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Summary Report

Project GA Spec&Check

Spec&Check Building Automation – Development and testing of a methodology fort he description, testing and supervision of buildinig management systems

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1 GA SPEC&CHECK

Spec&Check Building Automation – Development and testing of a methodology for the description, testing and supervision of buildinig management systems.

2 CAUSE

Technical building performance can only be improved, if it itself becomes a unit of measurable magnitude. The reason to start this project was that the methodology of Active Functional Specifications provides a concept to carry out the neccessary quality management tests for buildings and services based on a well structured specification model and a corresponding testing method for operation data.

3 SUBJECT OF THE PROEJCT

Within the last years, building management systems (BMS) have become the central systems of buildings. As a result, the level of quality has been reduced. As one of the causes the lack of methods and tools to specify and test building and system functions has been identified.

This project evaluated whether the concept of Active Functional Specifications (AFS) would be appropriate to implement an effective quality management loop for building automation systems in conventional building projects as well as for the certification of sustainability of buildings.

Active Functional Specifications define building operations along well defined operation states and rules. Based on this specification, the correspoding operation data from the BMS or other metering systems will be matched in short time steps to the specification and checked for accordance. The procedure is applicable to set points and switching commands as well as for key performance indicators of the specified system. The degree to which specification and operation match can be described within the indicator „Quality of Performance“ (QoP - „Betriebsgüte“) to evaluate and compare system performance. The QoP is calculated as the percentage of points of time within a given testing period for which all specified and applicable rules have been evaluated as true.

Since based on the specification the complete testing process can be automated, the method provides a powerful concept for standardized, economically feasable and scalable quality management.

Within this project the method of Active Functional Specifications has been applied to 6 demo buildings in different phases to evaluate their techical and economical potential. From the demo applications the following indictors were derived:

- **Service cost per data point:**

  Within all systems a total of 353 data points has been used. With total service cost of about 8.700 € the cost per data point are at about 26 €/dp.

- **Abatement costs primary energy**

  The identified saving potential totalled to an annual reduction in primary energy consumption of 211.000 kWh/a resulting into abatement costs of 0,04 €/kWh$_{PE}$.

- **Abatement costs CO2**

  The corresponding abatement costs for CO_2 amounted to 150 €/t$_{CO2}$.

The application of AFS goes along with the handling of large amounts of data. In reality these procedures will be handled by software applications. The software used in the project was the „Digital Test Bench“ of synavision GmbH proving possible that the process is robust to be scaled up massively.

The concept demonstrated a robust applicability and significant potential for fault detection indicating attractive options for cost effective application with a **return of invest of about one year** for corresponding quality management services.

The intelligent concept allow for a almost complete digitalization of the whole process. During the project the testing personnel was not once at the site of any of the demo buildings. Neither has any metering technology been installed. To use the potential of AFS, the challenge is now to transfer the methodology into successful services.

4 CONCLUSION

The project has shown that AFS are an effective method for quality management for BMS and system services performance in general. The following recommendations are made:

- BMS data must be made available.
- Service scopes and procedures for quality management need to be clearly specified.
- Technical Monitoring shoud be provided as an independed thrid party service.
- Quality management should be understood by all parties as a positive process.
- Indicators for quality must be transparently and comprehensibly collected.

Thus, AFS offer the potential to become a central tool to enhance the performance quality of modern buildings.

5 CHARTS / PICTURES

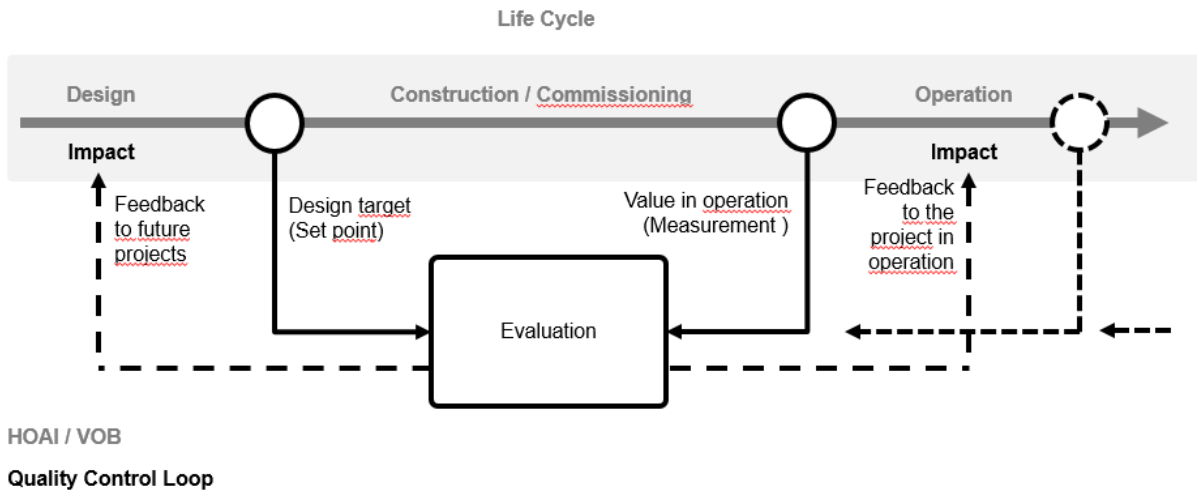

Bild 1: Quality Control Loop.jpg
Bildunterschrift: Generic Quality Control Loop for buildings

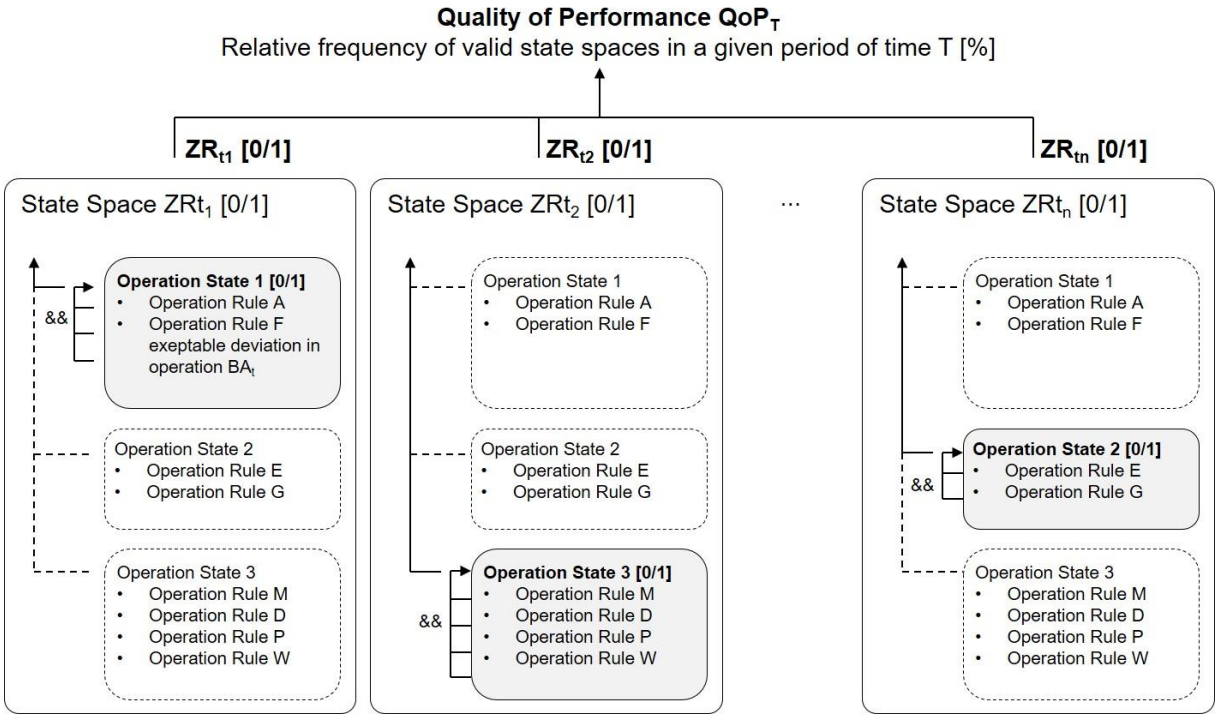

Bild 2: Evaluation Principle.jpg
Bildunterschrift: Principle of comparing and evaluation of specification and operation

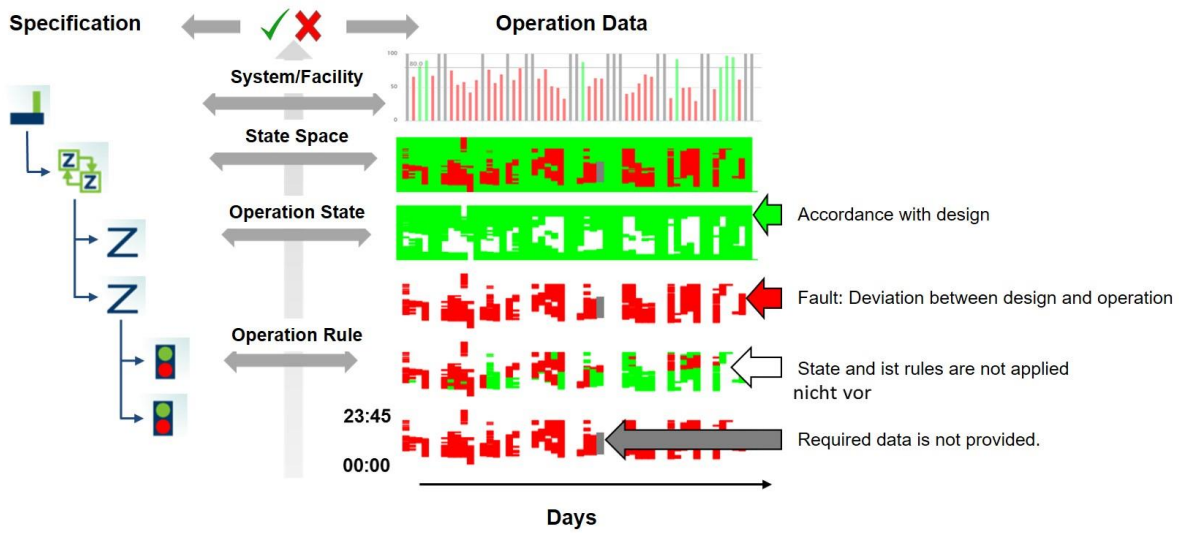

Bild 3: Evaluaton principle 2.jpg

Bildunterschrift: Principle of comparing and evaluation of specification and operation and aggregated presentation fo results

Bild 4: Example of Result Presentation.jpg

Bildunterschrift: Evaluation of operation rules in operation state „BZ01 Normalbetrieb“ for one of the demo buildings

Building	1 Time [h]	2 Cost for working hours [€]	3 Savings Primary Energy [kWh/a]	4 Savings CO_2 [t/a]	4 Savings Operating cost [€/a]	6 Amorti-zation [a]
Library (3 Facilites)	30	2250	87924	23,3	9730	0,23
Celler Badeland (1)	15	1125	k. A.	k. A.	k. A.	k. A.
Deutsche Bundesbank (4)	35	2625	40920	10,27	4324	0,61
Energy Campus (2)	25	1875	27226	6,9	2836	0,66
Retail market (1)	6	450	24130	5,6	1757	0,26
Auditorium (1)	5	375	31568	7,3	2505	0,15
Average (arithm.)	**19**	**1450**	**42354**	**11**	**4230**	**0,38**
Average (Median)	**20**	**1500**	**31568**	**7**	**2836**	**0,26**

Bild 5: results.jpg
Bildunterschrift: Techical and economic indicators