



Systematic Performance Requirements Management of Built Facilities

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Systematic Performance Requirements Management of Built Facilities

- Current state
- the Performance approach and Systematic requirements management
- Tool development and implementation
- Experiences from practice
- Future challenges

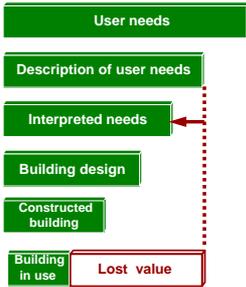
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Current problems

- Customer requirements are not always captured
- Original requirements are not documented
- Brief contains unclear or conflicting objectives
- Traceability of design decisions to client requirements
- Transformation (Design & Construction phase) lacks creativeness and flexibility
- Contractor selection is based on the price of the production capacity
- Construction phase is full of communication problems
- Essential requirements are lost due to cutting corners
- Mistrust between stakeholders
- Focus on the investment costs instead of whole life costs

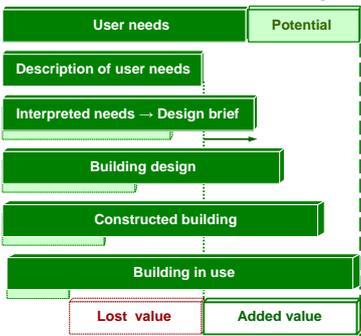
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Performance of Building



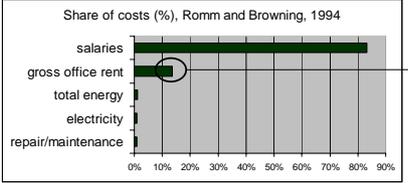
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Performance of Building



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Starting point



- Human and organizational questions need more attention than technical aspects in the project definition phase
- Clients' core business requirements are the most important issue in the project briefing/programming phase
- Project parties need means to communicate their requirements to the design team in a meaningful way

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Performance approach in construction

- Performance =**
 - a qualitative level of a critical property at any point of time considered (ISO 15686)
 - behaviour in service for a specified use.
- Performance Requirement =** Required property that is stated without describing the technical solution
- Performance Approach =** Procedure where properties of a building are described in briefing phase, rather than technical solutions
- End Result of Design =** technical solution that fulfils the requirements set for the case. Construction and use of the technical solution cause a certain environmental pressure and life cycle costs.

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Performance Approach

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Approach – Match the Demand and Supply

Required performance Verification/Benchmark Verified performance

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VTT building properties classification

owner, users, society

performance, conformity

life cycle costs, environmental pressure

VTT Prop®

- A CONFORMITY**
 - A1 LOCATION
 - A1.1 Site characteristics
 - A1.2 Transportation
 - A1.3 Impacts on surroundings
 - A2 SPATIAL SYSTEMS
 - A3 SERVICES
- B PERFORMANCE**
 - B1 INDOOR CONDITIONS
 - B1.1 Indoor climate
 - B1.2 Acoustics
 - B1.3 Illumination
 - B1.4 Vibration conditions
 - B2 SERVICE LIFE AND DETERIORATION RISK
 - B3 ADAPTABILITY
 - B4 SAFETY
 - B4.1 Structural safety
 - B4.2 Fire safety
 - B4.3 Safety in use
 - B4.4 Intrusion safety
 - B4.5 Natural catastrophes
 - B5 COMFORT
 - B6 ACCESSIBILITY
 - B7 USABILITY

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VTT Prop®

- C COST AND ENVIRONMENTAL PROPERTIES**
 - C1 LIFE CYCLE COSTS
 - C1.1 Investment costs
 - C1.2 Operation costs
 - C1.3 Maintenance costs
 - C1.4 Demolition and disposal costs
 - C2 ENVIRONMENTAL PRESSURE
 - C2.1 Biodiversity
 - C2.2 Resources
 - C2.3 Emissions

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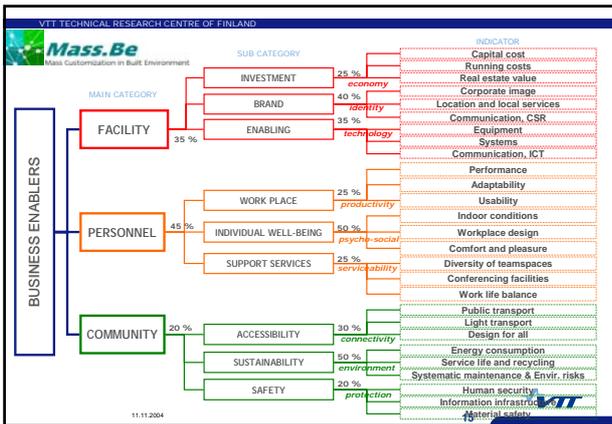
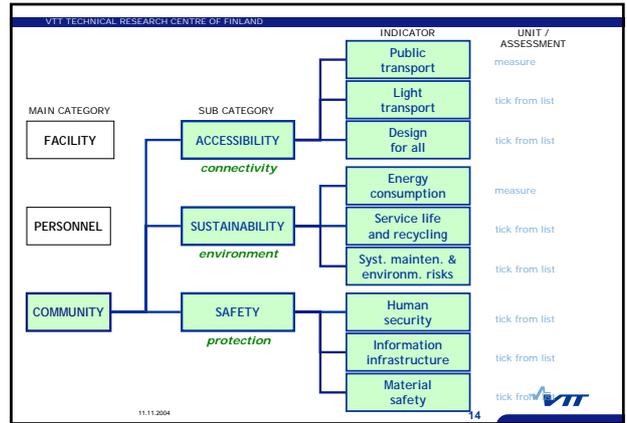
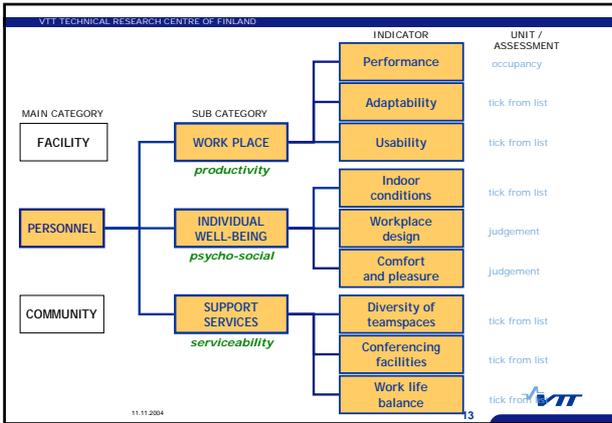
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VTT building properties classification

INDICATOR UNIT / ASSESSMENT

MAIN CATEGORY	SUB CATEGORY	INDICATOR	UNIT / ASSESSMENT
FACILITY	INVESTMENT <i>economy</i>	Capital cost	€ / m ²
		Running costs	€ / person / year
		Real estate value	€ / m ²
PERSONNEL	BRAND <i>identity</i>	Corporate image	Judgement
		Location and local services	tick from list
		Communication, CSR	tick from list
COMMUNITY	ENABLING <i>technology</i>	Equipment	tick from list
		Systems	tick from list
		Communication, ICT	tick from list

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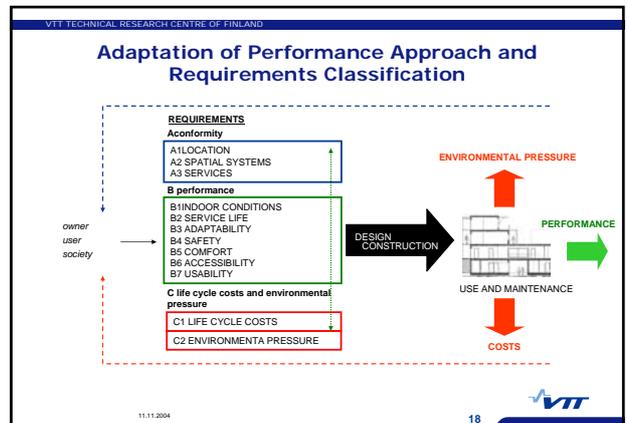
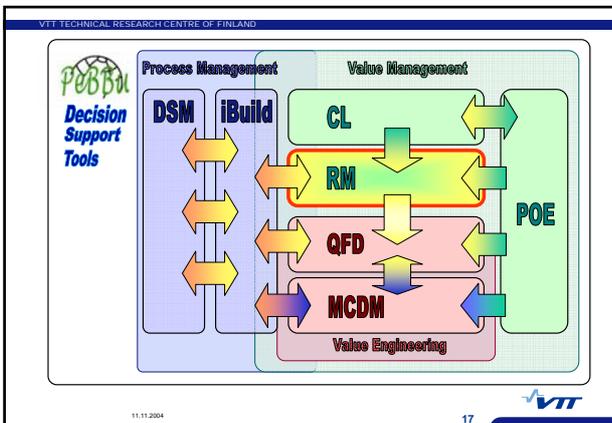
PEBBU

Decision Support Tools

	Briefing	Design	Delivery	Operation
Post Occupancy Evaluation (POE)		2	3	1
Check Lists (CL)		2	1	3
Requirements Management (RM)	1	2	3	
Quality Function Deployment (QFD)		1	2	3
Multi Criteria Decision Making (MCDM)	1		3	2
Design Structure Matrix (DSM)		2	1	3
iBuild	3	1	2	

PERFORMANCE

11.11.2004 | 16



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Clients in Finland

- Senate Properties
- City of Helsinki, HKR
- VVO
- City of Espoo
- NCC
- Aleksia (=> Realprojekti)
- Kesko

Latest version

- Jyväskylän koulutuskuntayhtymän kiinteistöliikelaitos
- Insinööritoimisto Controlteam Oy
- CSIRO
- Risto Toivonen Oy
- Number of Demo applications in tests around the world

Other Application areas

- Light ProP (Altech-project)
- BenchProP (Brand-project)

RockProP Application

- City of Espoo, Geotechnical Unit
- City of Espoo, Municipal Engineering Unit
- City of Espoo, Building Construction Unit
- Helsinki Energy
- City of Helsinki, Geotechnical Unit
- Helsinki Rescue Service
- Helsinki Water
- HKR Rakennuttaja
- Kalliorakennus T.K Vyryläinen Oy
- Lemcon Oy
- Posiva Oy
- Ministry of Interior
- Skanska-Tekra Oy
- Road Administration

11.11.2004 19 

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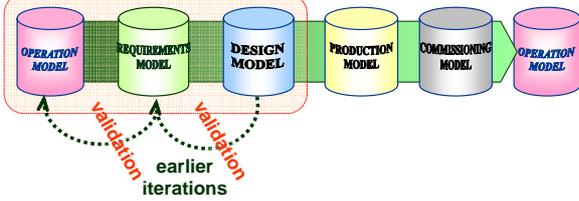
PRISM tool

- VTT – CSIRO collaboration
- Earlier development and successful implementation in Finland
- Supports a systematic approach to define performance objectives
- Has a generic nature, needs be tailored meeting local needs
- Potential in different market environments

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SETTING THE OBJECTIVES



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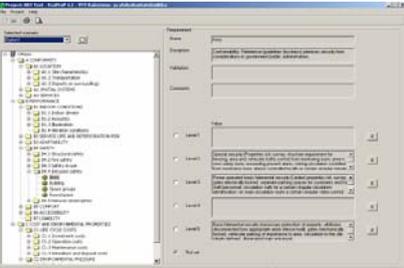
PRISM tool

- PRISM comprises of a database of requirements and an easy-to-use interface.
- There are a number of requirement definition sets which correspond to the possible requirements of different built environment project types.
- The application has been primarily designed for the built environment domain but it can also be used also in other domains by adding new requirement definition sets.
- The user can select from one to five pre-set performance levels for each requirement and then add own comments.
- PRISM can be used to manage performance requirements for new building projects, and can also be used for evaluating the performance levels of existing buildings.

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PRISM – (Performance) requirements management tool

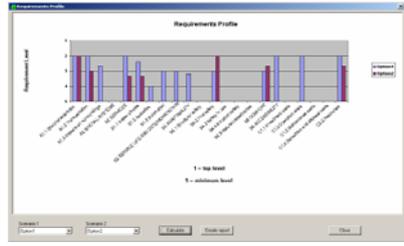


- Features
- Windows application
- Several building types
- Flexible contents
 - VTT ProP®
 - Other classifications
- User roles
 - administrator,
 - super user,
 - user
- Several scenarios for one project

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Requirements profile



Profile

- Describes the average set levels for each property
- Quick feedback on the decisions
- Comparison between two scenarios

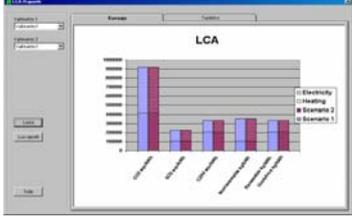
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Ecological indicators based on the energy consumption

Ecological indicators

- 5 indicators
 - CO₂ equ
 - SO₂ equ
 - C₂H₄ equ
 - Non-renewable material kg
 - Renewable material kg
- Calculation based on the energy generation profile and the energy consumption
- Comparison between two scenarios



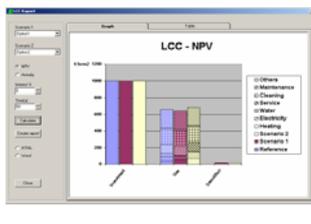
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Life-Cycle Cost Analysis

Life-Cycle Cost Analysis

- Goal: To enable rough level analysis on Life-Cycle Costs to support requirements engineering and decision making
- Analysis is based on:
 - the 'base' cost information filled in by the user
 - Life-Cycle Cost factors of different requirement levels
- Supports Net Present value and Annuity methods
- Comparison between two scenarios



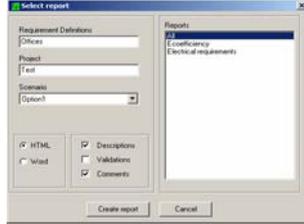
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Reports

Report features

- Report format (Text, HTML)
- Optional additional information
- Different report content like performance reports, adaptability reports and designer specific reports
 - super user can add new report types



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PRISM tool

- Setting performance objectives
- Reporting features
 - Requirement profile
 - LCC analysis
 - LCA calculation
 - Text document
- Requires expertise
- Considerable gain potential

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Future Extensions

- Domain extensions; Infrastructures, Communities, Transportation Systems, VTT MoneyProP[®], Other domains
- Management/Estimation of the Real Estate Values; DCF, Rules of Thumb
- Benchmarking & Verification Module
- Mapping & Reporting between Classifications (eg. VTT ProP[®] → Talo2000, VTT ProP[®] → InfraRYL)
- Product Model Interface (IFC 2.x)
- Changes in Functionality of the software
- Internet Application

11.11.2004 29