Functional Quality Assurance –
A Cx Approach For Innovative Systems
FQA - Functional Quality Assurance

Problem and Motivation

Deficits in actual Project Processing

Design

- Deficient flow of information
- System design without dynamic aspects
- Tender documents with too little contractual obligation for contractors to perform functional quality

Construction

- Insufficient functional quality assurance and performance testing
- TAB phase without consideration of real occupancy and climatic conditions

Operation / Occupancy

- No continuous system performance evaluation and optimization

Need for FQA

A Comprehensive and continuous technical-functional project controlling

No continuous system performance evaluation and optimization

FQA
FQA Objectives

- Ensure that initial project goals get realized
- Improve the information flow between project team members and between project phases
- Enhance system operation and functional quality through early consideration during design
- Optimize indoor environmental and air quality, minimize energy consumption and operation costs
- Improve system condition at turnover
- Persistent optimization of system performance for the whole project life cycle
FQA – Functional Quality Assurance

FQA Tasks and Methods – design phase

- **Definition of project goals and basic criteria**
  for design and function and control their correct implementation

- **Technical and functional project management and coordination**
  throughout the project run time

- **Design assistance due to innovative and integral concepts**
  for energy use, indoor environmental quality and operation costs

- **Verify the compliance with energy use regulations**
  and calculate the energy demand

- **Develop, document and optimize functional operation patterns**
  to specify operation sequence and use them as operation prognostics

- **Integrate contractual obligations and technical requirements**
  in tender documents for a construction according to FQA
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FQA Tasks and Methods – construction and occupancy

- Attendant guidance for contractors and site management to achieve FQA requirements
- Operation diagnostics part 1 (until acceptance): Specification and execution of enhanced function checks and performance tests for a better operation start
- Improved training of operator staff concerning FQA specific knowledge and techniques
- Manuals and documentation with FQA reference to regular O & M and additional customizing for conversions
- Operation diagnostics part 2 (during first occupancy, 1 year): Definition of an additional FQA testing, adjusting and balancing phase with the collaboration of involved contractors
- Guidance or assistance to FQA activities during operation for sustainable compliance with functional quality
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FQA Interactions with Project Team

- **Owner, Project Manager**
  - Project Objectives and Requirements
  - Target Dates and Costs

- **Architect**
  - Facade, Components, Heating and Cooling Loads

- **Operator Staff**
  - Training, Documentation, System Performance, Optimizing

- **Contractors, Site Management**
  - TAB, FPT, Acceptance, FQA-TAB

- **FQA Manager**
  - TAB, FPT, Acceptance, FQA-TAB
  - BACS Requirements, Energy Monitoring
  - BACS Consultant
  - MEP Consultant

- **MEP Consultant**
  - Functional Strategies and Operational Sequences

- **BACS Consultant**
  - BACS = Building Automation and Control System

- **Energy Concepts, Functional Quality**

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FQA Project Time Schedule

Concept  Pre-Design  Detailed Design  Tender Documents  Awarding  Construction  Start-Up  TAB  Acceptance and Repair of Deficiencies  Occupancy  FQA TAB (1 year)  FQA Final Report  Conversion

Design  Construction  Occupancy

Owner, Project Manager  Operator, Occupant

Architect  MEP Consultant

Site Manager  Contractors

Lay the Foundations for Functional Quality and FQA  Test, Evaluate and Document Functional Quality  Periodical FQA Tests

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FQA Tools – in the Design Phase

Operation Prognostics with Operation Patterns and Sequences

Simulation

Energy Demand Calculation e.g. according to DIN V 18599
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FQA Tools – in the Construction and Occupancy Phase

Function and Performance Testing

Operation Diagnostics Using Building Management Systems

Operation Diagnostics Using Graphic Tools to Compare with Prognostics
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FQA Benefits

- Improved coordination between project team and all phases means better flow of information
- Construction cost savings due to prognostic system specification and early problem identification and resolving
- Fewer system deficiencies at building turnover due to well timed quality assuring activities
- Improvement of indoor environmental quality because of optimized design and fitted system parameters
- Reduced energy consumption and operation costs due to optimized operation modes and sequences
- Sustainable functional quality and optimization of system condition during operation due to improved documentation, enhanced staff skills and the regular application of FQA methods
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FQA Conclusion and Status Quo

- FQA can contribute a lot to persistently improve building environmental quality, energy and economic efficiency

- Nevertheless FQA is currently in Germany not offered and is therefore not practised

- FQA exceeds the consultant services required by the rigid HOAI (German Fee Structure for Architects and Engineers) → FQA must be separately bargained with the owner

- The FQA methods will soon be extended and enhanced in the forthcoming research project inProG (funded within the scope of EnBop)

- Ebert Engineers wants to apply FQA in proper future projects and gain experience from it
FQA – Functional Quality Assurance

FQA Outlook

- FQA must become an acknowledged service in Germany and establish in project processing within the next years in order to improve the quality of complex building services engineering.

- Need for FQA will definitely increase due to Green Building certificates, like LEED™, DGNB German Sustainable Building Council.

Desirable development of applied tools in the future:

- Integrate visualization tools for operational diagnostics in BMS software for common use by staff.

- Develop customizable digital operation pattern catalogues that can be fit to different use cases with setpoints and tolerances.

- Implement these catalogues in software routines and enhance BMS to an automated system diagnostic and FPT tool.

- Extend BMS function to perform auto-adaptive optimization routines if system diagnostics detect possible improvement.
Thank you for your attention!

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