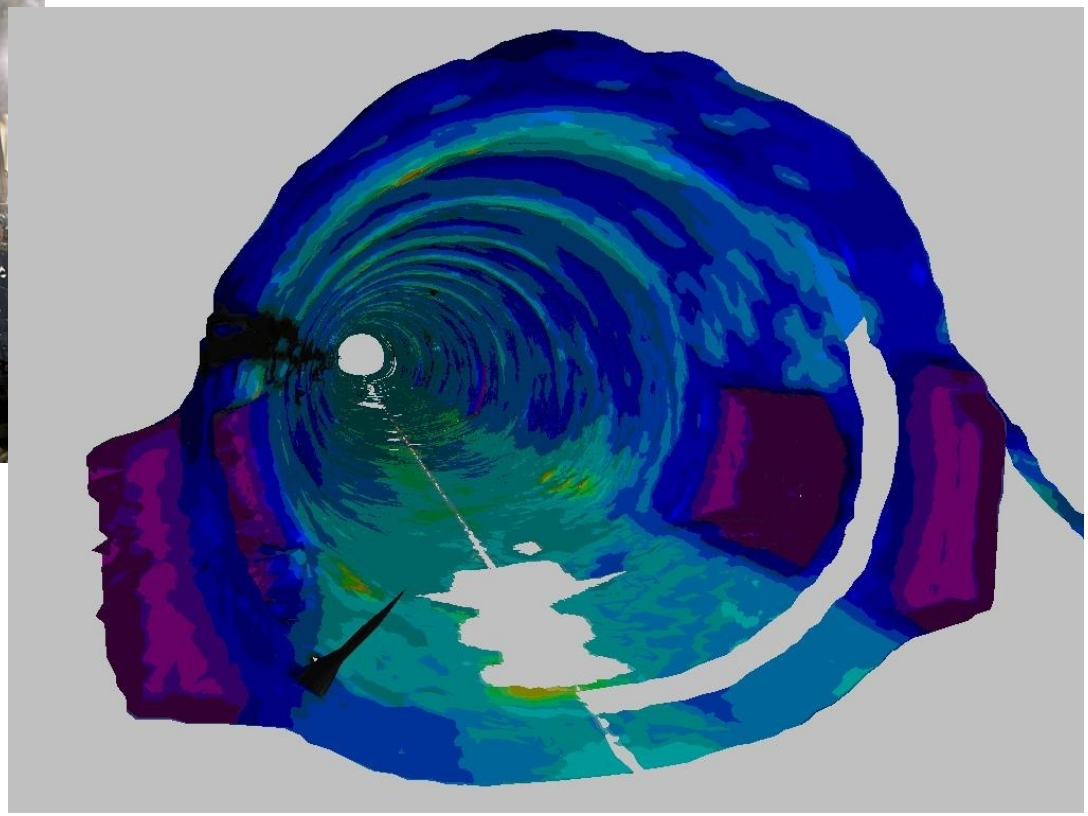
Innovative solutions for shotcrete

- Mix design using micro-mechanics based models
- Decreased costs, increased durability



Monitoring

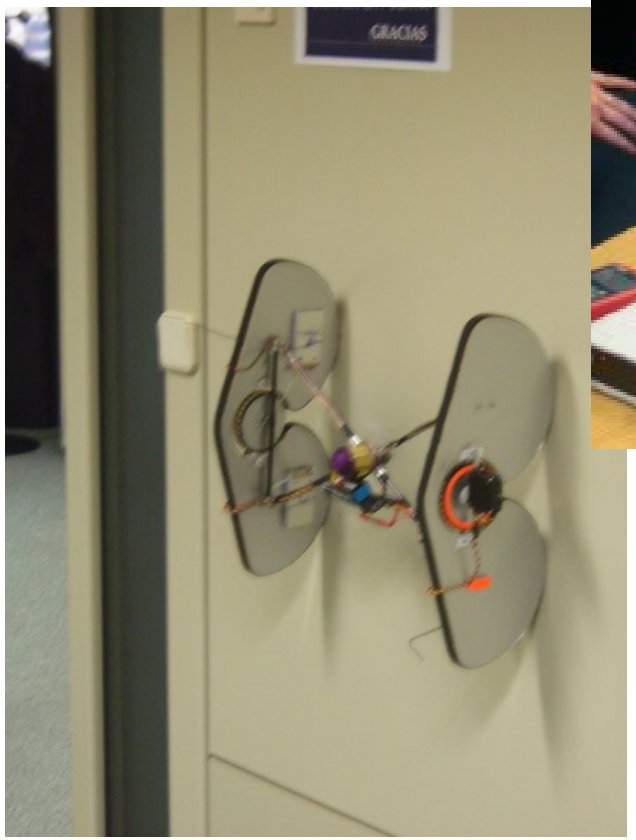
Tunnel face scanner

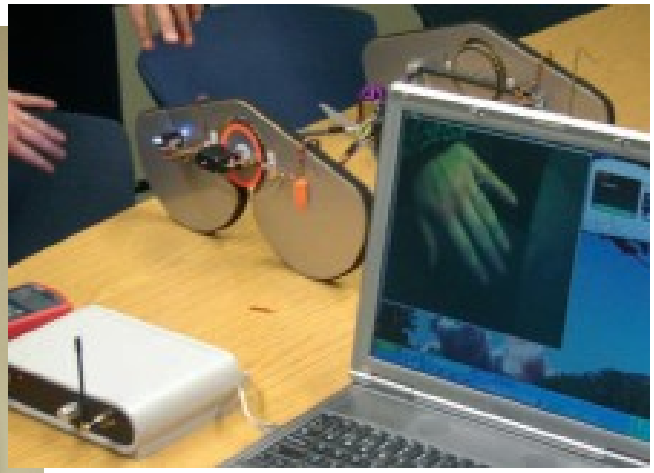


Maintenance and repair

DRAGARITA inspection robot

- Inspection of tunnel wall without traffic disruption

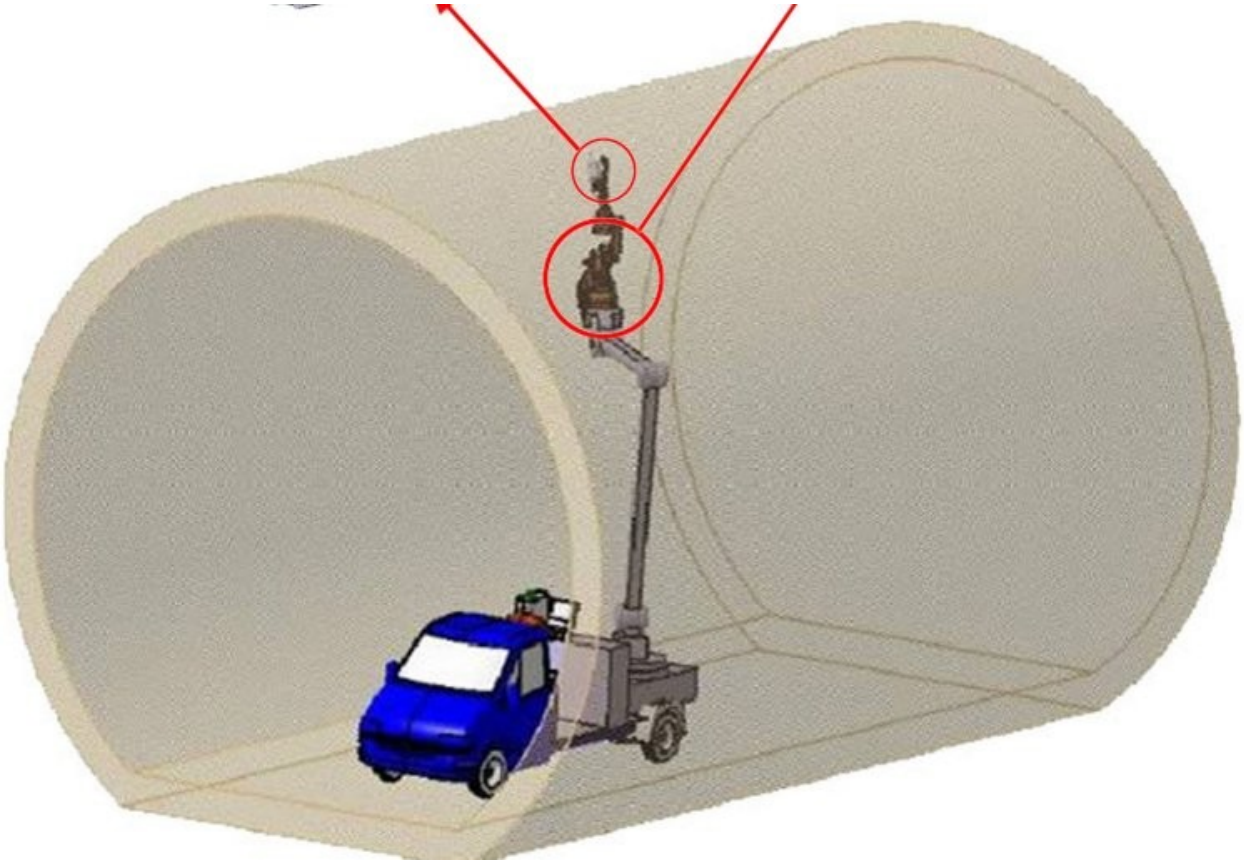




Maintenance and repair

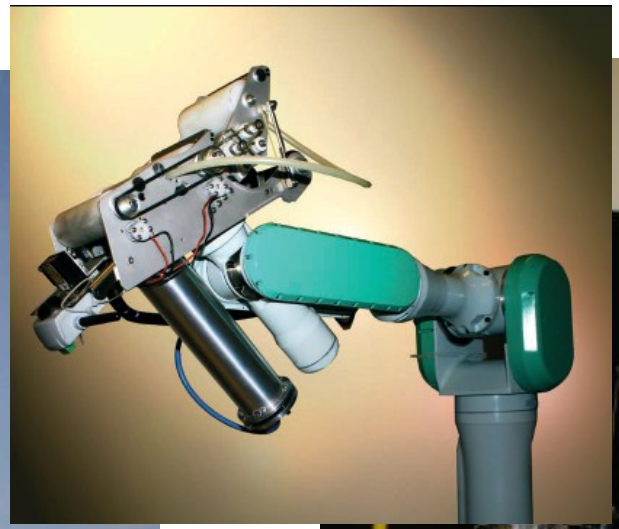
IRIS: Integrated robotic inspection and service system

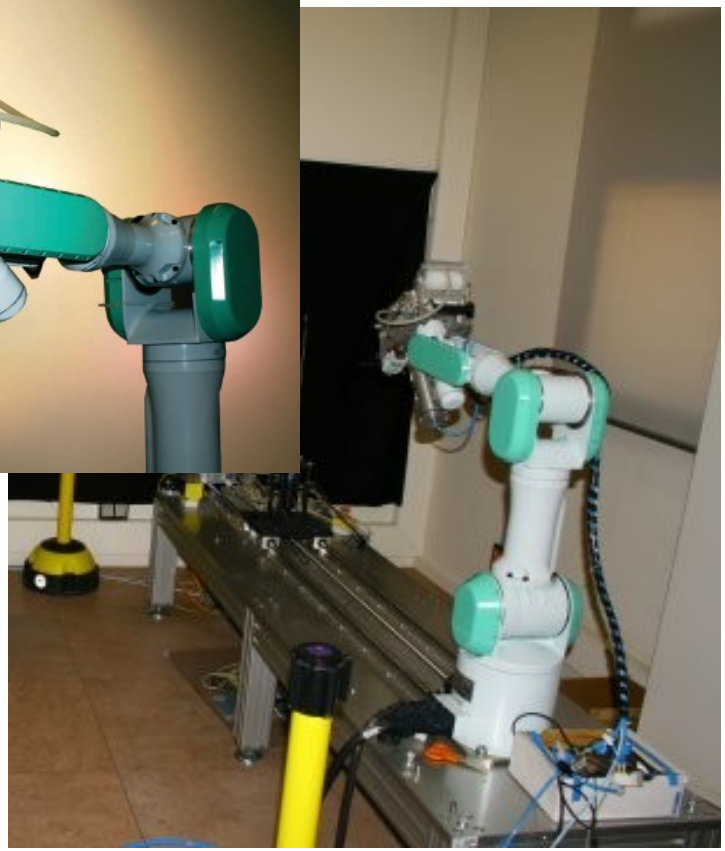
- Repair of tunnel wall without traffic disruption



Maintenance and repair

IRIS: Integrated robotic inspection and service





more information

www.tunconstruct.org

Project funded by the European Commission