A Quality Model for Residential Houses Construction Processes

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TS 10D
Building Measurement and Modelling

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A Quality Model for Construction Processes

Structure

- **Introduction**
- **Project „QuCon“**
- **Different Available Quality Models**
- **Construction Process for Residential Houses**
- **Quality Model for Construction Processes**
- **Measuring Quality**
- **Conclusions**

A Quality Model for Construction Processes

Introduction

- **In general, construction of houses consists of individual processes leading to an individual building;**
  for residential houses the processes may be standarizable to a certain extent.
- **SMEs are the most active players in the residential houses sector: problems to build up a quality management system (too expensive and time-consuming)**
- **Quality demands and competition are rising in the construction sector.**
- **Lack of general quality description in the construction industry.**

Need for a general quality model !

Need for a quality support tool for SMEs !

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Project QuCon

Development of a Real Time Quality Support System for the Houses Construction Industry

Financing:

AIF /

European

Commission

Source Institut für Baubetriebslehre, Universität Stuttgart

Partners:

Cyprus: Frederick University Nicosia (FIT), Synectics Ltd Nicosia (SYN), Cyprus Quality Association Nicosia

Germany: Federation of Quality Research and Science Frankfurt (FQS), University Stuttgart (USTUTT)

Netherlands: Bouwend Nederland, TU Delft (DUT)

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Project Objectives

- **Investigating and analysing the building process**
- **Developing a quality model and quality parameters as well as assurance indices**
- **Optimizing the indices with respect to time and money**
- **Developing a prototype software appropriate for SMEs**
- **Studies and analyses of the current quality assurance practices realized by different SMEs in different countries**
- **Development of guidelines for performance improvement and quality parameter optimization**

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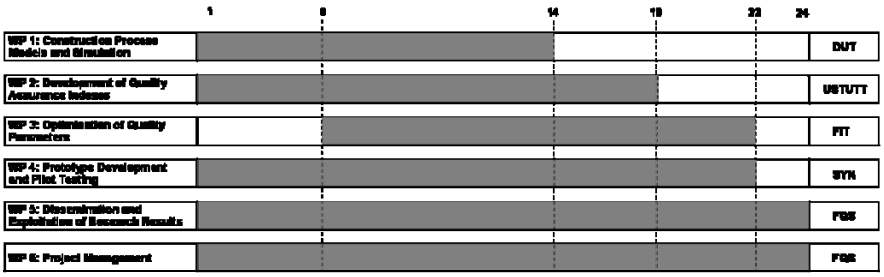
Project Structure



Main Tasks of University Stuttgart, IAGB

- Development of a consistent quality model

- Real-time determination of quality assurance indixes

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Different available Quality Models

- **Civil Engineering**
  - **tolerances as product-related quality parameters**
- **Geodesy**
  - **accuracy, reliability and sensitivity as product-related quality characteristics (geodetic nets)**
- **Geodata / Traffic Telematics**
  - **complete quality model with the characteristics: availability, up-to-dateness, completeness, consistency, correctness, accuracy**

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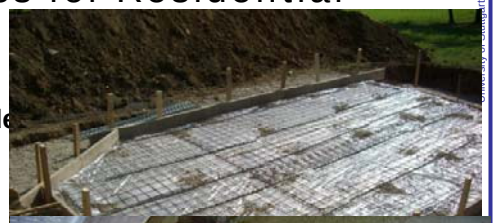
Construction Process for Residential Houses

- **Process as base for quality mode**
- **Hierarchical structure preferred:**
  1. **total process,**
  2. **sub-processes,**
  3. **activities.**
- **Level of detail differs:**
  - **Germany: appr.100 activities,**
  - **Cyprus: appr. 500 activities.**



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- activities of one sub-process
- further detail levels or alternatives possible
- integration of checkpoints to measure quality
- checked parameters have to be defined (partly)
- relationships are still missing:

Gantt Chart

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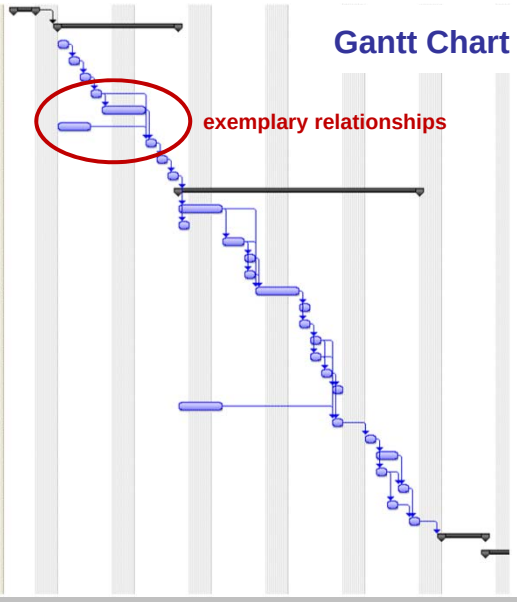
preparation of construction	
carcass construction of earthwork	1
site facilities	
survey:Measurement for basement excavation	7
earthwork: basement exvation	8
Other work e.g. : basement safegurarding	9
acceptance excavation ground inspection (excavati	10
connection shaft	
Survey: building of aligment stage	10;11;12
Earthwork: base pipe(connection to canalization), f	13
Acceptance drainage	14
carcass construction of basement	15
concrete work: foundation	15
electric work: earthing	15
acceptance foundation: height of raft foundation	17
eletric work: empty conduit, wall breakthrough, facil	19
heating and sanitary:wall breakthrough	19
concrete work/brickwork:basement external wall	17;19;20;2
disassembly of aligment stage	22
concrete work/brickwork:basement internal wall	22
eletric work: empty conduitin, basement ceiling	24
heating and sanitary:ceiling breakthrough	24
acceptance ceiling reinforcement	25;26
concrete work:basement ceiling	25;26;27
quality survey of basement stair	
concrete work:basement stair	25;26;27;2
drainage	30
isolation and waterproofing of basement external wa	31
light well	31
acceptance light well, basement insulation	32;33
house service	33
earthwork: backfilling of the workroom	34;35
carcass construction of ground floor	36
carcass construction of attic story	41
Internal extension	66
External extension	89



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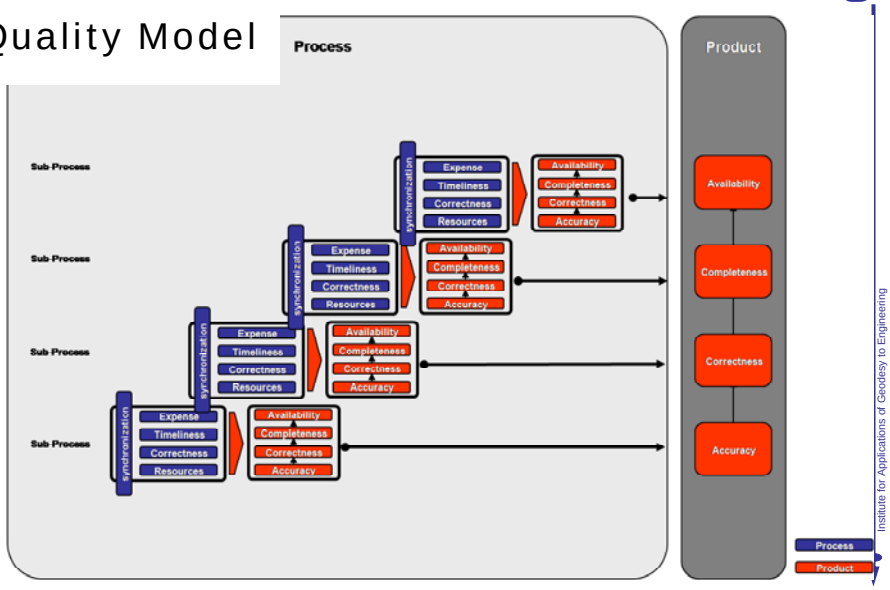
Quality Model



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Process-related Characteristics (1)

Expense: ***Adherence to the expense plan***.

The process is carried out within / exceeds / falls below the budget.

Timeliness: ***Adherence to the time schedule***.

The (sub-) process begins and ends at the scheduled points of time / shows a time delay / is ahead the time schedule.

Process-Correctness: ***Adherence to the predetermined procedure***.

Correctness is regarded with respect to the technical demands; e.g. correct sequence of working steps or of compliance with all regulations.

These criteria may be fulfilled, partly fulfilled or not fulfilled.

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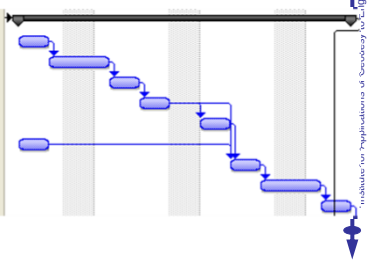
Process-related Characteristics (2)

Resources: ***Adherence to the predetermined resources***.

The process is carried out within/ exceeds / falls below the predetermined resources.

Synchronization: ***Adherence to the overall predetermined inter-process workflow*.**

carcass construction of earthwork	1
site facilities	
survey:Measurement for basement excavation	8
earthwork: basement exvation	9
Other work e.g. : basement safegurarding	10
acceptance excavation ground inspection (excavation depth)	11
connection shaft	
Survey: building of aligment stage	11;12;13
Earthwork: base pipe(connection to canalization), foundation trech,soil improvement	14
Acceptance drainage	15



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Product-related Characteristics (1)

Availability: ***Overall quality characteristic that takes into account all other definitions*.**

Product is completed at the required point of time within the budget using the planned resources. The characteristic is not purely product-related. It is the combination of process and product-related characteristics.

Completeness*: Adherence to defined completeness of product.*

Product is completed correctly as defined and planned or it is fragmentary.

Condition: only correctly realized products are counted as completed.

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Product-related Characteristics (2)

Product-Correctness: ***Adherence to the defined demands, requirements, standards, generally recognized codes of practice and technical demands written in the contract.***

The demands, requirements, standards, etc. are fulfilled or not.

a) The correctness of the product is measurable. These characteristics can be parameterized using accuracy parameters.

b) Some characteristics are not measurable. In these cases there are checks only, e.g. visual controls. If requirements are not fulfilled, the product is incorrect.

Accuracy: ***Degree of adherence to demands, etc.***

Accuracy is the basis for correctness decisions of variant a) of product-correctness. It takes into account random deviations only.

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Examples

***Expense** for earthwork:*

- relative expense rate

with E_a actual expenses

e.g. **95%** of the predeterr

- absolute expense diffe

e.g. **150€** have been eco

***Completeness** for build*

CRR = **75%** (12 from 16) g

the plan, with $CPR = \frac{CP_a}{CP_b} \cdot 1$

with CP_a actual completed

and CP_b product parts / gr

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Measuring Quality

- **Quality control measurement**
- **The measurement methods a** **s standard and are generally a**
- **Concrete descriptions regard product-correctness as well a**

„e.g. if e.g. the measurements of the angles between two points are carried out with a theodolite and made in two sets, the RMS can be calculated. If the shorter side of the angle equals 100m, for the angle the permitted deviation is ± 0.01 gon. If $\sqrt{rms} < 0.01gon$, the angle is regarded as correct, otherwise it is incorrect."

- **Restriction on geometric accuracy, additional measurements are described in e.g. ISO 3443-8, DIN EN 14992**

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Conclusions

- **New quality model for construction of residential houses**
- **Consideration of product and process quality**
- **Integration into quality asurance tool is objective in the EU-project QuCon**
- **Checkpoints for quality measurements have to be defined**
- **Surveyor as quality controller shall be established in the future**

Quantity and Quality Surveyor !

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Thank you very much for your attention !

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