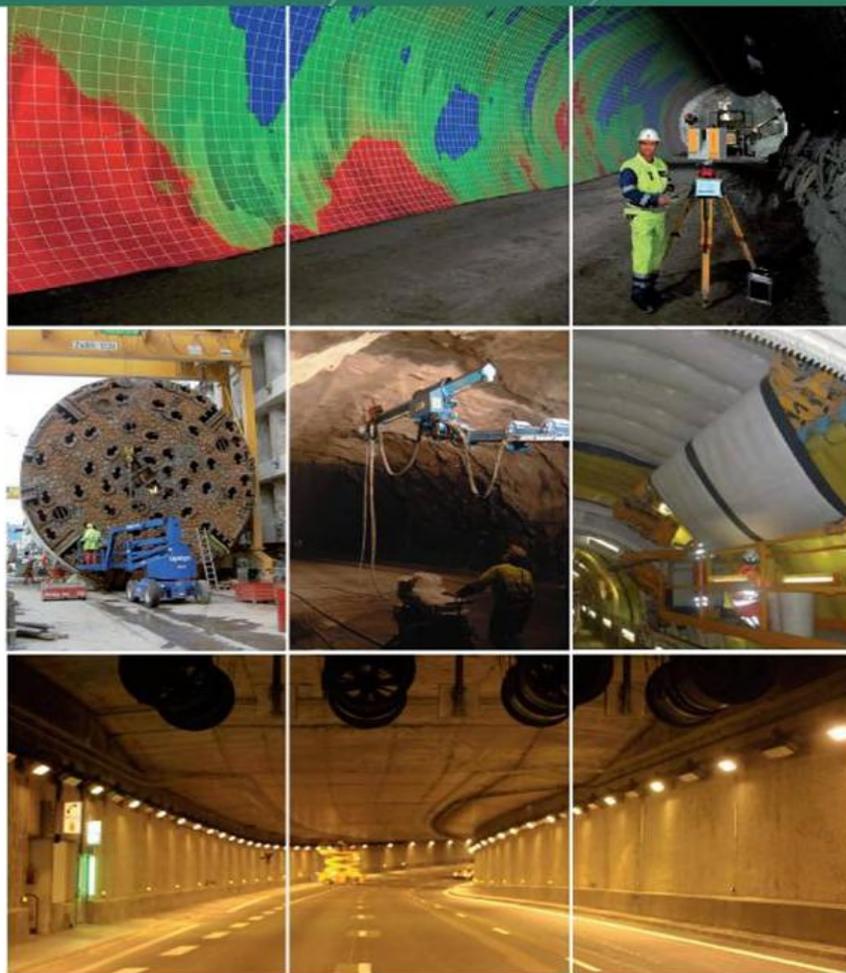


### ACTIVITY REPORT



Our clients expect from INDUSTRY to provide economic and safe means for rock and ground SUPPORT after excavation.

#### SUPPORT Elements

##### Conventional Tunnelling:

- (Injections)
- **Rockbolts**
- **Girders, arches**
- **Reinforced sprayed concrete**
- Forepoling
- Pipe umbrella

##### TBM Tunnelling

- **Pre-cast concrete tunnel segments**

## BASIC CONCEPTS



Sub Activity Group  
Segments



Sub Activity Group  
Sprayed Concrete

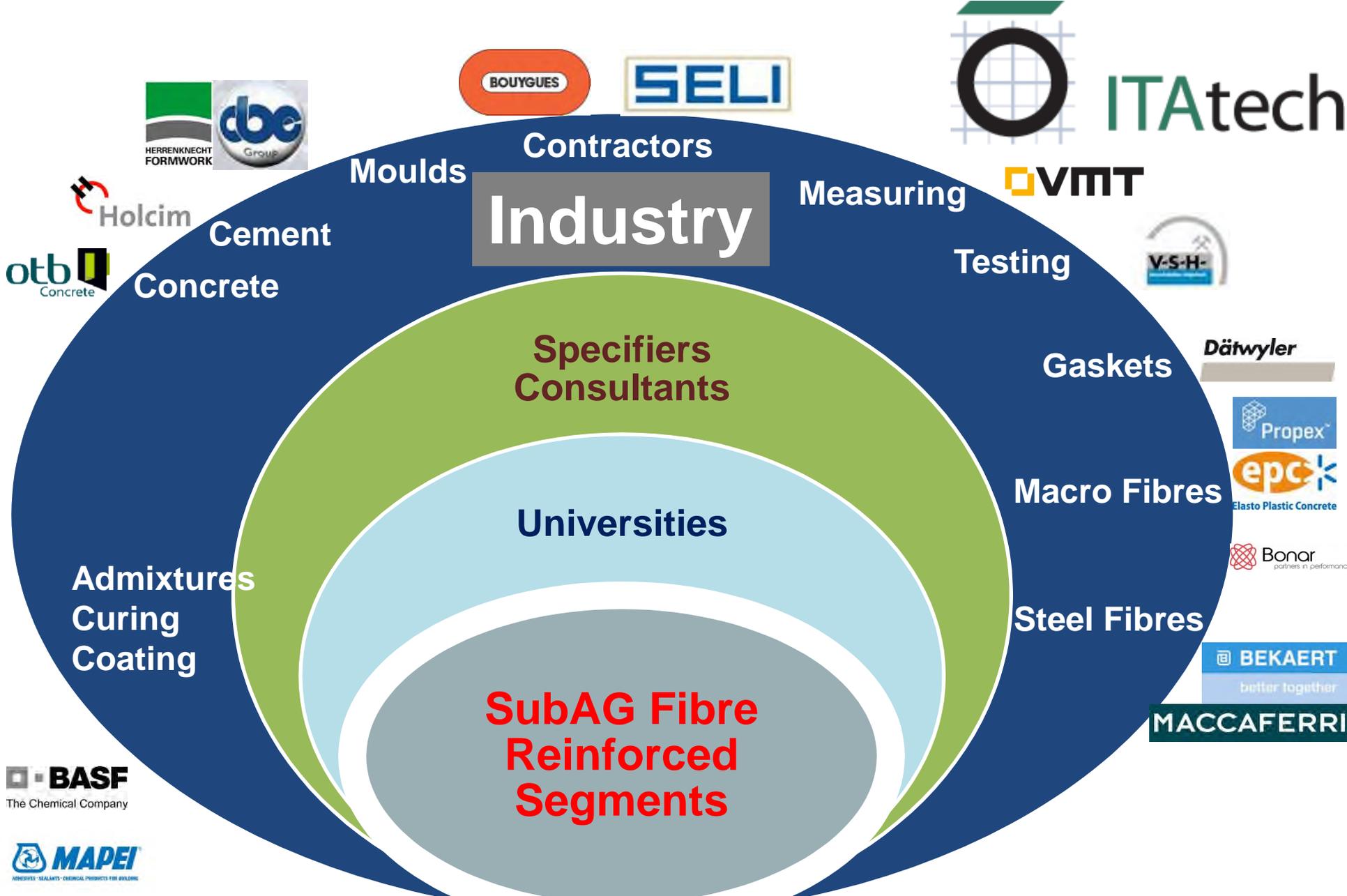


Sub Activity Group  
Bolting

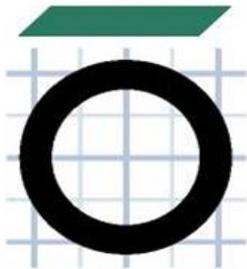
① Proper design method, durability, avoid damages, fire resistance: **Fibre reinforced segments**

② Sustainability (cement and rebound reduction), Mechanisation, Fibre Reinforcement, Early strength development, change from temporary support to permanent support

③ Higher safety and efficiency to decrease General Project Costs



**Industry Partnership to promote new and State-of-the Art construction technologies for Pre-cast Tunnelling Segments**



# ITAttech

APPLICATION FIELDS

## Tunnel Lining Segments

Application Fields:



Railway tunnels



Metro tunnels



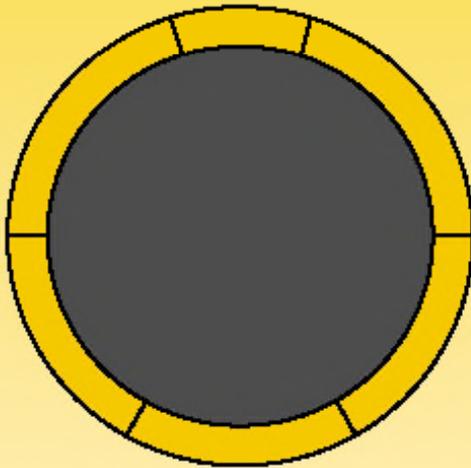
Highway tunnels



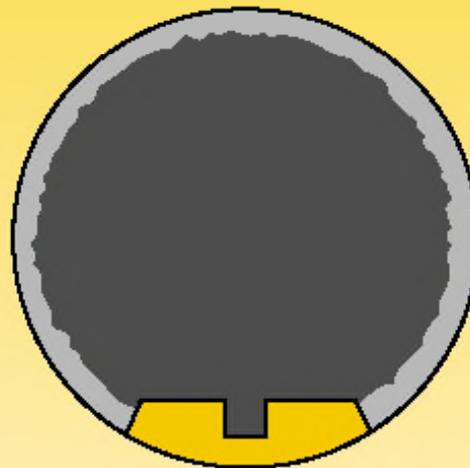
Hydroelectric tunnels



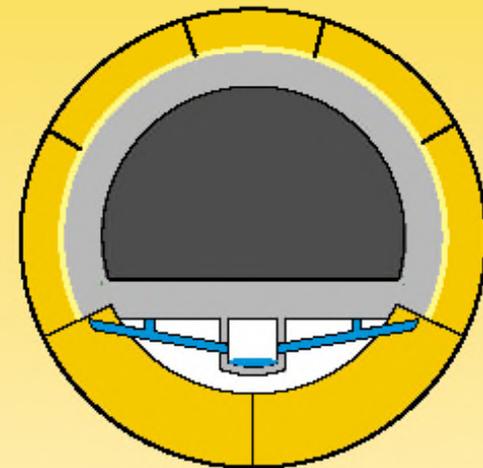
Water tunnels  
(drinking water,  
sewage,  
irrigation)



**Single shell tunnelling  
method with  
ring-segments**



**Single shell tunnelling  
method using base  
segments and  
a sprayed concrete  
lining**



**Double shell tunnelling  
method with  
ring-segments as the  
outer lining, a tunnel  
membrane and an inner  
pumped concrete lining**



Thickness: from 90cm down to 20cm  
Weight: from 19tons down to 1ton

STOCKAGE



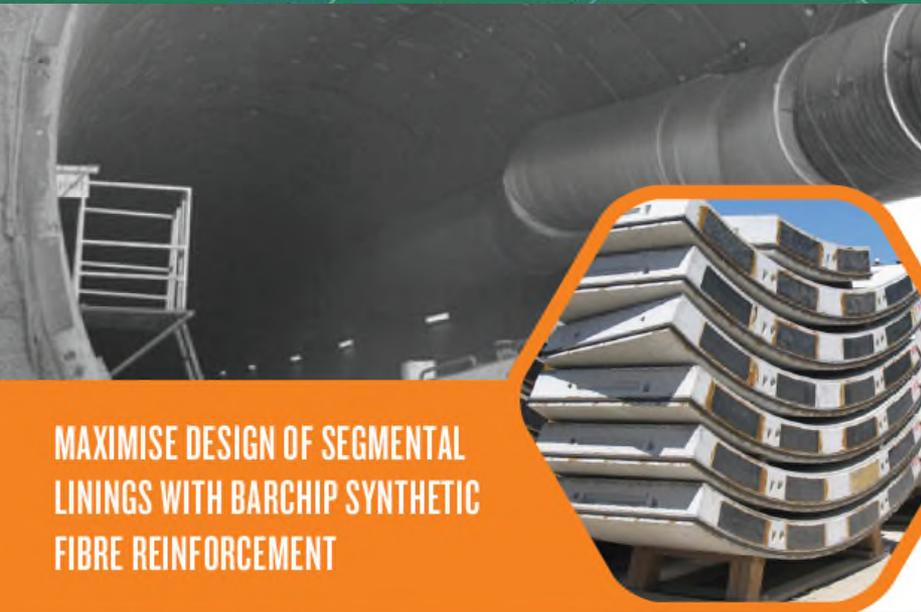
horizontal



vertical







MAXIMISE DESIGN OF SEGMENTAL LININGS WITH BARCHIP SYNTHETIC FIBRE REINFORCEMENT

+ Macro synthetic fibres



+ Steel fibres



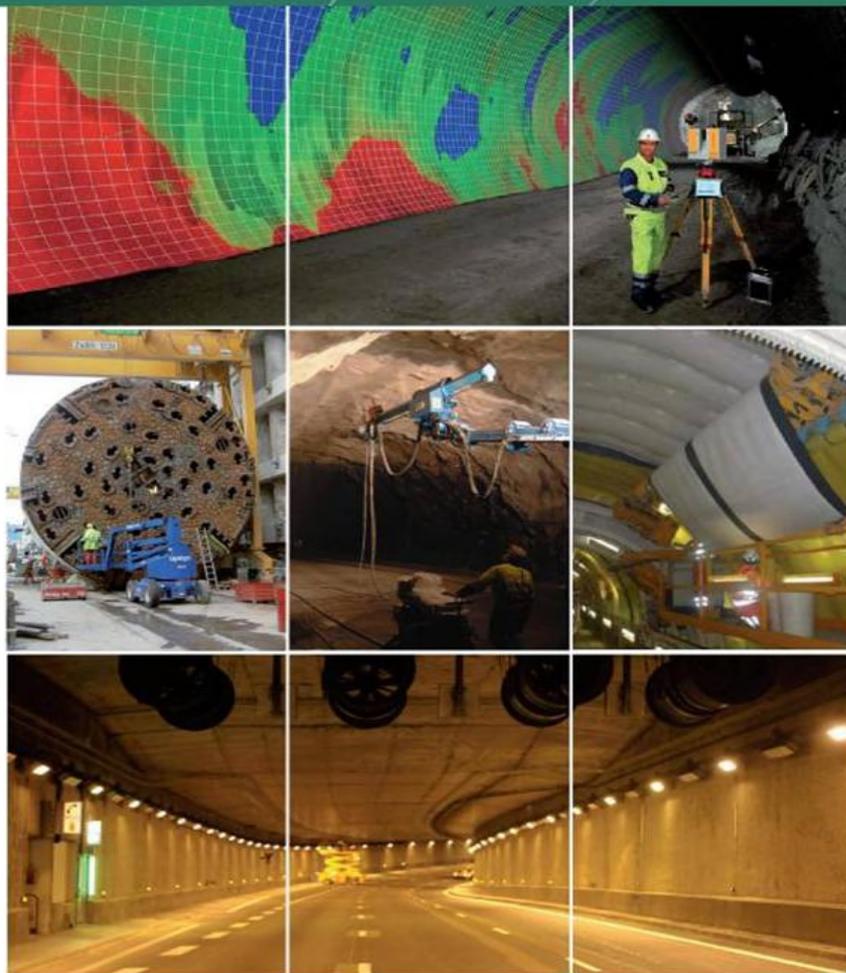


Pre-cast tunnel segments after the fire  
in the Channel tunnel



Pre-cast tunnel segment with PP fibre  
after fire testing

## Sub Activity Group Segments: Benoît de Rivaz (Bekaert)



### Fibre Reinforced Segments

The goal of this SubActivity group is to provide recommendations for the design, specifications for production of fibre reinforced tunnel lining segments. The objective will be to present the final document at WTC2014 in Brazil

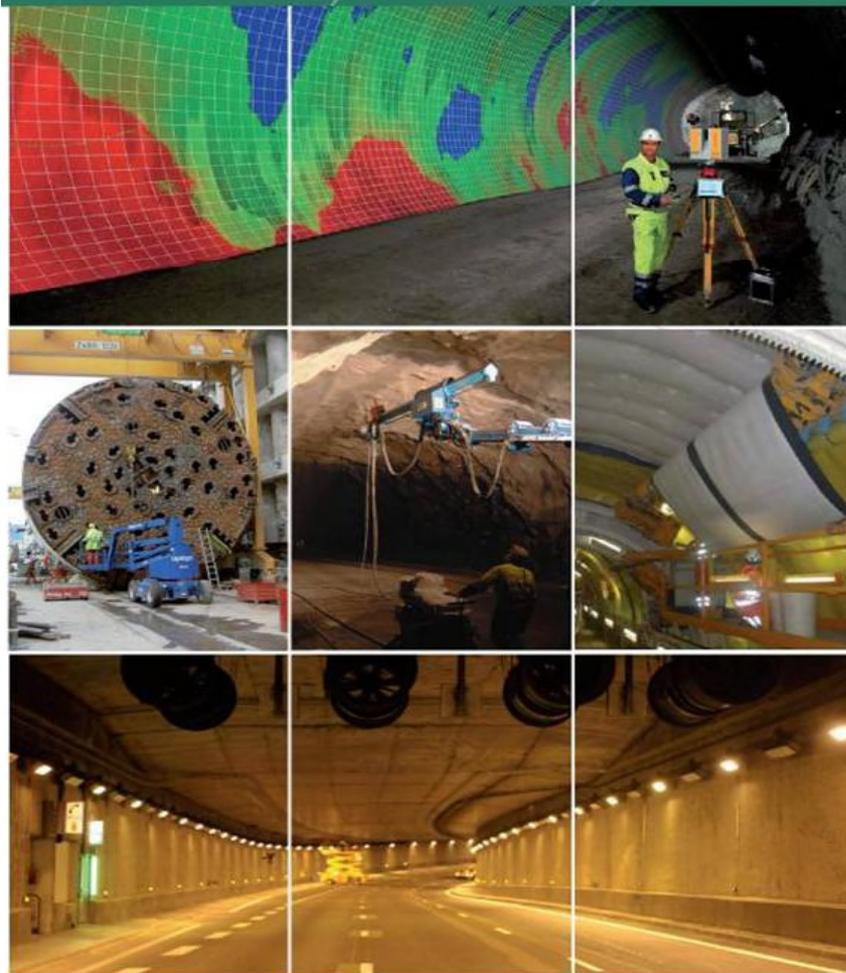
#### Priority on design aspects:

Avoid over specifications, do not eliminate new developments with structural macro fibres, mixed systems with cage reinforcement and steel or macro fibres (Hybrid systems)

#### Future items:

Durability design including aggressive environment  
Fire resistance  
Gasket design

### ② Sub Activity Group Sprayed Concrete: José Antonio Nieto (Putzmeister)



No need for further Guidelines or specifications (EN-Standards, EFNARC G, Austrian G, American G, Australian G, ITA WG12)

#### Main Focus:

Sustainability (Health & Safety, rebound, cement, cement content, machine parameters, automatisisation)

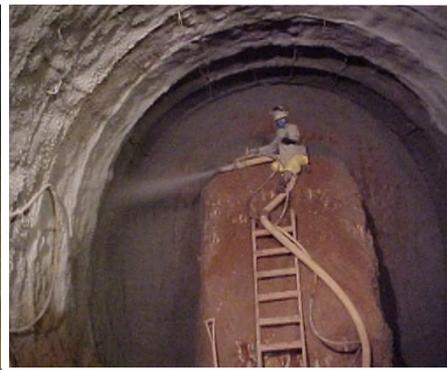
#### General future goal:

CO<sub>2</sub> balance of sprayed concrete

#### Special remark:

A Sub Activity Group can only be successful, if the members of the group give an active contribution to our goal and do not only participate at the meetings

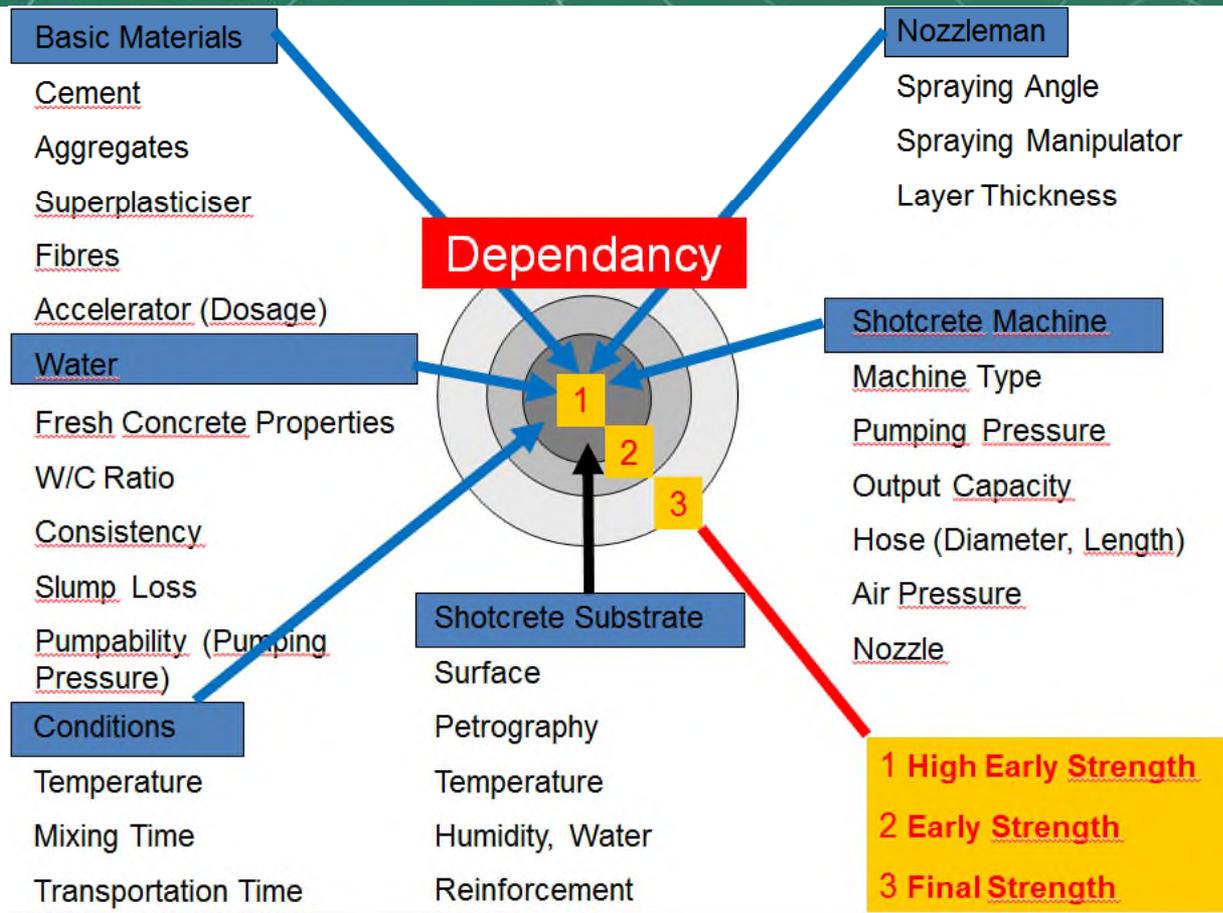
### ② Sub Activity Group Sprayed Concrete: José Antonio Nieto (Putzmeister)



SUSTAINABILITY OF SPRAYED  
CONCRETE?



### ② Sub Activity Group Sprayed Concrete: José Antonio Nieto (Putzmeister)



## ② Sub Activity Group Sprayed Concrete: José Antonio Nieto (Putzmeister)

### Approach:

- Selection and analysis of representative sprayed concrete projects from the world
- Determine a CO<sub>2</sub> balance for the selected projects and propose a more sustainable process
- Final testing on the project according to the proposals of the group
- Results will be presented at the WTC2014 in Brazil

### So far obtained Results:

- No results
- New orientation of Sub Activity Group Sprayed Concrete
- Looking for new active members:

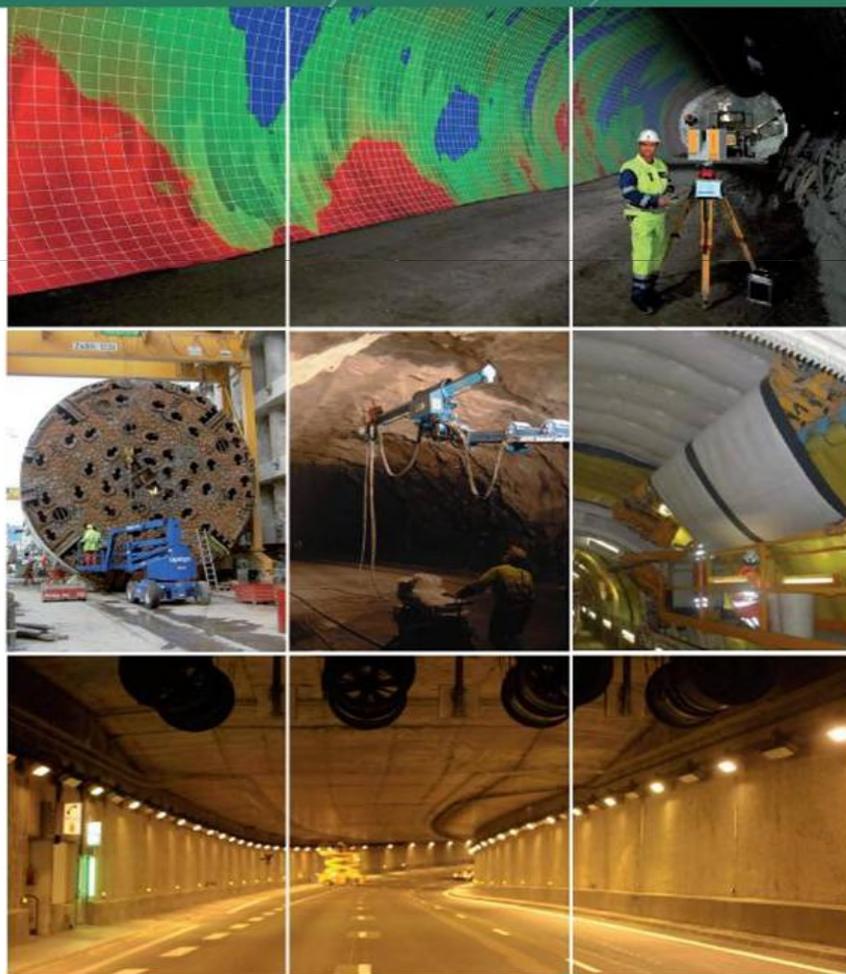
Please contact:

José Antonio Nieto (Putzmeister): E-Mail: [nietoj@putzmeister.es](mailto:nietoj@putzmeister.es) Mobile: [+34649483079](tel:+34649483079)

Gustav Bracher (Sika): E-Mail: [bracher.gustav@ch.sika.com](mailto:bracher.gustav@ch.sika.com) Mobile: [+41793572989](tel:+41793572989)

3

### Sub Activity Group Bolting: Karl Böhm (DYWIDAG-Systems International)



#### Goals

- Increase of safety during construction
- correct usage of arches, rock reinforcement & pre-support technologies
- development of automation units for the installation
- Publishing proposed methods
- Technical specifications
- Proposals for “Tender Documents”

**Keep in mind: Higher safety and efficiency to decrease general project costs**

3

## Sub Activity Group Bolting: Karl Böhm (DYWIDAG-Systems International)

Sub Activity Group Bolting has not yet started because of lack of interest to co-operate within the relevant industry partners.

Nevertheless there is an urgent need to start the SubAG to achieve our goals and to avoid situations like can be seen in the following picture:



Interested persons please contact:

Karl Böhm (DSI) [karl.boehm@dywidag-systems.at](mailto:karl.boehm@dywidag-systems.at) Mobile: +43 676 959 4749

Gustav Bracher (Sika): E-Mail: [bracher.gustav@ch.sika.com](mailto:bracher.gustav@ch.sika.com) Mobile: +41793572989

AG SUPPORT



Thank you for your future support inside the Activity Group SUPPORT from ITAttech