TAMING MULTIDIMENSIONAL COMPLEXITY OF MAJOR PROJECTS

New Frontiers in Construction | CERC Applied Research Conference
March 16, 2017

Prof. Dr. Katharina Klemt-Albert
Director
Department of Construction Management and Digital Engineering

PROF. DR. KATHARINA KLEMT-ALBERT
LINKING SCIENCE AND PRACTICE

German Railway and Infrastructure Group

Member of the board of an international engineering and consulting company

Leading function as: Regional Director Construction Supervision Project Manager

Top-Management

Leibniz Universität Hannover

Department of Construction Management and Digital Engineering

Faculty of Civil Engineering and Geodetic Science

Topics of Research:
Digital Construction | BIM | Project-Management | Leibniz Digital Lab
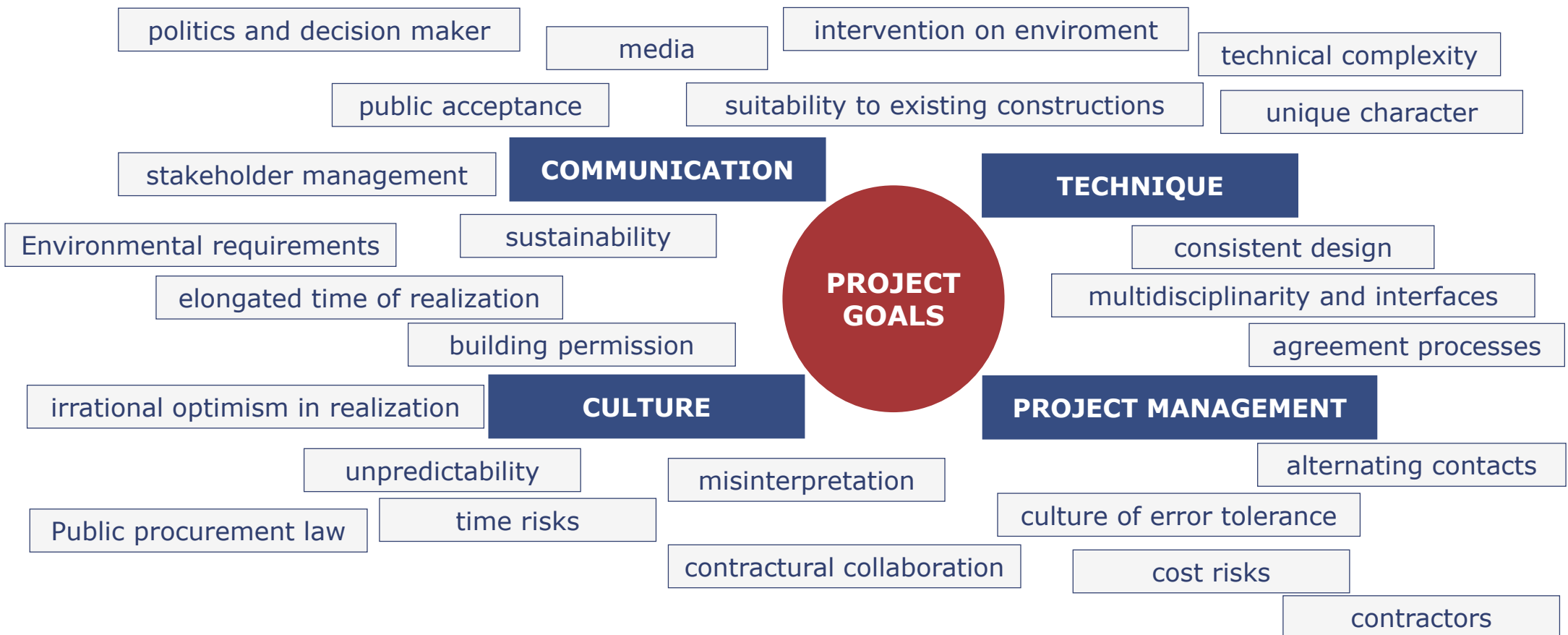
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Director

albert·ing

albert.ing GmbH

Consultancy for owners and designers
Implementation of IT and realization of Digital Solutions

Founder and CEO

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Hannover

Construction Management
and Digital Engineering

politics and decision maker

media

intervention on enviroment

technical complexity

public acceptance

suitability to existing constructions

unique character

COMMUNICATION

TECHNIQUE

stakeholder management

sustainability

consistent design

Environmental requirements

PROJECT GOALS

multidisciplinarity and interfaces

elongated time of realization

building permission

agreement processes

irrational optimism in realization

CULTURE

PROJECT MANAGEMENT

unpredictability

misinterpretation

alternating contacts

Public procurement law

time risks

culture of error tolerance

contractural collaboration

cost risks

contractors

Branche overview

Source: momentum-magazin.de

MEDIUM-SIZED INDUSTRY

- 90% of the design and engineering companies < 10 employees
- Most companies focus on regional projects only
- Market consolidation in construction due to tough competition
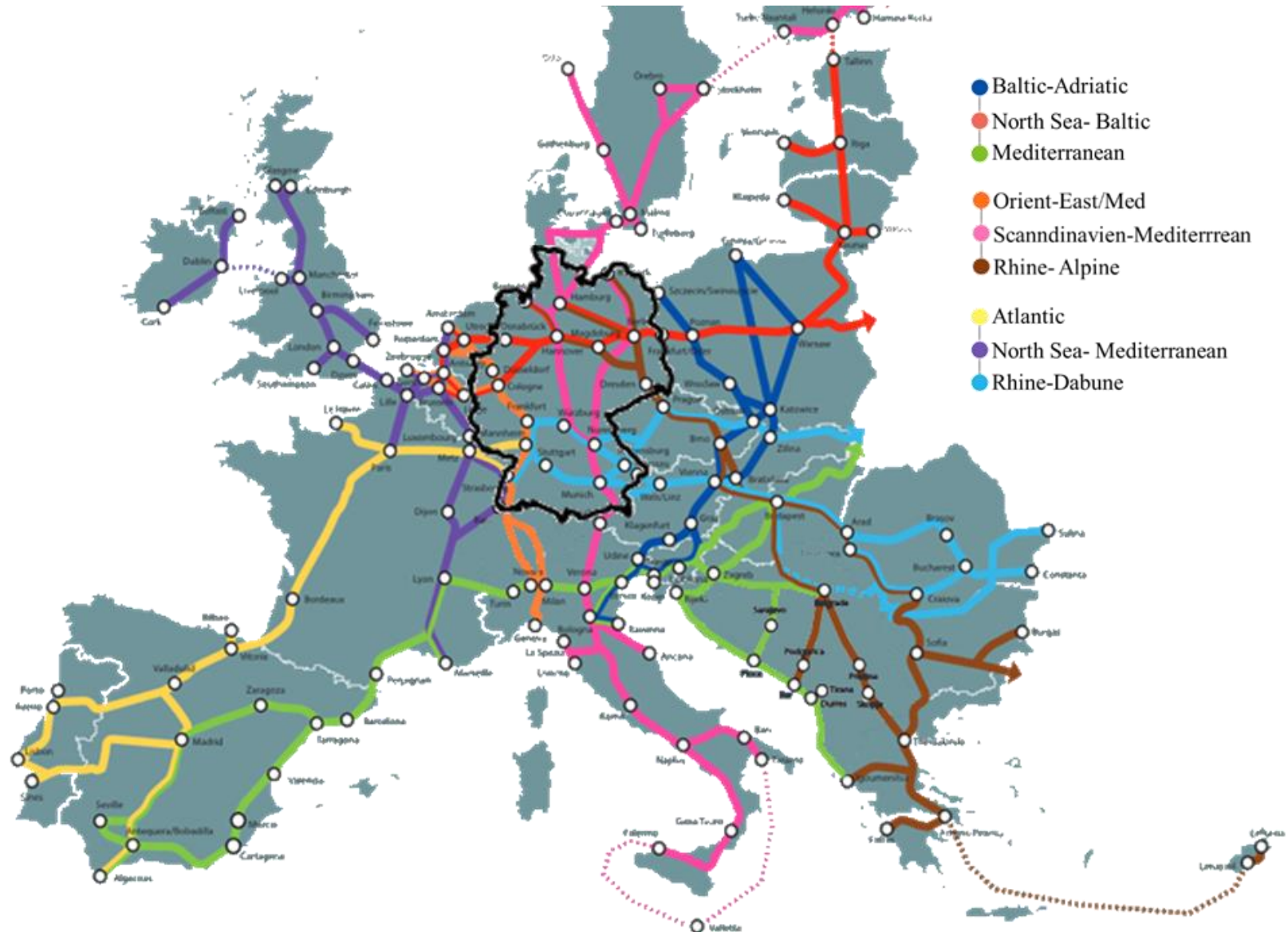
RESSOURCES AND CAPACITY

- Nearly full employment in Germany
- Rising lack of qualified technicians and engineers
- Design and construction companies run over their capacity

CONTRACTUAL FRAMEWORK

- Price law for architects and engineers - HOAI
- Mostly strict division into design and construction phase
- Long time for building permission especially in European context

INVESTMENTS

- Very high investments on governmental side, focus on infrastructure
- High investments in buildings in all major cities
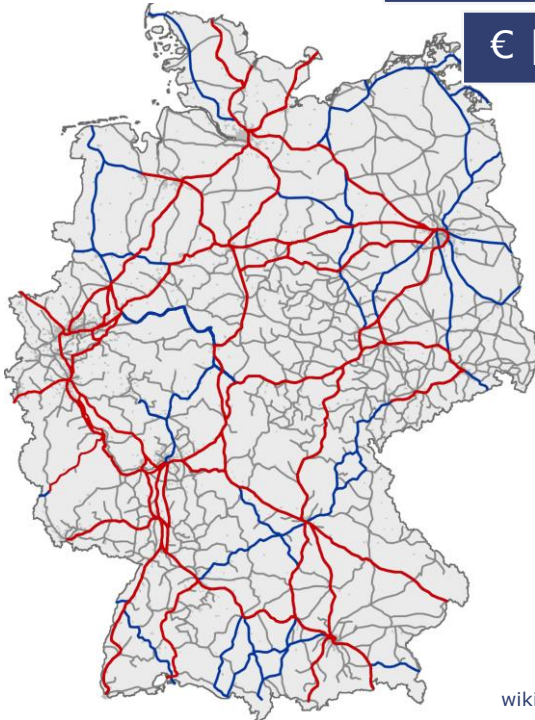- Special requirements for sustainable structures

Transeuropean Traffic Transport Networks TEN-T

Legend:
- Baltic-Adriatic
- North Sea- Baltic
- Mediterranean
- Orient-East/Med
- Scanndinavien-Mediterrrean
- Rhine- Alpine
- Atlantic
- North Sea- Mediterranean
- Rhine-Dabune

High investments (€ 270bn up to 2030)

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Rail	Road	Waterway
33,300 km	230,000 km	7,350 km
€ | 41%	€ | 50%	€ | 9%

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wikimedia.org

- daily transportation of 6.2 Mio. people via rail
- Speed up to 300 km/h (190 mph)

- 13,000 km federal motorway
- 52% of federal motorways without speed limit

- 75 % of the cities are connected to waterways
- 450 lock chambers \| 2 ship lifts \| 15 canal bridges \| 100 ports

Special topics of implementing BIM in infrastructure

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METHODIC AND STRUCTURE

- horizontal structure, alignment, various infrastructure disciplines
- high involvement of public and politics
- complex approval process
- incomplete documentation of existing construction
- life-cycle

INFORMATION TECHNOLOGY

- software landscape (e.g. few modeling tools for special disciplines, alignment and different coordination systems)
- data security
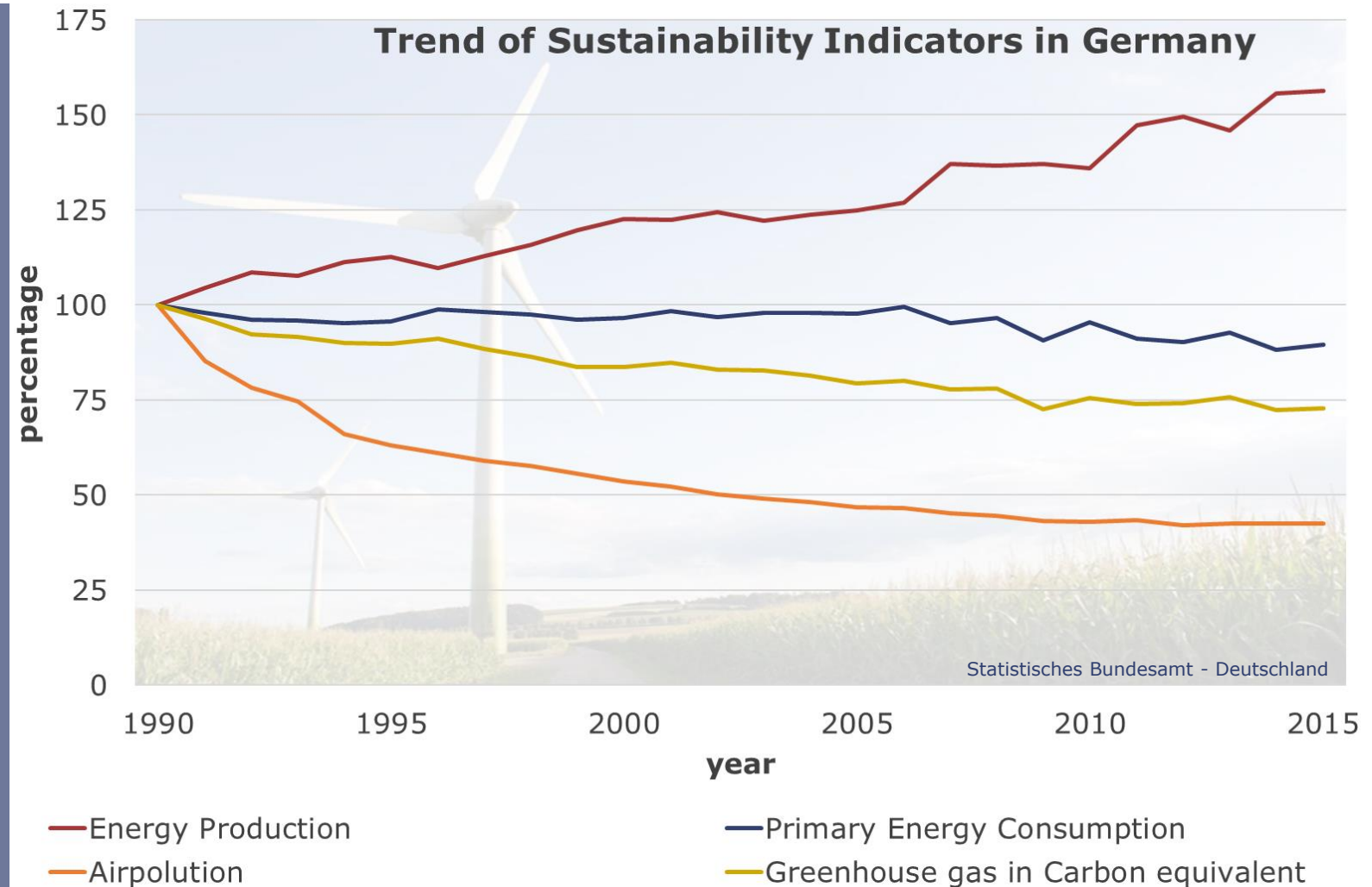- big data volume

BIM

CONTRACT

- public owner with special regulations, e.g. procurement, financing
- formal splitting of investments and operation costs
- high number of project participants
- BIM design process not in line with German price law for design

QUALIFICATION

- change is necessary!
- interdisciplinary complexity
- understanding of high specialized software and processes
- involvement of all project participants and several stakeholders

Governmental and industry focus

SUSTAINABILITY IN GERMANY

- Comparison based on Values of 1990 = 100%

- Nowadays 20% lower greenhouse gas emission

- Construction industry is aware about sustainability
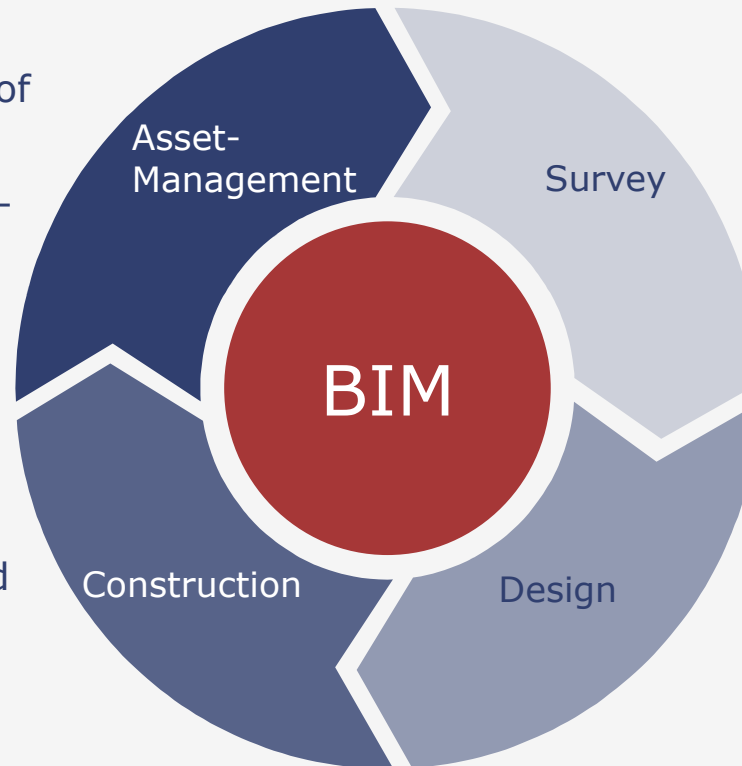
- Construction industry is focusing sustainability

Trend of Sustainability Indicators in Germany

Statistisches Bundesamt - Deutschland

— Energy Production
— Primary Energy Consumption
— Airpolution
— Greenhouse gas in Carbon equivalent

BUILDING INFORMATION MODELING
Transparency | Efficiency | Acceptability | Sustainability

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INFORMATION MANAGEMENT

ASSET MANAGEMENT

- Lifetime Asset-Management
- Planning and Documentation of maintenance and operation
- Optimized model-based, area-management
- AsBuilt-Documentation

CONSTRUCTION

- Efficient construction planning
- Automatic cost calculation and efficient tendering and billing
- Ongoing schedule and cost control
- Visualization of construction phases

SURVEY

- Time-saving surveying, e.g. with application of 3D-Laser Scanning
- Digital terrain modeling based on survey data
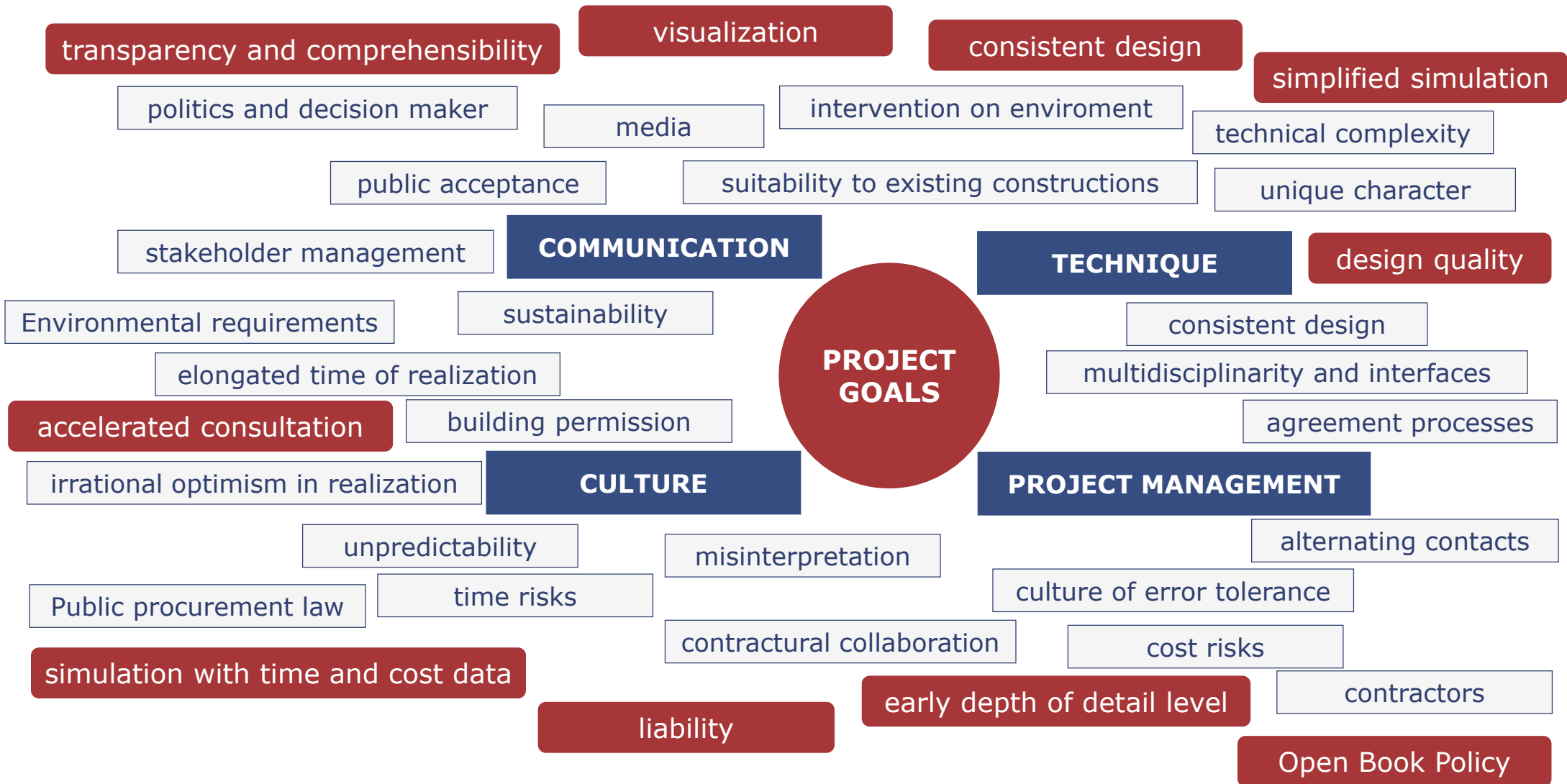- Integration of as-built documentation

DESIGN

- Interdisciplinary design on basis of a shared model
- Simple collision detection and design change management
- Digital review und approval procedures
- Visualizations to increase
- Public support

COLLABORATION

Asset-Management

Survey

BIM

Construction

Design

BUILDING AND CONSTRUCTION
Targeting challenges in major projects

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transparency and comprehensibility

visualization

consistent design

simplified simulation

politics and decision maker

intervention on enviroment

media

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simulation with time and cost data

early depth of detail level

contractors

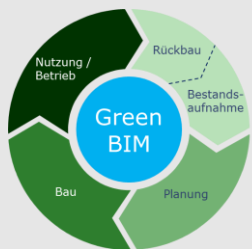liability

Open Book Policy

DIGITAL CONSTRUCTION

- Integrative fabrication for construction industry
- Qualification of technical staff and engineers
- Intelligent linking of generative fabrication with digital construction models
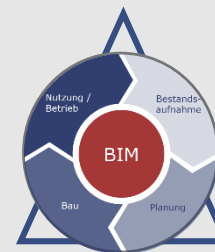
METHODOLOGY AND DIGITAL SOLUTIONS

- Simulation of processes for optimization
- Virtual and augmented reality visualizations for integrated collaboration and public acceptance
- Intelligent model upgrading and automatization

GREEN BIM

- Lifecycle assessment and lifecycle simulation
- Integration of the Green Building certification systems using the BIM-method
- Implementation of ecology and socio-economics aspects into design and project management

MANAGEMENT OF MAJOR PROJECTS

- Reduction of multidimensional complexity with digital solutions
- Resilient infrastructure
- Qualified and quantitative assessment
- intelligent extension and optimization of modelling

DIGITAL METHODS IN AEC - Hanover/Germany

Digital Convention   September 6th-7th
Summer School   September 4th-8th

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Construction Management and Digital Engineering

Prof. Eilif Hjelseth
Oslo and Akershus University College
Norway

Prof. Singh Vishal
Aalto University
Finland

Dr. Laura Osburn
University of Washington
U.S.A

Prof. Albert Chan
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China

Prof. John Messner
Penn State University
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Prof. David Chua
National University Of Singapore
Singapore

Cheng Tai Fatt
Building and Construction Authority
Singapore

Prof. Robin Drogemuller
Queensland University of Technology Brisbane
Australia

Prof. Bilal Succar
University of New Castle
Australia

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Thank you!