

*Robotizing Workforce in
Future Built Environments*

Frans van Gassel & Ger Maas

Automation and Robotics

Frans van Gassel

Eindhoven University of
Technology

(The Netherlands)

- Mechanization on construction site
- Collaborative design

Ger Maas

Eindhoven University of
Technology and

Royal BAM Group

(The Netherlands)

- Construction management & engineering
- European strategy in construction

1995 Key note in Warszawa

A method for analyzing
unsafe en unhealthy
production processes on
the construction site.

Develop equipment in
relation to products.

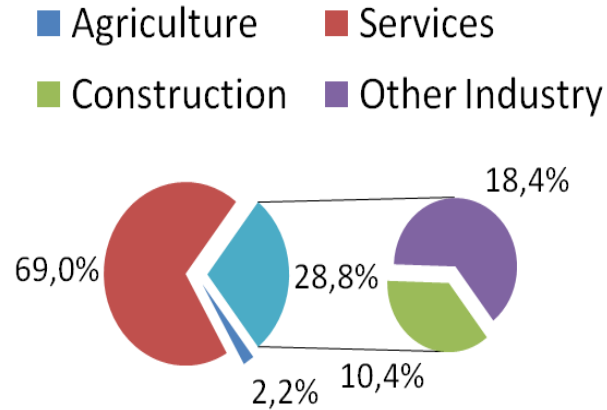


Key note

12th ISARC 1995
Warszawa, Poland

The Construction Sector in EU27 (1)

Share of GDP

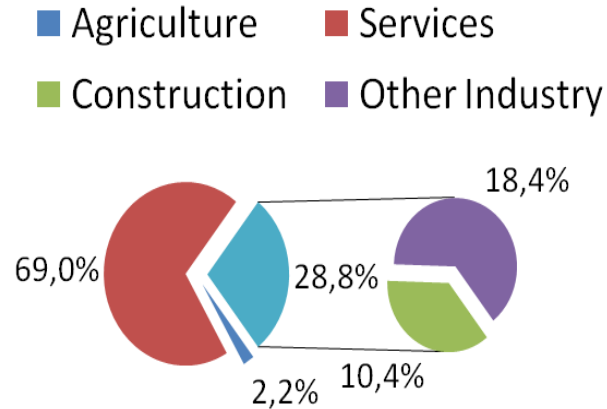


The biggest industrial employer:

- **10.4% of GDP** and 49.2% of Gross Fixed Capital Formation (FIEC, 2008)
- **30% of industrial employment**, 7.6% of total employment (16.3 million operatives)
- 3 millions enterprises (**95% SMEs** with <20 workers, local markets, low innovative)

The Construction Sector in EU27 (2)

Share of GDP

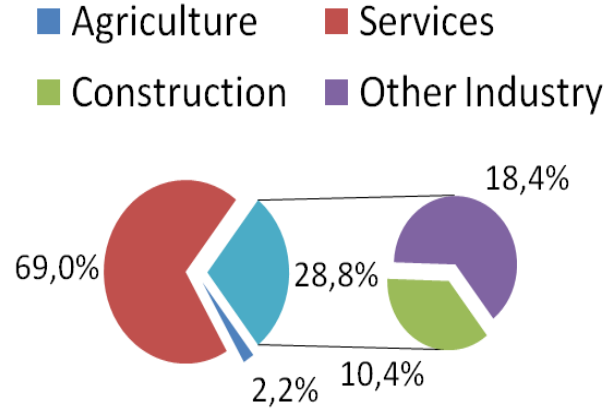


A **large influence** on the whole economy

- **48,9 millions workers** depending on Construction
- The **buildings/infrastructure** supplied by the Construction sector **serve a lot of other industries and services**

The Construction Sector in EU27 (3)

Share of GDP



A large influence on the whole economy

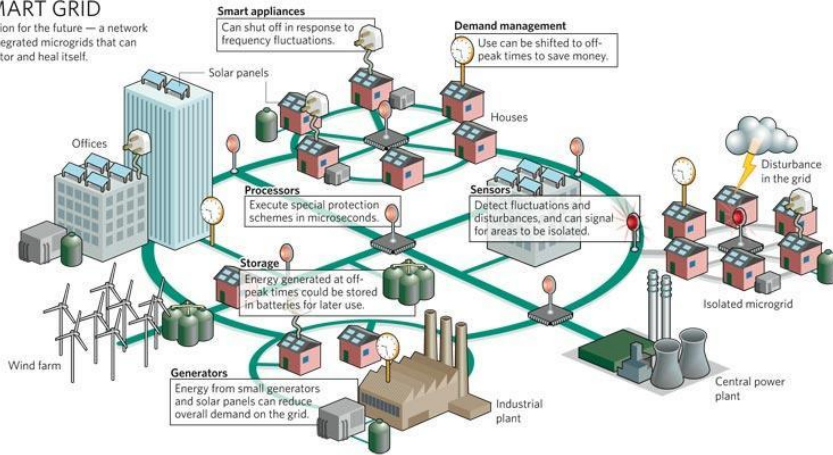
- **Construction can make the difference**
- **Automation and Robotics can help construction to do so!**

European policy (1)

Smart Grid

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



Challenges:

To address and to adapt

- Climate change
- Demographic change,
- Energy supply and security,
- Food shortages
- Safety
- Environmental concerns.



G European policy (2)

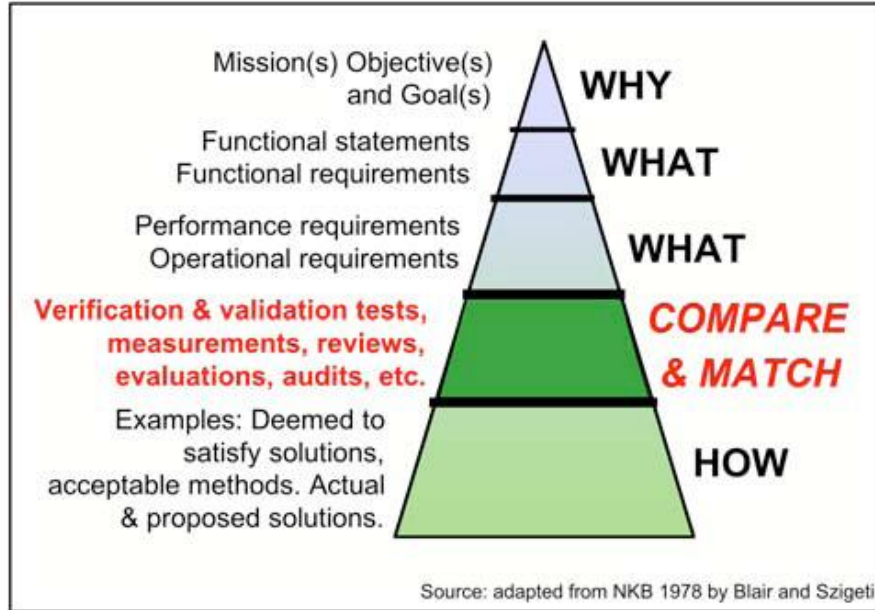
Demands:

For convenience

- Low maintenance
- Automation
- Flexibility
- Health improve features
- Optimal environmental integration



From Production to Performance



- Not just what construction makes
- Does it fit?
- Are users happy?
- Are working conditions safe?

Busan Geoje Fixed Link

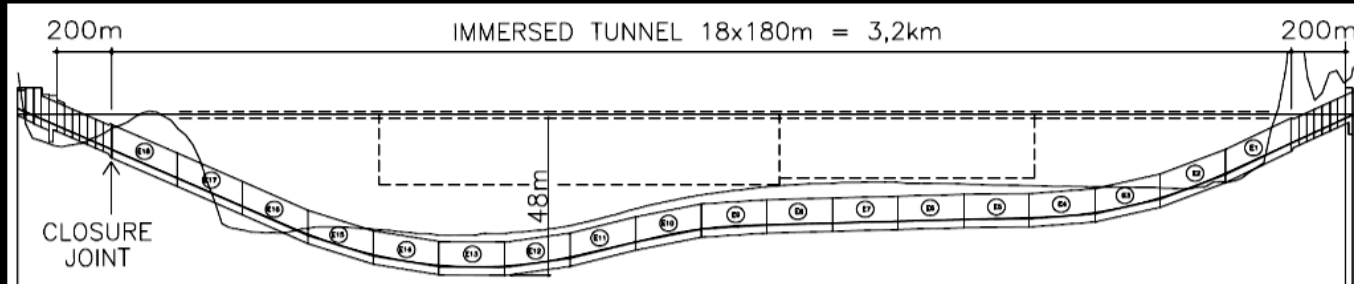


Busan Geoje Fixed Link



12m

26,5m



Busan Geoje Fixed Link

Automation

To measure location

To measure the flow and waves

To control, check and steer tunnel elements

Future needs in Automation and Robotics



Human machine technologies

Process management

Performance technologies

Client and societal values

Topics

Human machine technologies
Mechanization phases, Labor analysis, Modular construction



Process management
Design meetings, Quality control, Lean construction



Performance technologies
Users needs, Active aging, Automated data collection, Safety



Client and Societal values

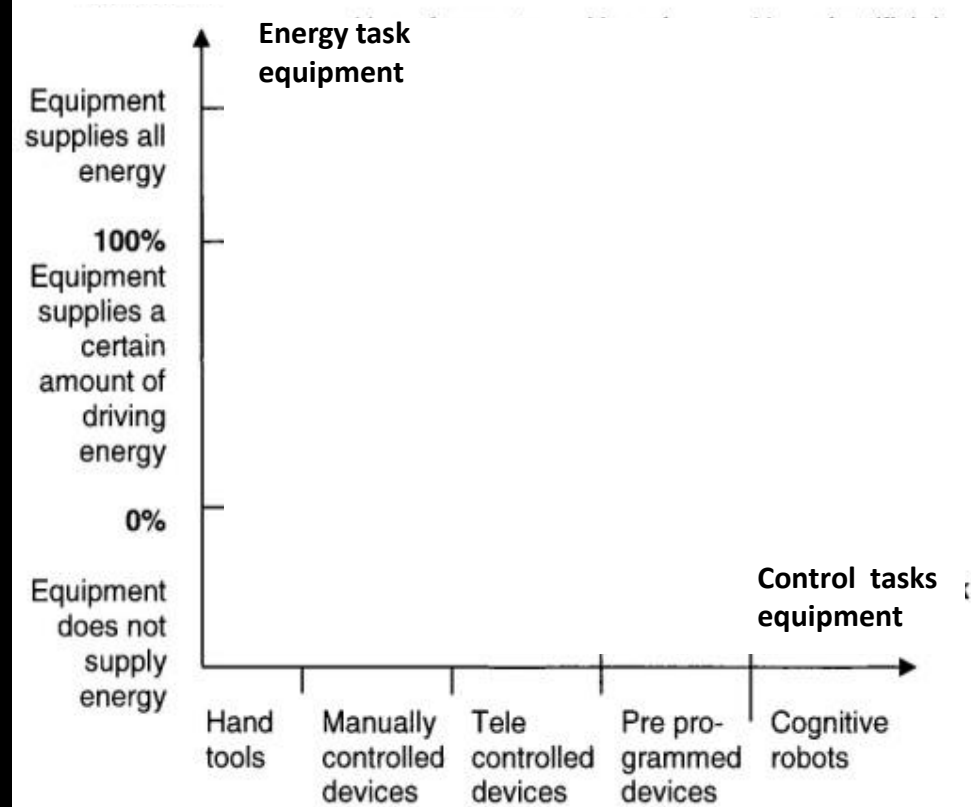
Mechanization graph (1)

Horizontal axis:

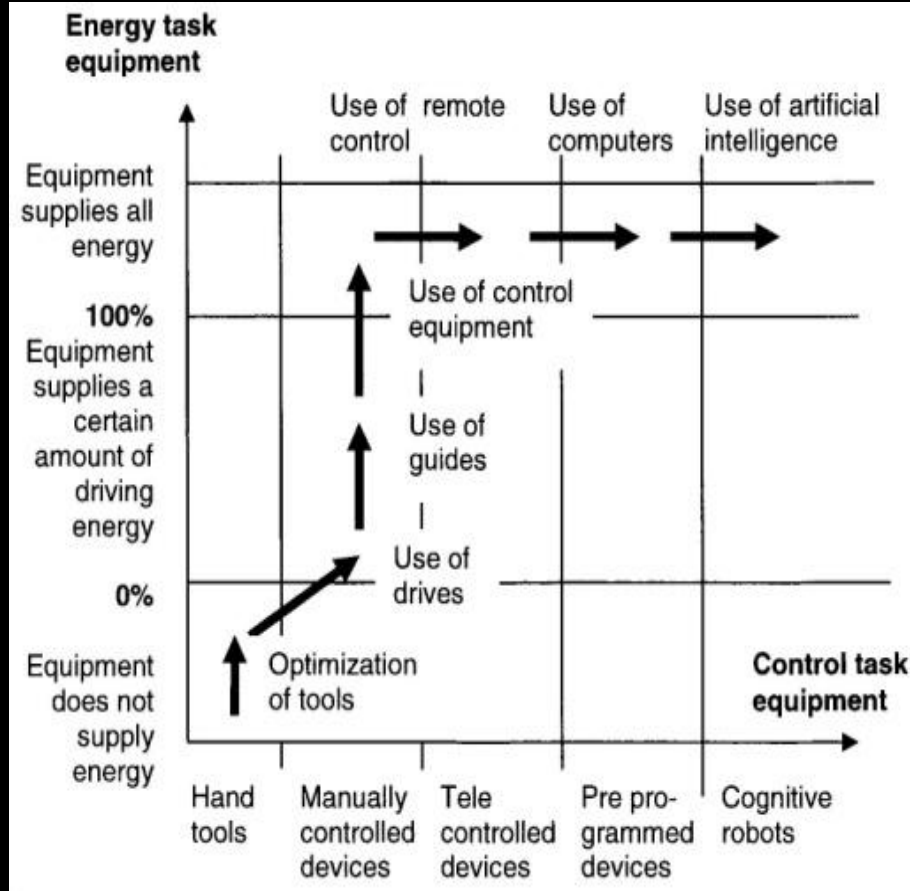
- Control tasks equipment

Vertical axis:

- Energy supply in production process.



Mechanization graph (2)



Topics

Human machine Technologies

Mechanization phases, **Labor analysis**, Modular construction



Process management

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Performance technologies

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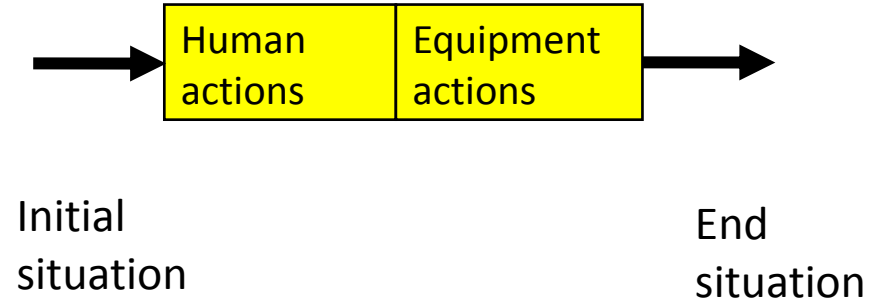


Client and Societal values

Labor analysis (1)

Before starting to mechanize and robotize construction processes there is a need to get more insight into the production tasks of the construction worker and equipment.

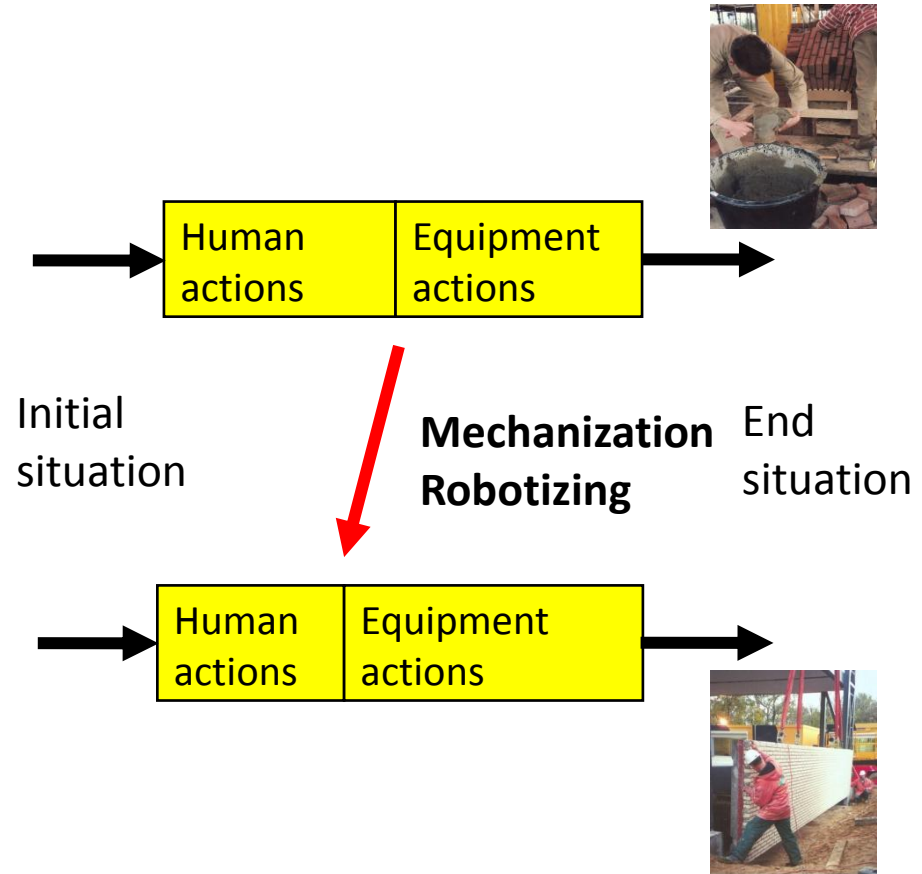
To get this insight an analysis method has been developed.



Labor analysis (2)

Before starting to mechanize and robotize construction processes there is a need to get more insight into the production tasks of the construction worker and equipment.

To get this insight an analysis method has been developed.



Topics

Human machine Technologies

Mechanization phases, Labor analysis, **Modular construction**



Process management

Design meetings, Quality control, Lean construction



Performance technologies

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Client and Societal values

Modular construction

To shift heavy and complex construction tasks from the site to the factory modular construction can be a solution.

To design the production process of such modular system a method has been developed and applied.



Topics

Human machine Technologies

Mechanization phases, Labour analysis, Modulair construction



Process management

Design meetings, Quality control, Lean construction



Performance technologies

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Client and Societal values

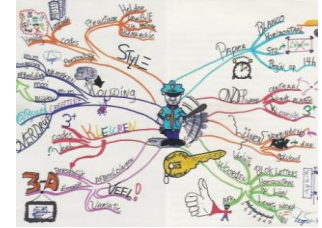
Design meetings (1)

Designing mechanized and robotized production processes needs collaboration between all kinds of professionals.

During design meetings this collaboration can be taken place.

Working methods are needed to produce new concepts.

Working methods



Design meetings (2)

1. Making what you think visible: mind maps
2. Group idea creation: brainstorm sessions
3. Systematic idea generation: Systematic Inventive Thinking (SIT)
4. To create insight: simulation games

Working methods

1



2



3



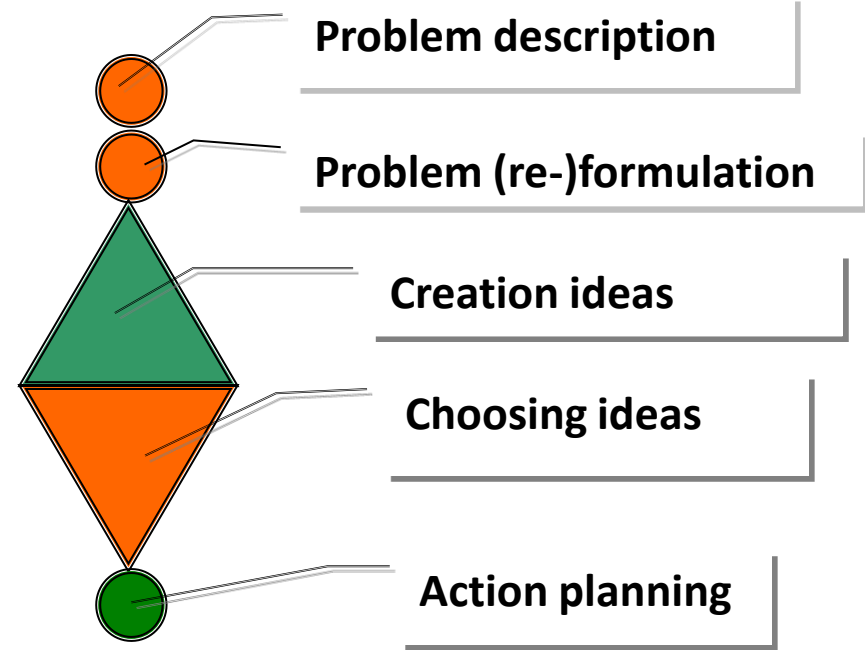
4



Design meetings (3)

A design meeting has to be prepared very carefully.

To obtain really new concepts a certain order of activities is necessary.



Topics

Human machine Technologies

Mechanization phases, Labor analysis, Modular construction



Process management

Design meetings, **Quality control**, Lean construction



Performance technologies

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Client and Societal values

Quality control (1)



Clients don't know how to measure the performance of contractors.

Quality control (2)



- Need for automated data collection
- Need for real time automated data processing

Topics

Human machine Technologies

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Process management

Design meetings, Quality control, **Lean construction**



Performance technologies

Users needs, Active aging, Automated data collection, Safety



Client and Societal values

Lean Construction (1)



Transferring this approach to construction focuses on:

- the reduction of construction period
- the reduction of the variability
- the simplification of tasks
- the increase of transparency
- the increase of flexibility

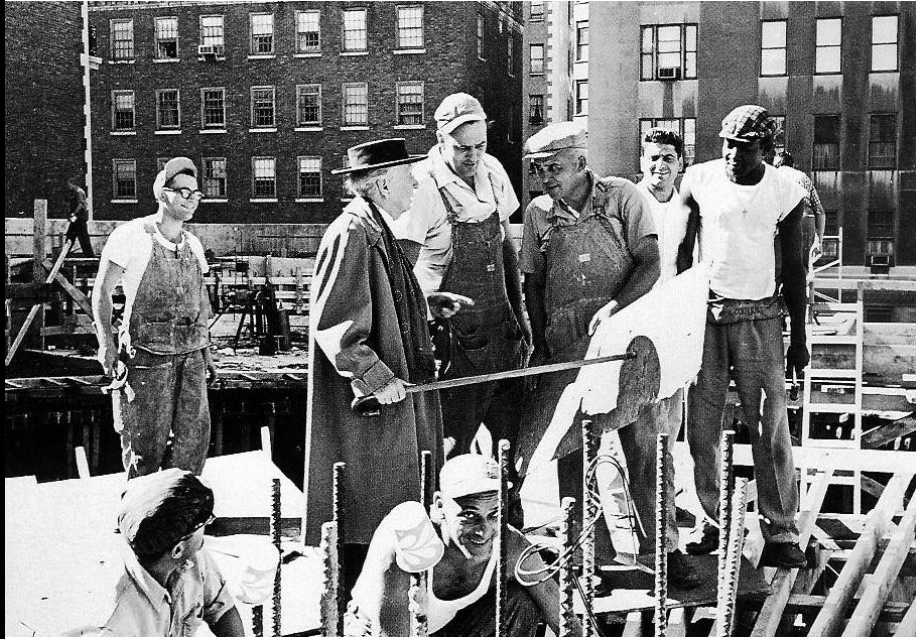
Lean Construction (2)



Project values 1

- Reduction building period (25-50%)
- Better communication
- Less stress on the work floor
- Reduction on general construction costs (e.g. man-hours, equipment, offices for staff, rooms for personnel)

Lean Construction (3)



Project values 2

- Building specialists know what they and the others have to do
- Building specialists take responsibility for their scope of work, the interfaces and the success of the entire project

Topics

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Process management

Design meetings, Quality control, Lean construction



Performance technologies

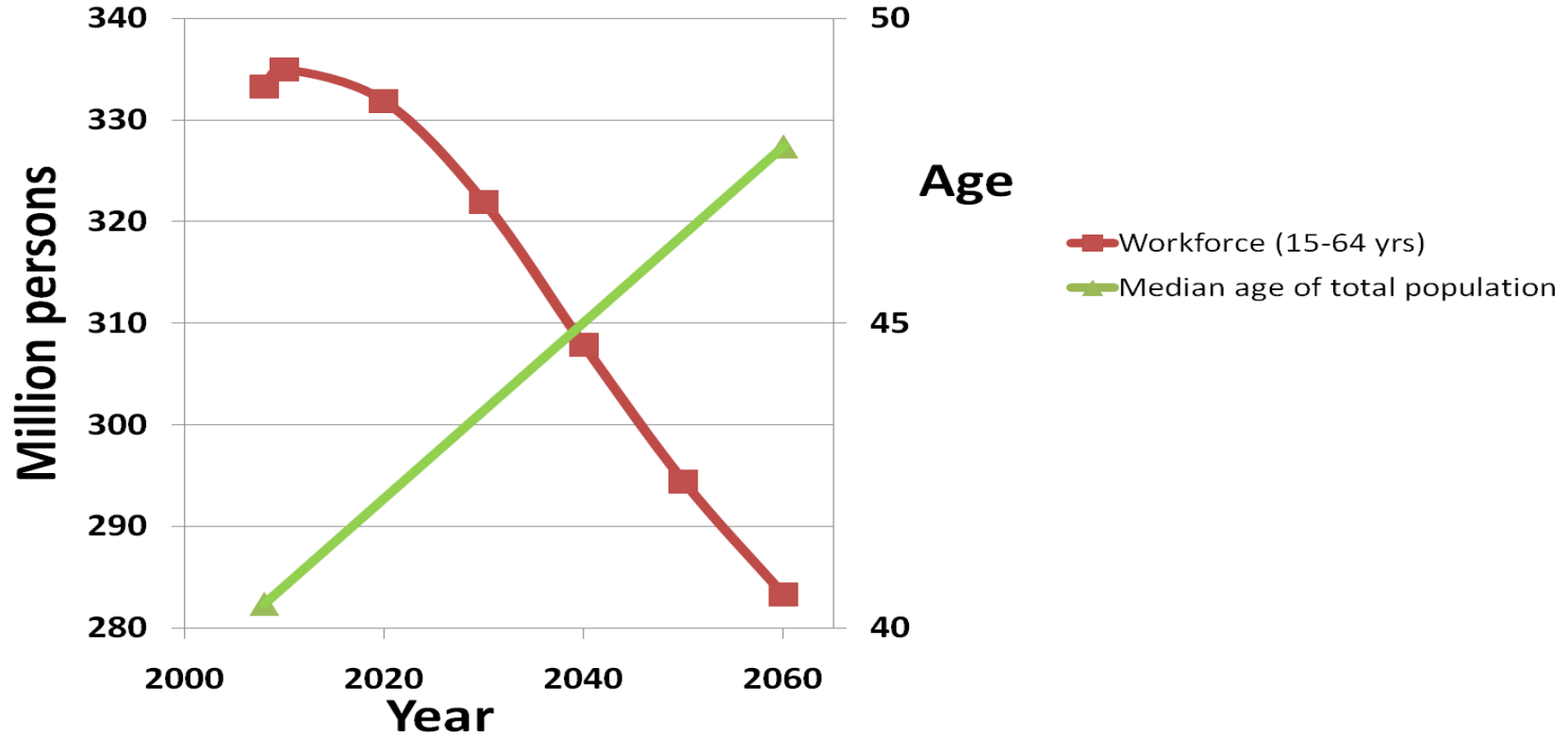
Users needs, **Active aging**, Automated data collection, Safety



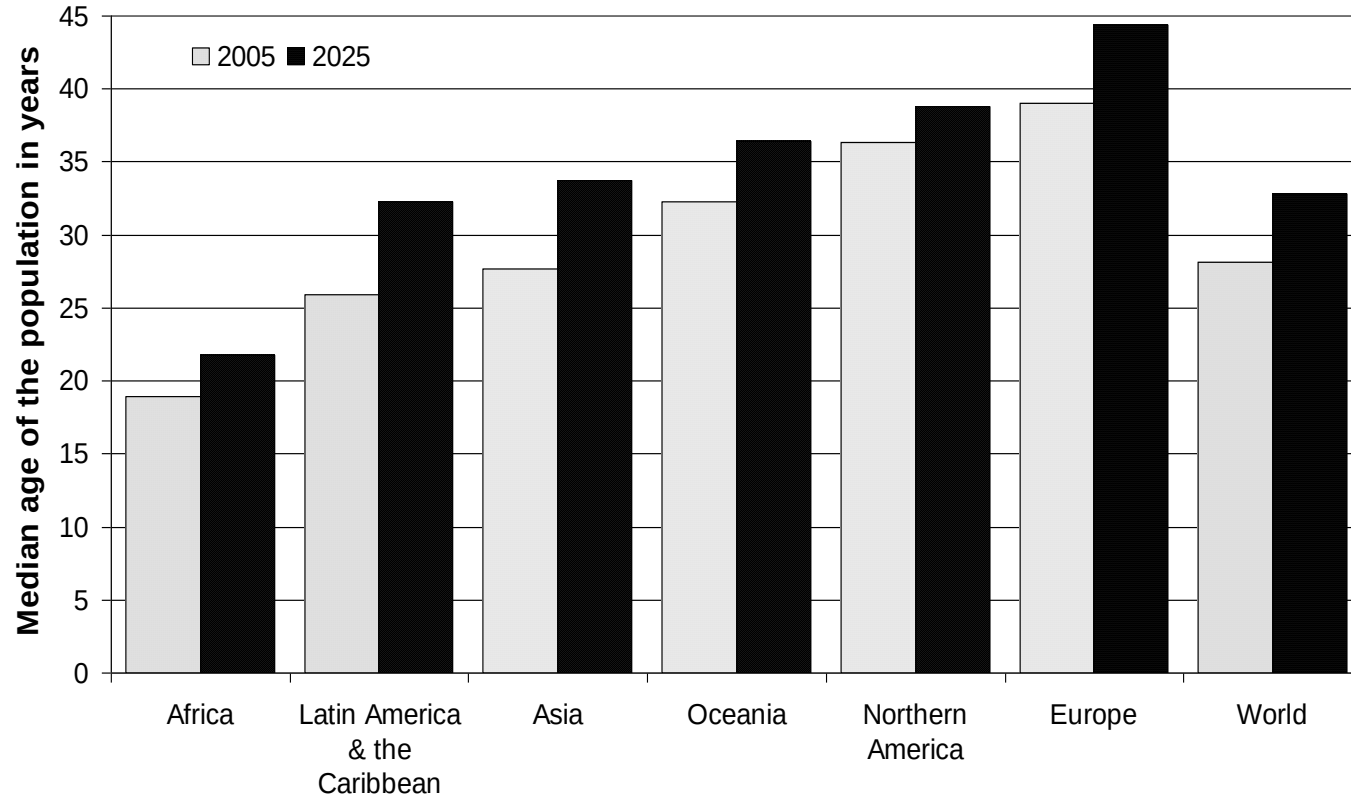
Client and Societal values

Active aging in an Aging Society (1)

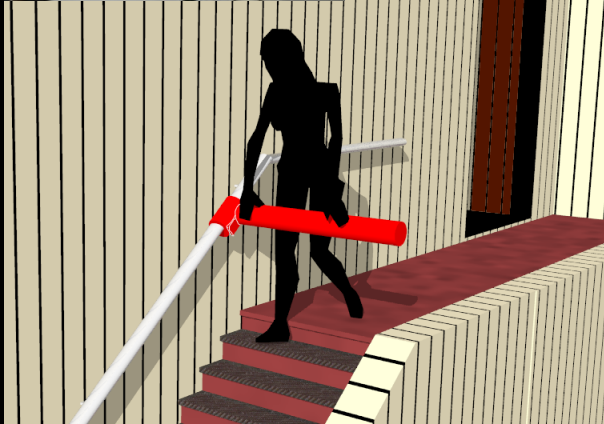
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Active aging in an Aging Society (2)



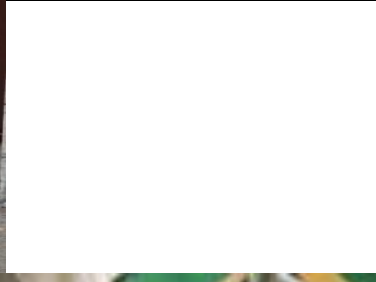
Active aging in an Aging Society (3)



Themes:

- **Housing & Daily Living**

Active aging in an Aging Society (4)



Themes:

- Housing & Daily Living
- Mobility & Transport

Active aging in an Aging Society (5)



Themes:

- Housing & Daily Living
- Mobility & Transport
- Work & Leisure



WORK, LEISURE, CARE, ROBOTICS AND CONSTRUCTION FOR AGING



ISG*ISARC2012



Gerontechnology

Aging-in-place
Aging workforces
Robotics
Societal changes



Automation and Robotics
in Construction

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Performance technologies

Users needs, Active aging, **Automated data collection**, Safety



Client and Societal values

Automated data collection (1)



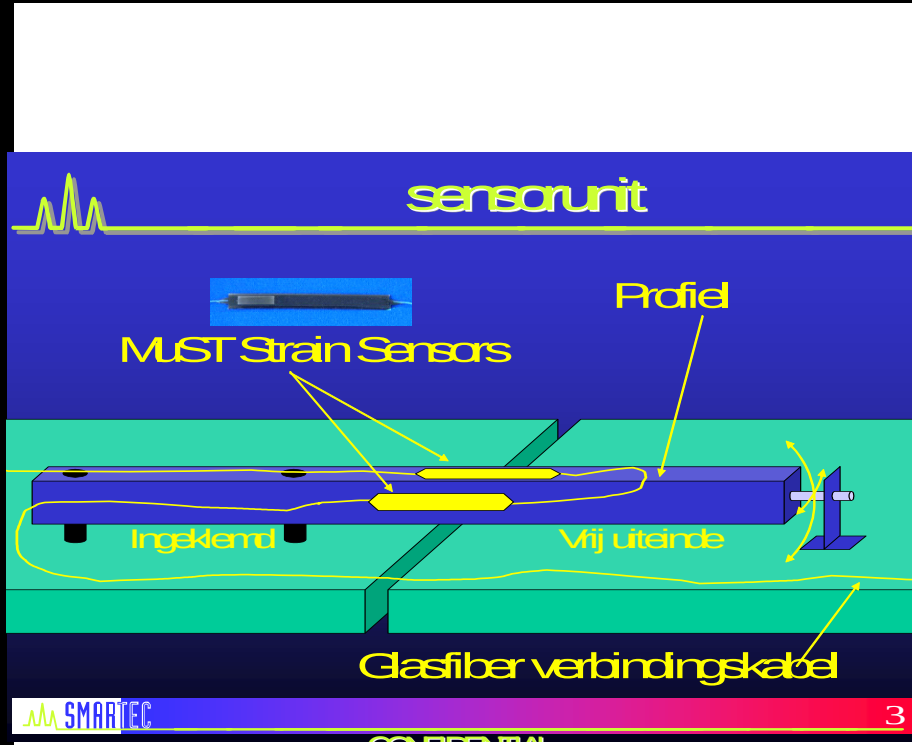
Large public works

DBFM (O)

Performance

Measure during operation

Automated data collection (2)



Geometrical track quality by optical glassfiber sensors

Each sensor measures, with an accuracy of 0.05 mm:

- movement in vertical direction
- movement in lateral direction, i.e. crosswise on the track
- rotation in cross direction

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Client and Societal values

Client's and societal values



❖ *Process*

- Make work less heavy and more safe
- Support collaborative design and construction
- Monitor the performance of the designers/suppliers/contractors

❖ *Product*

- Create low maintenance products
- Support aging people at work and at home

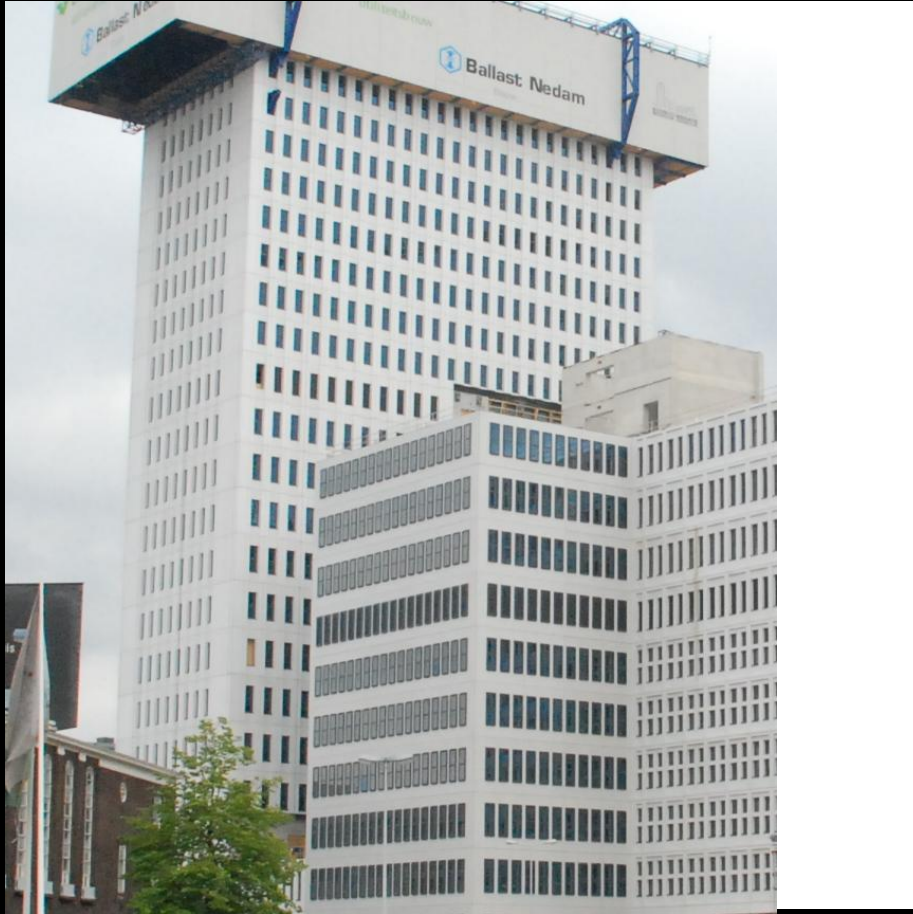
Rotterdam Medical Centre (1)



- City centre of Rotterdam
- New hospital
- Condensed urban area
- No space
- 31 stories high building
- In a factory



Rotterdam Medical Centre (3)



- No space
- 31 stories high building
- In a factory

Medical Centre (4)

Every week one floor in the factory on top of the new building

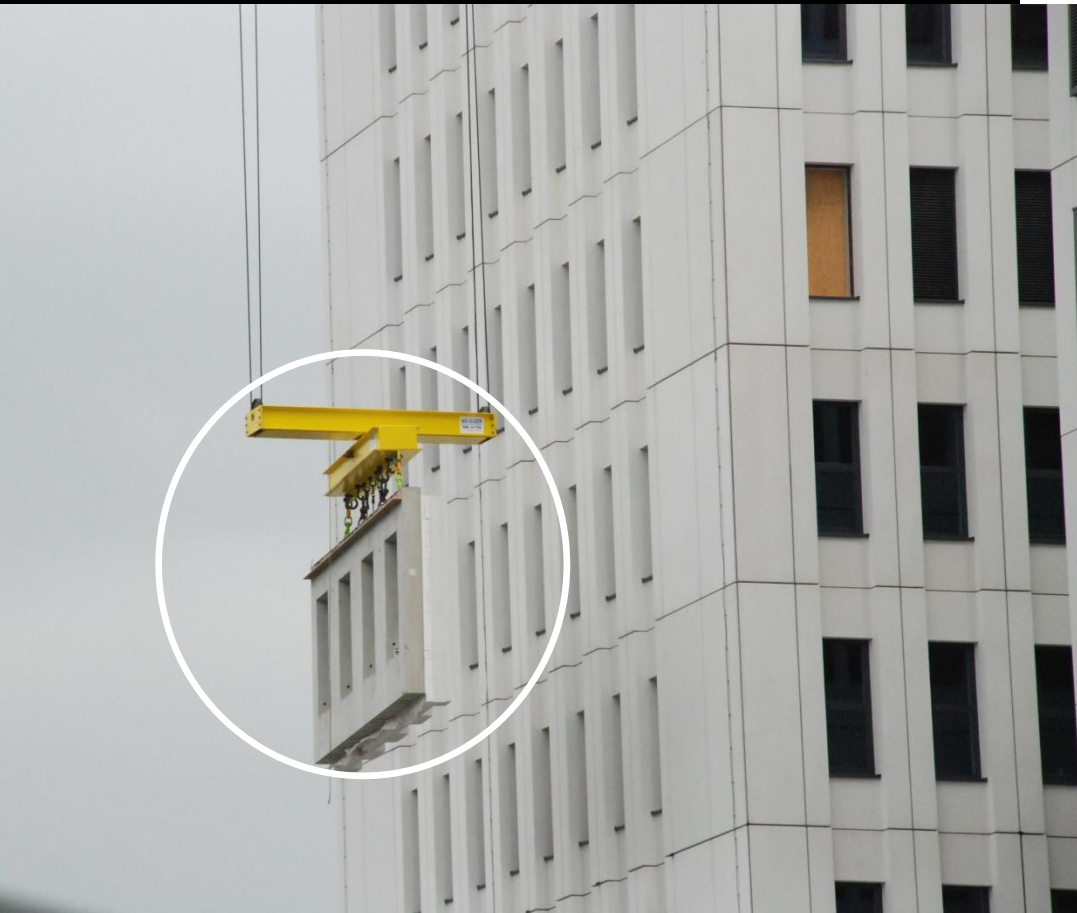


Rotterdam Medical Centre (5)



- Every week one floor in the factory on top of the new building
- Prefab wall elements
- Prefab floor elements
- In situ top layer at the floor

Rotterdam Medical Centre (7)



Centre (8)



Rotterdam Medical Centre (9)



Rotterdam Medical Centre (10)



Rotterdam Medical Centre (11)



Rotterdam Medical Centre (12)



concrete elements

As wall

As floor

Fixed with dry joints

Rotterdam Medical Centre (13)

2 “Frames” support the steel factory



Rotterdam Medical Centre (14)



2 steel beams support the shed from 2 levels below.

Rotterdam Medical Centre (15)



Hydraulic jacks move the factory up
every week one floor

Rotterdam Medical Centre (16)



- Health and Safety conditions
- Integration of Design and Build
- Community relation
- Quality



**Thank you for listening and
enjoy the 28th ISARC Symposium in Seoul**

Frans van Gassel & Ger Maas