

„Sustainable Construction - Contribution of the Engineering  
Community to the Environmental Protection“

Changing Current Engineering Practice through Innovative  
Solutions

Trends and Innovations in Prefabricated Building Envelope

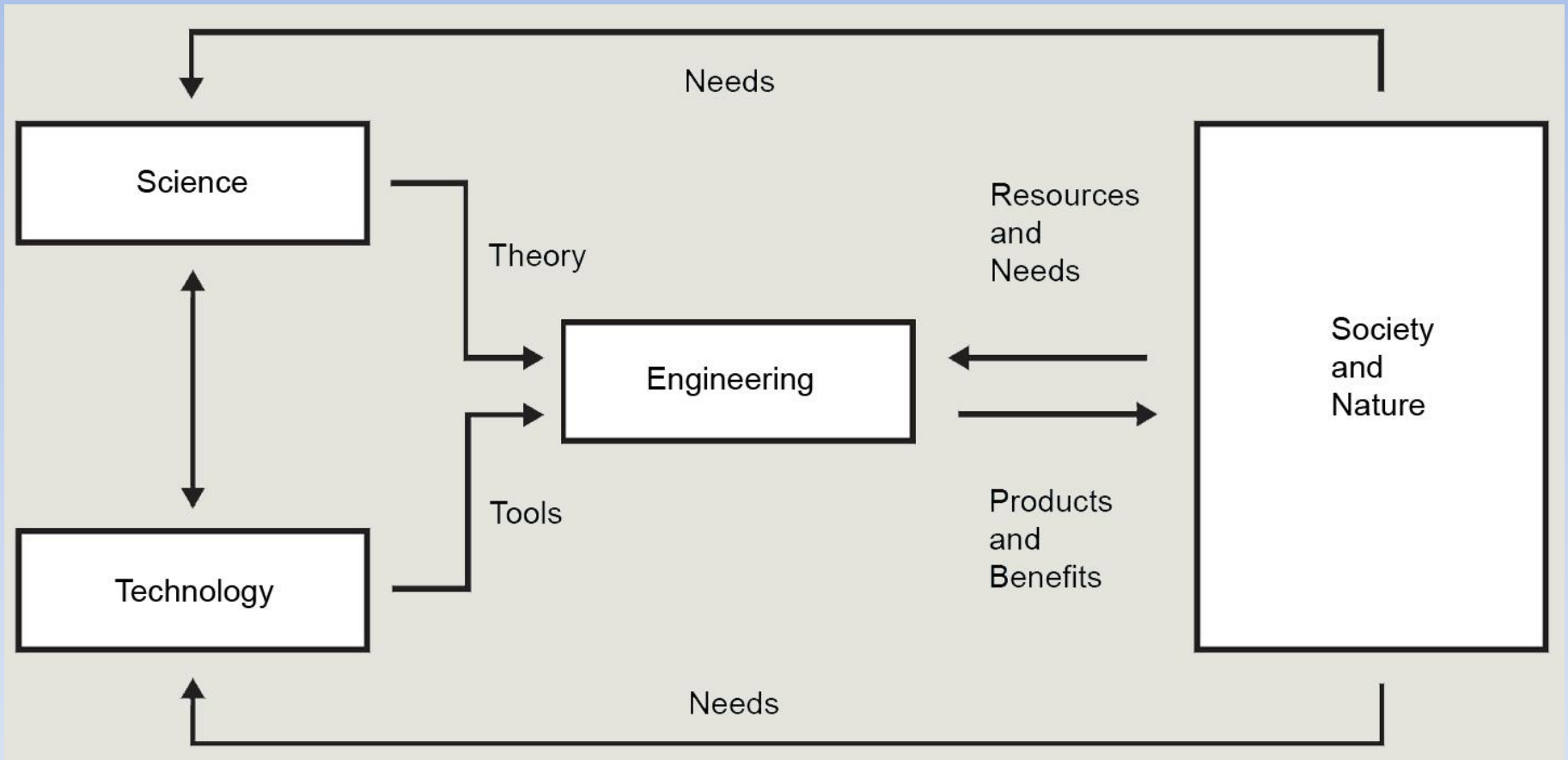
dr. Ljudmila Koprivec, Trimco, d.d., Slovenia  
mag. Črtomir Remec, CBS Institut, Slovenia

# Ingeneering for a better World

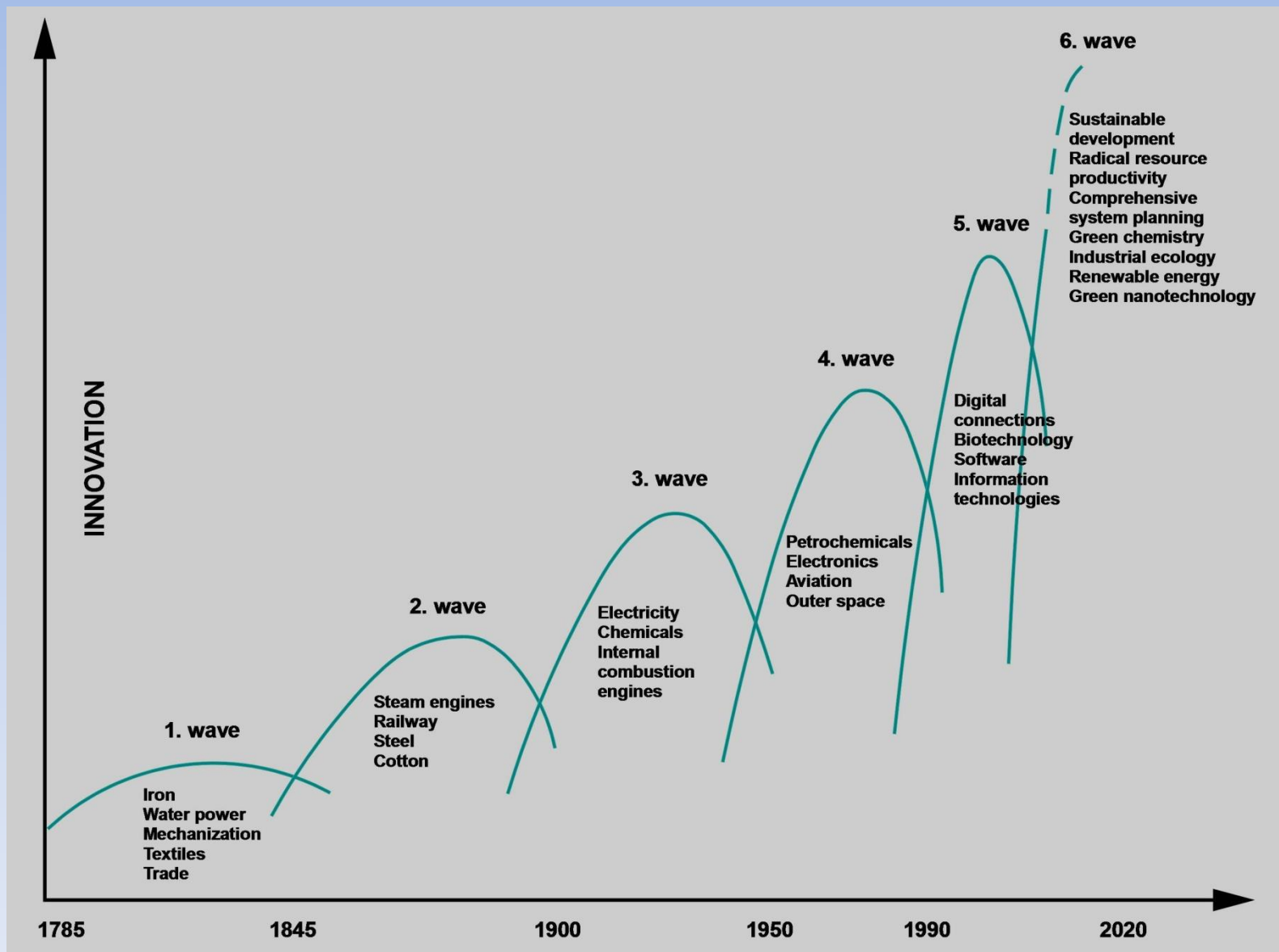
## Goals & Definition

- Goal
  - The essence of engineering is to improve quality of life in the fields of health care, nutrition, transport, communications, ...
- Definition
  - Engineering is a discipline, practice, occupation or art that is closely connected with the development, obtaining and implementing technical, scientific and mathematic knowledge in understanding, planning and developing innovations
  - Materials, machines, constructions, systems and processes are used for the specially defined purposes

# Engineering, Science and Technology

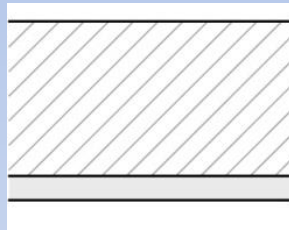


# Historical Waves of Innovation



# Building Envelope's Development Phases

## I. Phase

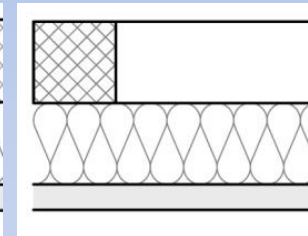
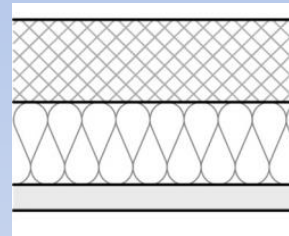


Load-bearing layer

External layer



## II. Phase



Load-bearing layer

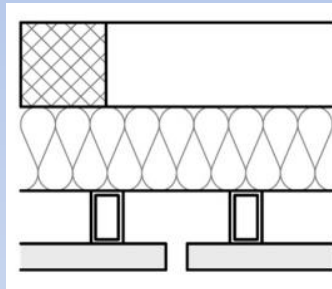
Insulating layer

External layer



# Building Envelope's Development Phases

## III. Phase

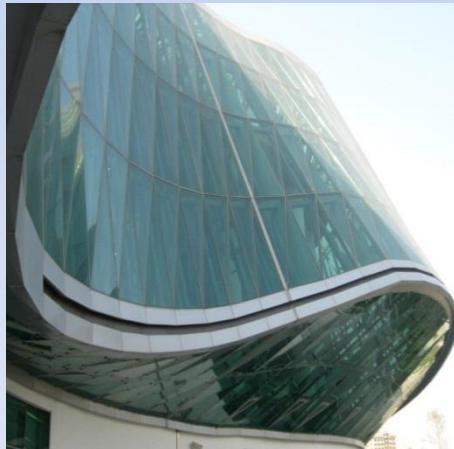


Load-bearing layer

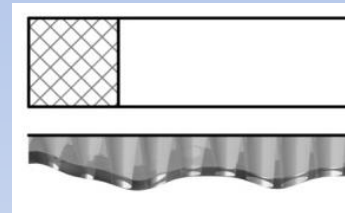
Insulating layer

Ventilating layer

External layer

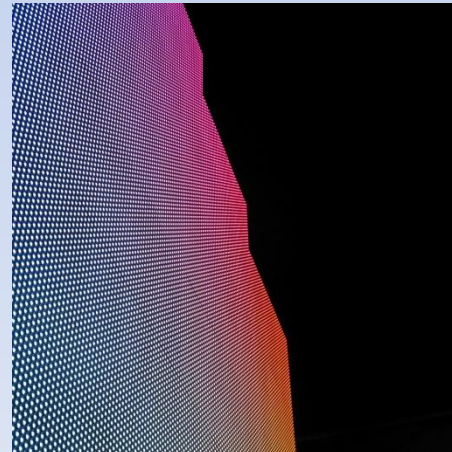


## IV. Phase



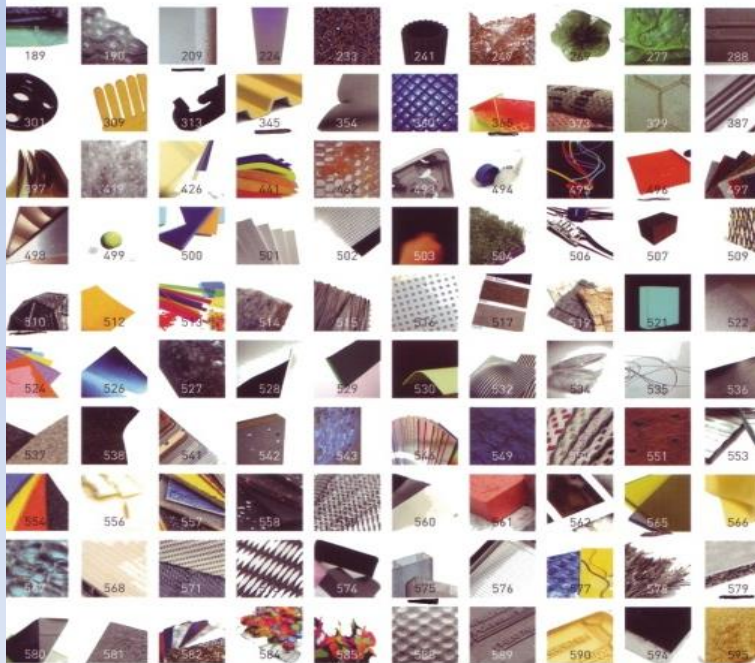
Load-bearing layer

Responsive layer





# Trends Material & Technology Transfere



## New Technologies New Design Systems

Aerospace industry  
Car industry  
Computer technology  
Nanotechnology  
Biotechnology

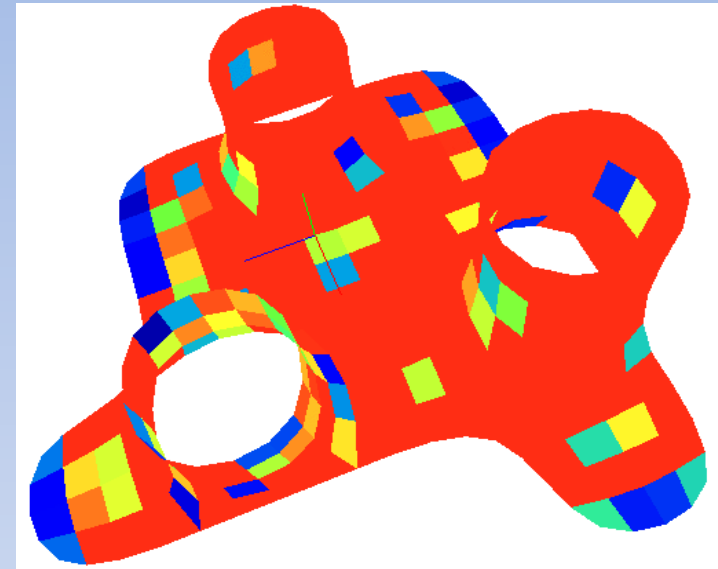
...

## New Materials New Usages

Different industries  
Interdisciplinary collaboration

# Trends Future Building Envelope

- Active Building Envelope
- Modular/Prefabricated Building Envelope
- Flexible Building Envelope Design





Innovation

Examples from the current practice

## **I. PRODUCT INNOVATION**

**Innovative, Energy Efficient, Prefabricated Facade System**  
(Research, Development , Application, 2009-2014)

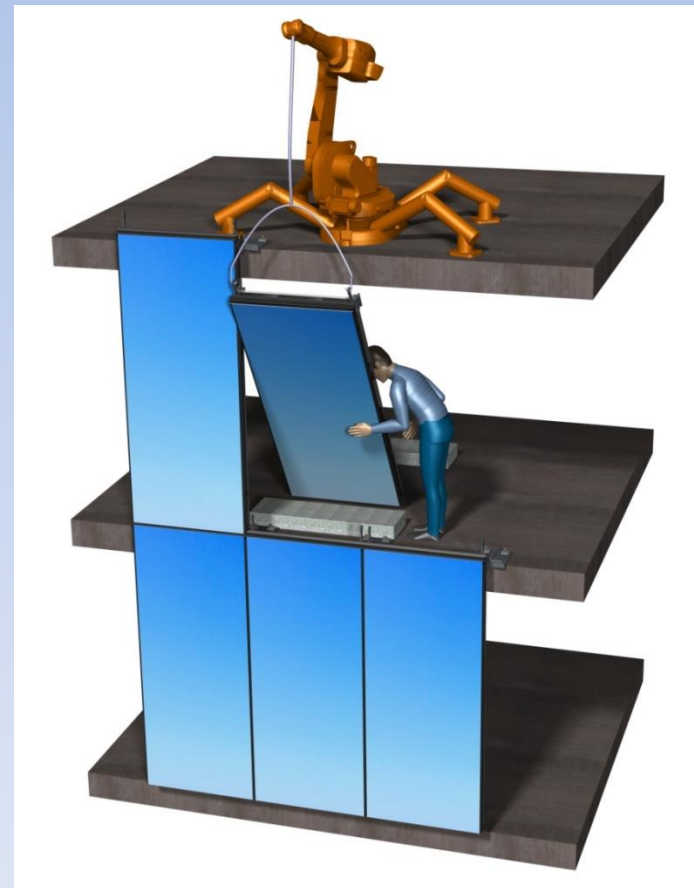
## **II. PROCESS INNOVATION**

**Building Information Modeling Design tool for the Building Envelope**  
(Research, Development , Application, 2012-2013)

## Product innovation

- High energy efficiency
- Integrated load-bearing subconstruction
- High sound insulation
- Fire safety
- Different facing materials
- Research of the new materials

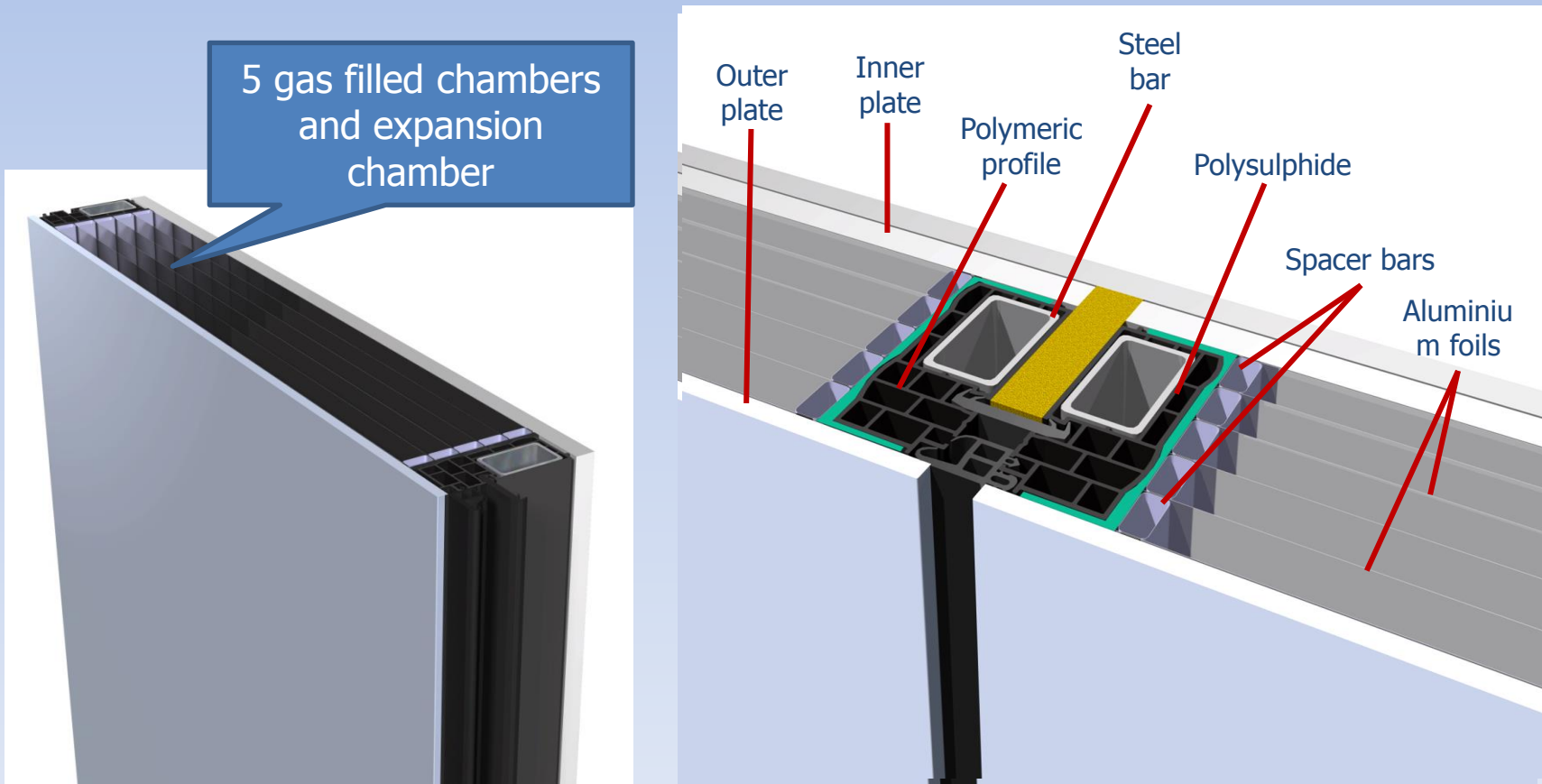
## Concept of the new prefabricated facade system



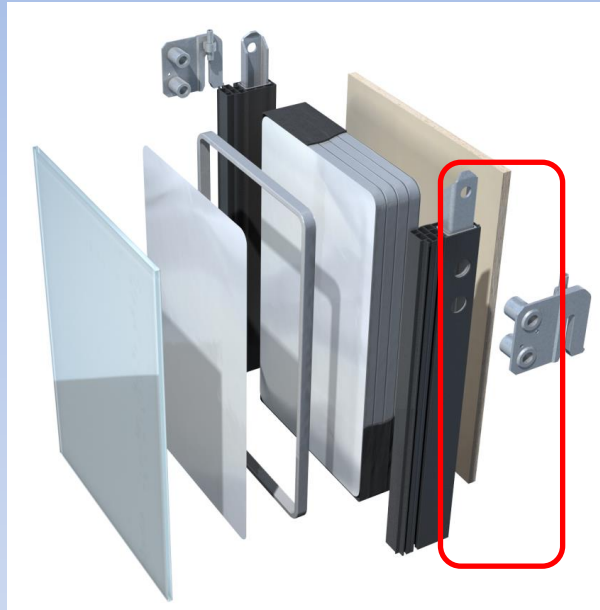
## Product innovation

## High energy efficiency

- **U value of the insulation core** –  $U_g = 0.17 \text{ W/m}^2\text{K}$
- **U value of the complete system** –  $U_{cw} = 0.10 \text{ do } 0.25 \text{ W/m}^2\text{K}$



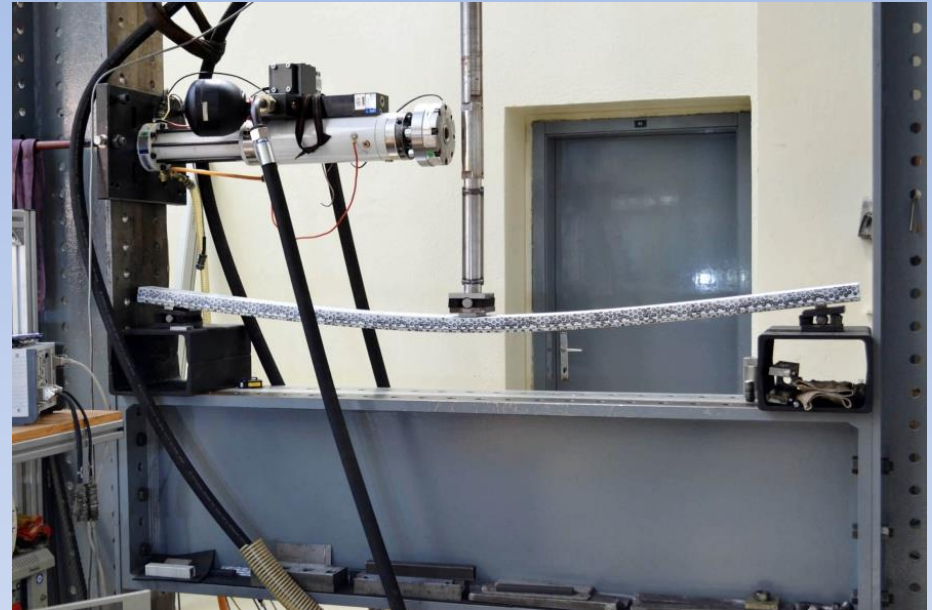
## Product innovation



### Extruded polymeric profile:

- Flexural modulus of elasticity up to 7.000 MPa
- Thermal conductivity from 0.28 W/mK
- Combustible

## Integrated load bearing subconstruction

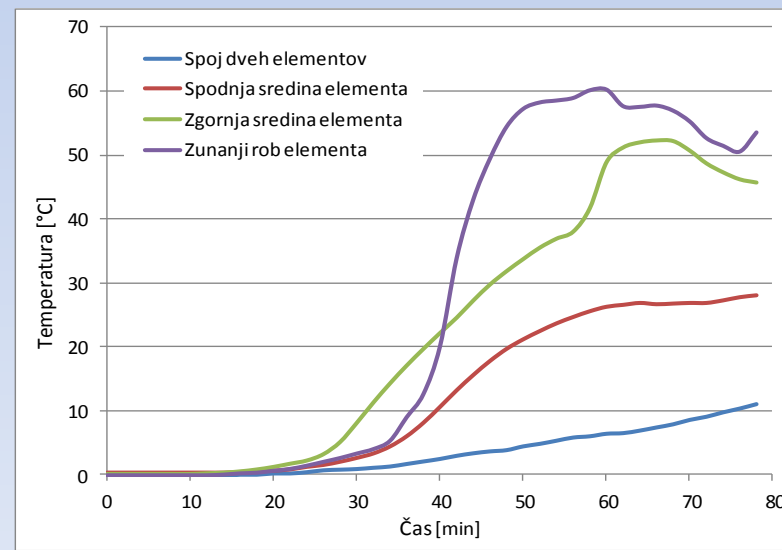
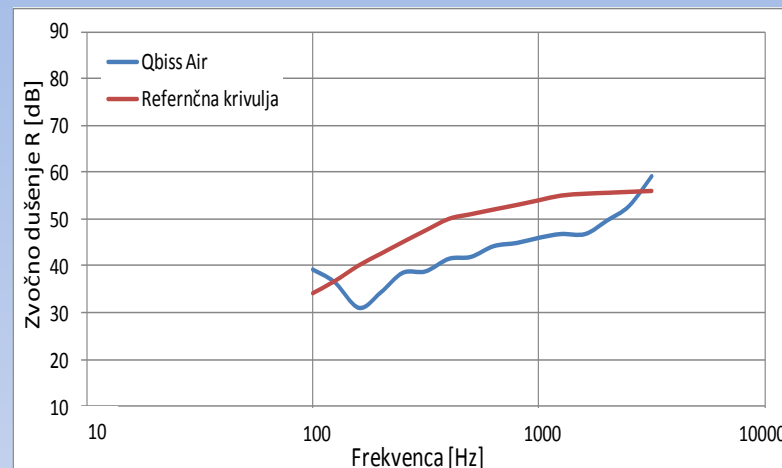
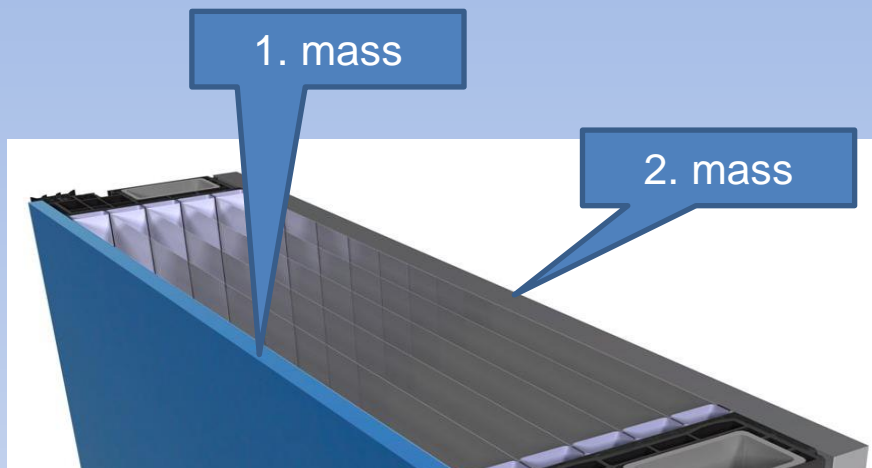


### Pultruded polymeric profile:

- Orthotropic properties
- Flexural modulus of elasticity from 15.000 MPa
- Thermal conductivity below 0.45 W/mK
- Flame retardant

# Product innovation

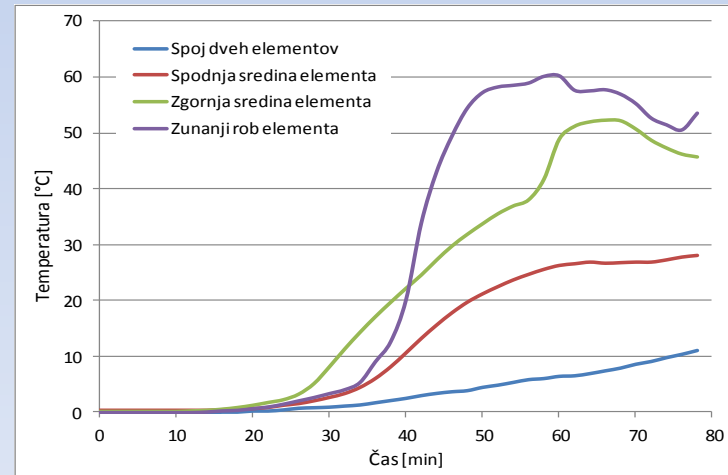
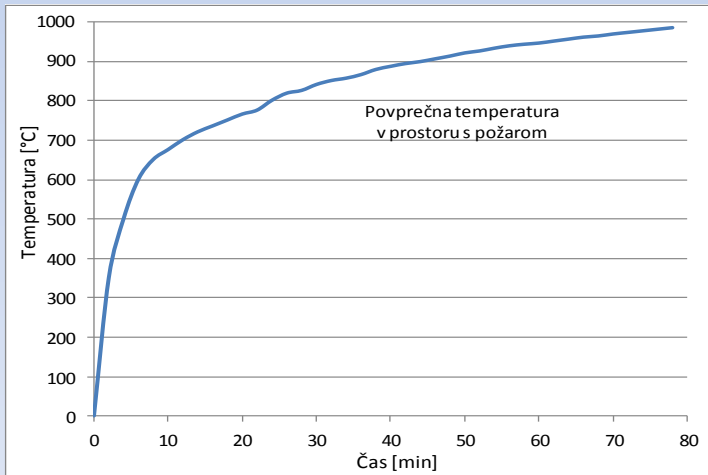
# High sound insulation





Product innovation

Fire safety



## Product innovation

## Different facing materials

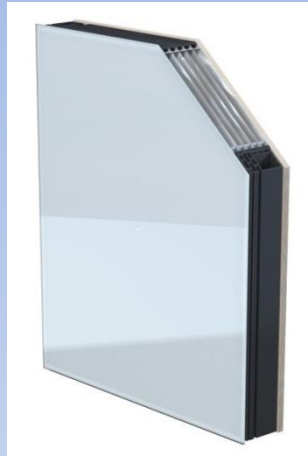


### Outer skin options:

- Glass: toughened, enamelled, laminated and ceramic print
- HPL: RAL based colours, wood and stone immitations

## Product innovation

## Unrivalled system performance



<b>Qbiss Air system:</b>	<b>Opaque</b>	<b>Transparent</b>	<b>Translucent</b>
Energy efficiency (U value)	0.25 W/m <sup>2</sup> K	0.27 - 0.45 W/m <sup>2</sup> K	0.27 - 0.45 W/m <sup>2</sup> K
Solar heat gain (g value)	/	0.1 – 0.25	0.1 – 0.25
Natural light (LT value)	/	15 - 35%	15 - 35%
Acoustics	46 – 60 dB	45 – 60 dB	45 - 60 dB
Fire safety	EI 60 - 120	0 - EI 45	0 - EI 45

## Product innovation

### Classification

- Unitized facade system
- Skeleton building structure
- Structural glazing system
- Visual material alteration

## Building types

### Public buildings

Offices, Banks,  
Hotels, Cultural Centers  
Libraries, Hospitals  
Hybrids (public & private space)

...





# Product innovation

# Kindergarten, Slovenia, 2011



Energy for heating per year (m<sup>2</sup>)

- < 35 kWh/ m<sup>2</sup> per year
- Low energy building rate  
B class

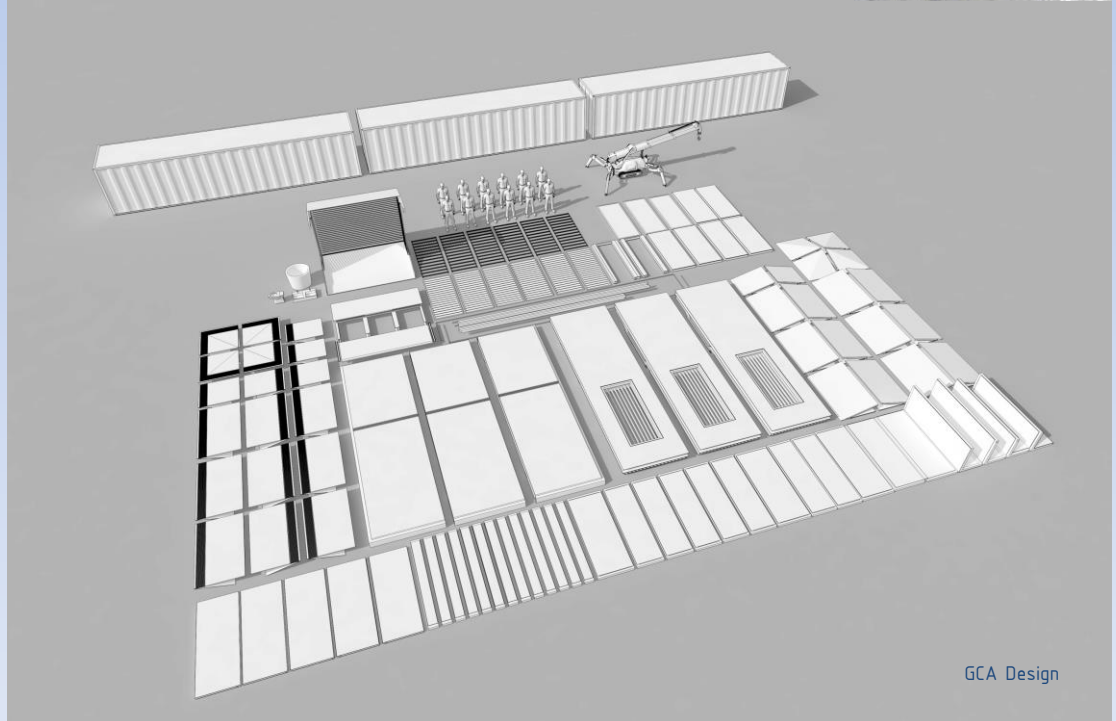
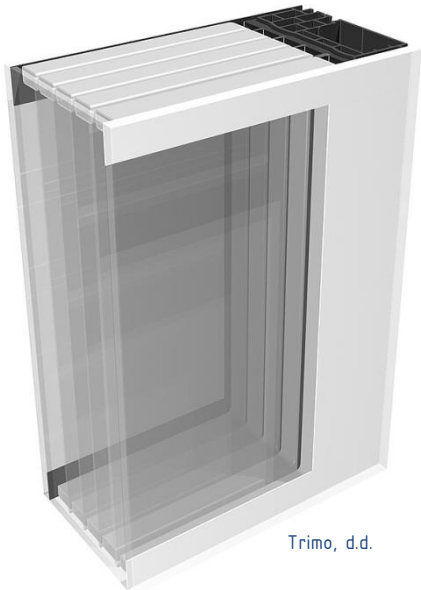
**B2 = 34,7 kWh/m<sup>2</sup>**





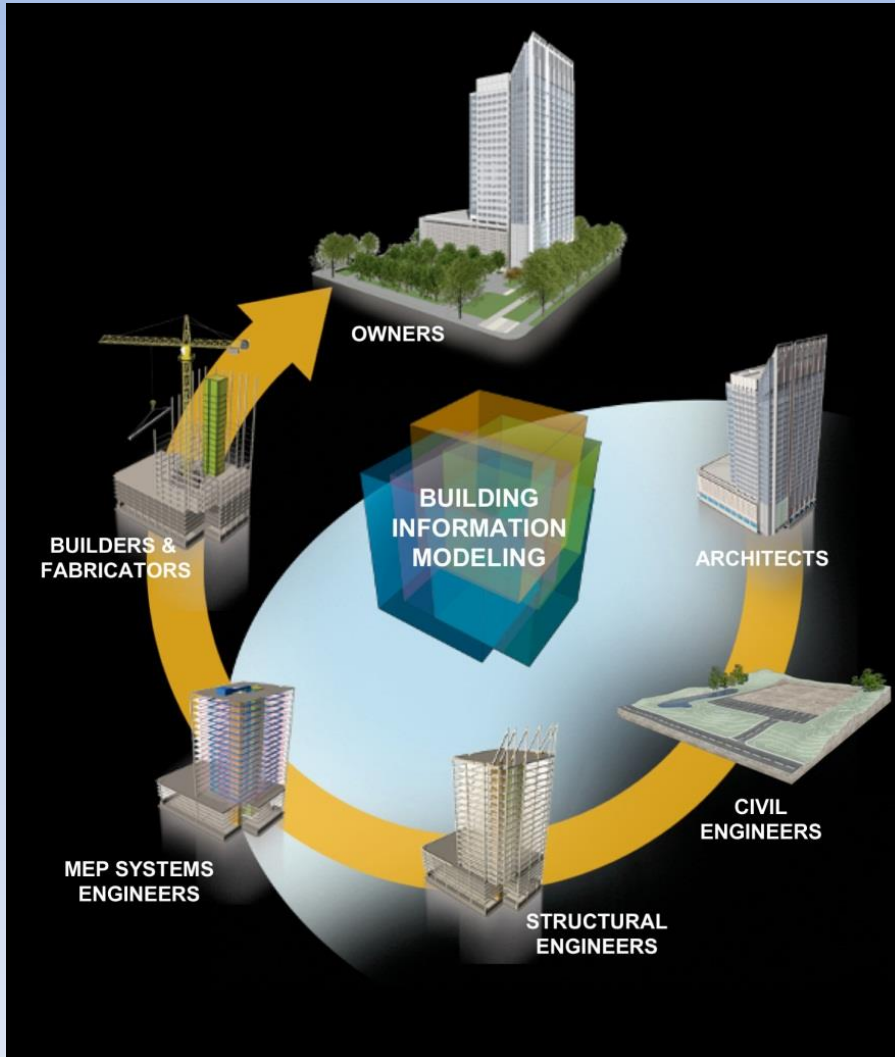
# Product innovation

# Prefabricated Hotel Unit, UK, 2013-2014



## Process innovation

## Building Information Modeling

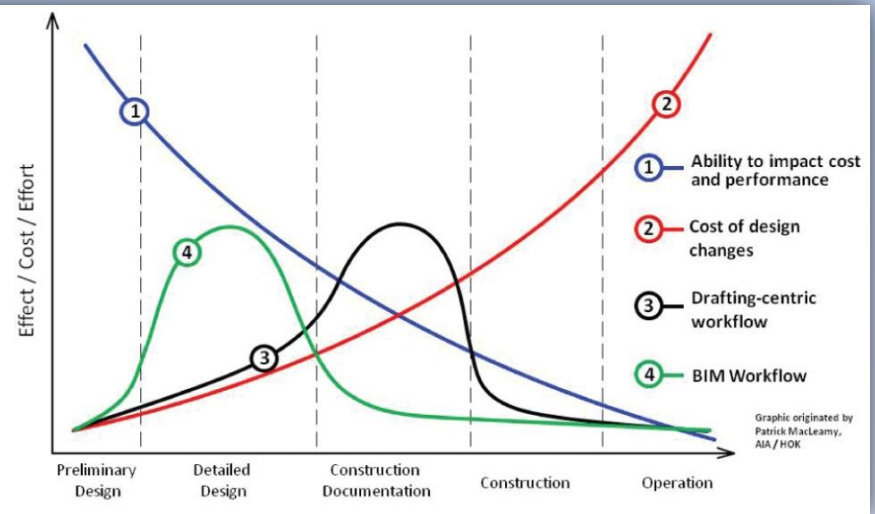
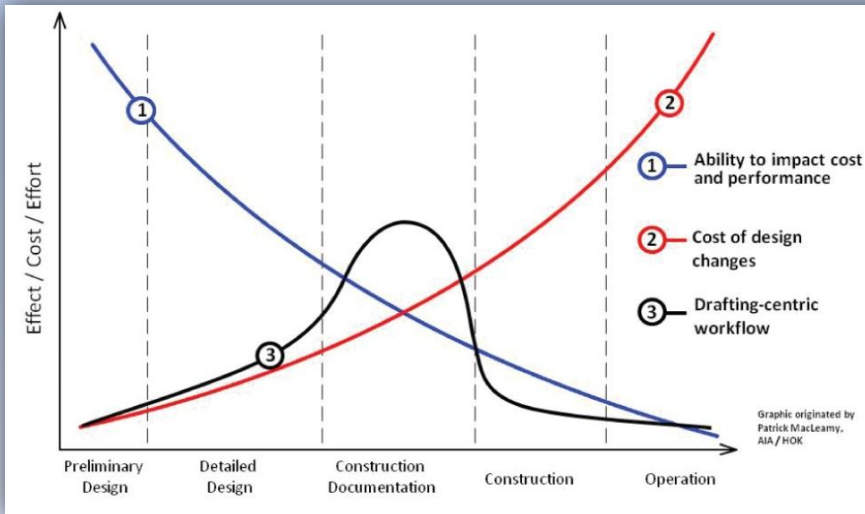


- 3D + Data + Relationship
- Life Cycle of a Building
- Digital building data
- Work in 3D, 4D, 5D
- Interoperability
- Global collaboration
- New construction strategy
- ...

# Process innovation

# BIM as added value for Manufacturers

- New type of communication between architect and manufacturer
- Manufacturer's early project involvement
- High ability to lower project costs and improve design performance



Graphic: Patrick MacLeamy, AIA/HOK

↑  
Traditional process

↑  
BIM process

Process innovation

BIM Tool for Architectural Design

SOFTWARE

Graphisoft **ArchiCAD 16, 17**

Autodesk **Revit 2012, 2013**

LIBRARY **Curtain Wall Tool**

STANDARDISATION **IFC**



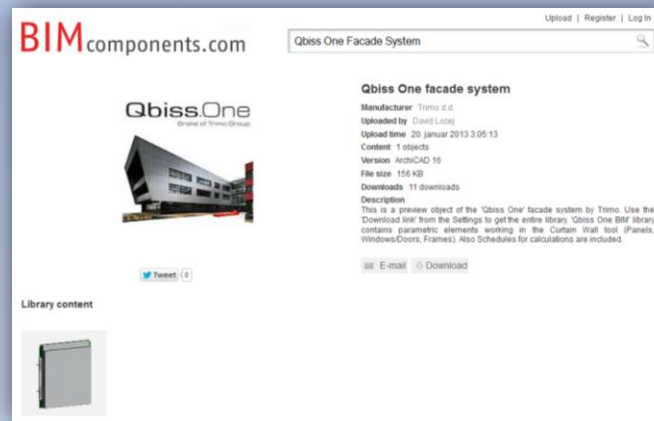


# Process innovation

# BIM Tool for Architectural Design

## ARCHITECT

[www.trimo.si](http://www.trimo.si), [www.qbiss.eu](http://www.qbiss.eu), [www.bimcomponents.com](http://www.bimcomponents.com), articles, e-mail;...



## Qbiss One BIM

### Download library

- Registration
- Free download
- User statistics

### Download Instructions

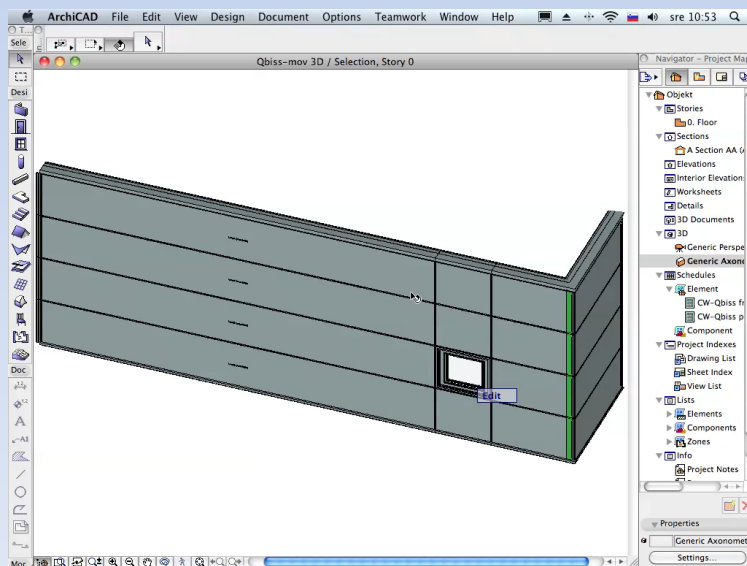
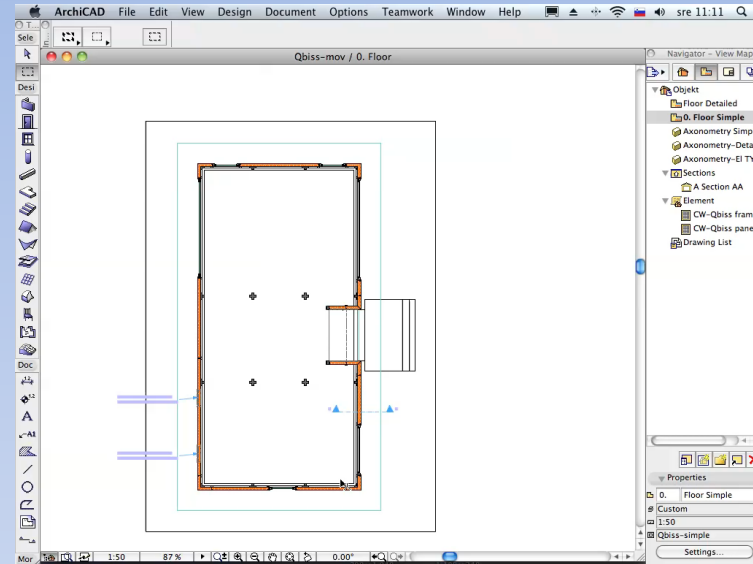
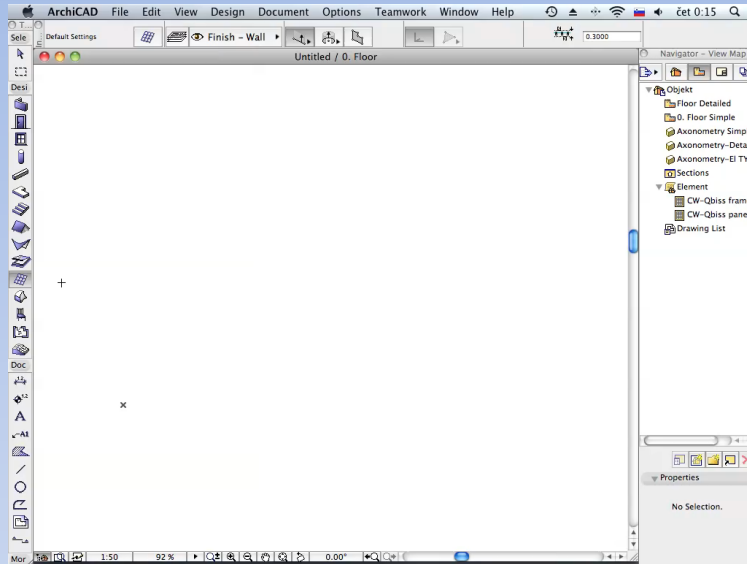
- Ready made elements
- Short movies
- Contact Informations

### Deeper knowledge

- Qbiss One system
- Design possibilities
- References



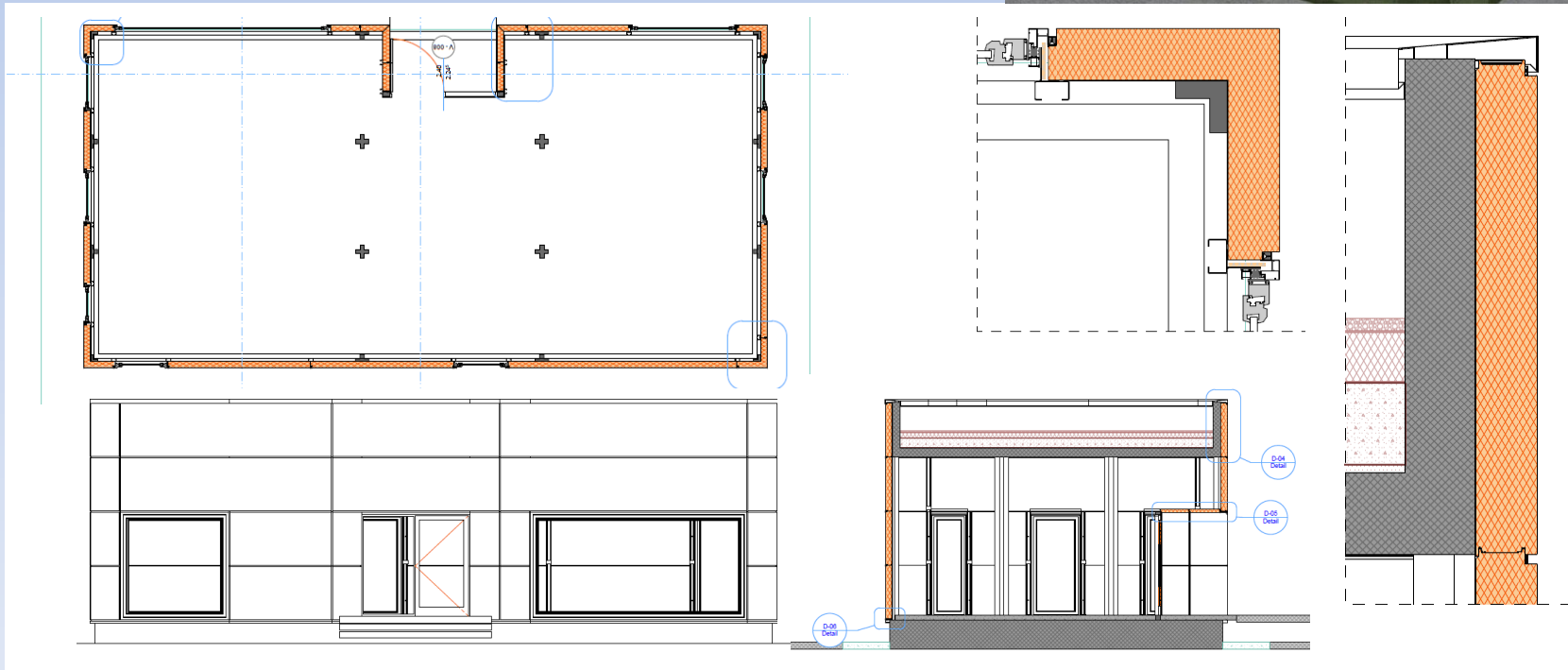
# Innovation BIM Tool for Architectural Design



# Process innovation

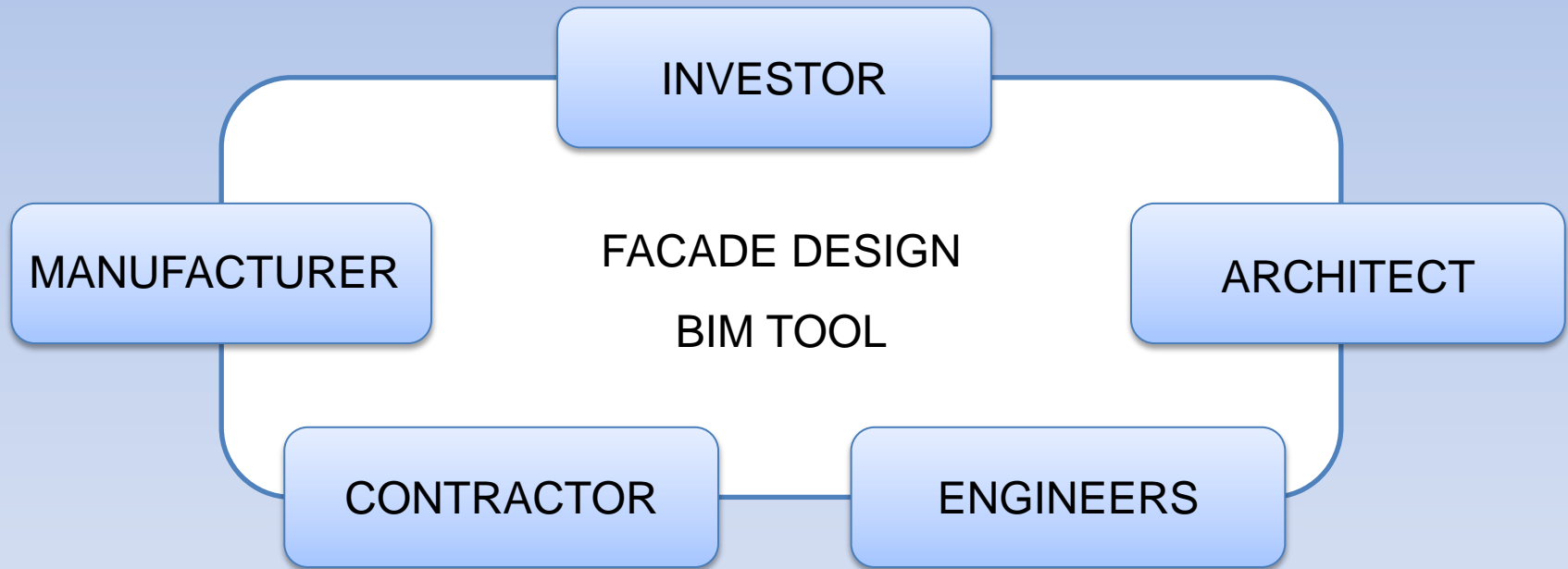
# BIM Case study

- Faster project design
- 3D parametric design
- Floor plans, sections, elevations, details
- Visualization, Multiple views, Video
- Digital documentation, schedules & lists
- Cost evaluation, System information



Process innovation

Process Chart



## Conclusion

- Further development in science, engineering and technology will lead to innovative solutions in the future.
- Fullfill the demands of the sustainable society, reducing poverty, risk control against natural disasters, lifelong learning and encouraging lifelong learning.
- Engineers have the opportunity to develop innovative solutions and implement them to provide better sustainable development of our planet.



Thank you for your  
attention!

[ljudmila.koprivec@trimo.si](mailto:ljudmila.koprivec@trimo.si)

[c.remec@cbs-institut.si](mailto:c.remec@cbs-institut.si)