ACCURACY OF THE INITIAL BUDGET OF REDEVELOPMENT PROJECTS

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Document details
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Master Real Estate and Housing – P5
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**PROGRAMME**

13:45 – 14:15 Presentation
14:15 – 14:30 Questions
14:30 – 15:30 Grade
15:30 – 18:30 Bouwpub!

**CONTENT**

1. **WHY**
   - Motivation & research background

2. **HOW**
   - Research methodology

3. **WHAT**
   - Research results and conclusion
MOTIVATION
MOTIVATION
UNCERTAINTY IN THE INITIAL PHASE

Nature of construction industry

Uncertainty vs information

Accuracy of budget vs information
  Underestimated vs overestimated

Raftery, 1994; Flyvbjerg et al., 2007, Winch, 2010
MAIN (PERSONAL) OBJECTIVES

Current knowledge
Reasons for inaccuracies
Complexity of redevelopment
Costs vs revenues
Process vs budget
Risk analysis
MAIN (PERSONAL) OBJECTIVES

Current knowledge  Reasons for inaccuracies  Complexity of redevelopment  Costs vs revenues  Process vs budget  Risk analysis

Improvement of the accuracy
MAIN RESEARCH QUESTION

Which improvements can be made in the redevelopment process, and in particular in the establishment of the budget in the initial phase, in order to increase the accuracy of budget estimations and to diminish the probability and effect of risks?
LITERATURE RESEARCH

6 RESEARCH TOPICS

PROCESS CHARACTERISTICS
REASONS FOR INACCURACY

SURVEY RESEARCH

37 RESPONDENTS

ACCURACY INITIAL BUDGET
REASONS FOR INACCURACY

CASE STUDY RESEARCH

3 CASES

PROCESS, PLAN AND
BUDGET DEVELOPMENT
REASONS FOR INACCURACY

Bryman, 2012
LITERATURE RESEARCH

6 RESEARCH TOPICS
PROCESS CHARACTERISTICS
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CASE STUDY RESEARCH

3 CASES
PROCESS, PLAN AND
BUDGET DEVELOPMENT
REASONS FOR INACCURACY

TRIANGULATION

Bryman, 2012
Theoretical framework
(RE)DEVELOPMENT PROCESS

1. Preparation
2. Realisation
3. Initiation
4. Exploitation
INITIAL BUDGET: ESTIMATING METHOD

Income from property: €600, €1,250, €1,450
Transformation costs: €550, €1,050, €1,150
Residual value: €50, €200, €300

Theoretical framework
INITIAL BUDGET: ESTABLISHMENT

Cost estimation
- Sketch design
- Key figures

Income estimation: BAR/NAR-method
- Market characteristics
- Location characteristics
- Building characteristics
- Predictions

De Vrij, 2004; Mackay, 2008; Muller, 2008; Schmidt, 2012; NEN2699, 2013; Shapiro et al., 2013; Mensing, 2014
## Causes of Cost Inaccuracies

<table>
<thead>
<tr>
<th>Availability of information during the process</th>
<th>Design development</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.g. general lack of information; lack of information at tender stage; lack of information at briefing</td>
<td>E.g. incomplete design at tender phase; initial design lacks details</td>
</tr>
<tr>
<td>Availability of information about the existing building</td>
<td>Design brief</td>
</tr>
<tr>
<td>E.g. lack of information about asbestos, structure, façade, soil, installations and other building components; condition of the building unknown (measurements, foundation, roof, materialisation)</td>
<td>E.g. lack of detail or definition; client does not know what he/she wants</td>
</tr>
<tr>
<td>Building characteristics</td>
<td>Design team performance</td>
</tr>
<tr>
<td>E.g. weak foundation; grid of building causes useless space; impossible to realise outdoor space; insufficient daylight for residential use; materials not fire resistant / rejected by fire department</td>
<td>E.g. designer’s attitude; understanding of cost/value; inadequate cost control; designer’s awareness as to areas of cost risk</td>
</tr>
<tr>
<td>Claims</td>
<td>Organisation</td>
</tr>
<tr>
<td>E.g. aggressive or claims conscious contractors; contractors risk pressure; late information release</td>
<td>E.g. poor preparation and planning</td>
</tr>
<tr>
<td>Contractual factors</td>
<td>Project management</td>
</tr>
<tr>
<td>E.g. wrong contract used; wrong allocation of risk in contract document</td>
<td>E.g. management of design, site, contractors and suppliers; lack of leadership; lack of value management; communication methods; management approach</td>
</tr>
<tr>
<td>Commercial pressure</td>
<td>Psychological factors</td>
</tr>
<tr>
<td>E.g. tight bidding conditions; corner cutting clients</td>
<td>E.g. optimism; cognitive bias; intuition; risk attitude</td>
</tr>
<tr>
<td>Estimations / calculations</td>
<td>Site conditions</td>
</tr>
<tr>
<td>E.g. poor cost advises; poor risk analysis; wrong estimation of unforeseen costs</td>
<td>E.g. unforeseen site conditions, restrictions, things that basically go wrong resulting in a more expensive construction method</td>
</tr>
<tr>
<td>Legal factors</td>
<td>Strategic behaviour</td>
</tr>
<tr>
<td>E.g. legislation unclear; impossible to meet requirements of municipality or zoning plan</td>
<td>E.g. deliberate cost underestimation; manipulation of estimations; no release of information</td>
</tr>
<tr>
<td>People / project team</td>
<td>Time limits</td>
</tr>
<tr>
<td>E.g. inexperience or not qualified team; relationship between actors; stubborn client</td>
<td>E.g. unrealistic time planning for design; delays due to slow decision making; insufficient time or budget to establish realistic budget; unrealistic construction period</td>
</tr>
<tr>
<td>Unforeseen interventions</td>
<td>External factors</td>
</tr>
<tr>
<td>E.g. changes in structure, façade, installations or other building components due to unforeseen situations</td>
<td>E.g. changes in prices, indexes, inflation, legal factors or market trends</td>
</tr>
<tr>
<td>Design changes</td>
<td></td>
</tr>
<tr>
<td>E.g. client driven design changes; design changes to maximise LFA/GFA ratio; design changes to maximise development potential</td>
<td></td>
</tr>
</tbody>
</table>

Derived from 20 sources
CAUSES OF INCOME INACCURACIES

General level of prosperity
Population changes
Qualitative change
Rent as proportion of income or margin
Competitive demand
Limitation of supply

Muller, 2008; Shapiro et al., 2013; Mensing, 2014
Survey research
SURVEY

- Aim: main causes and accuracy
- Criteria: anonymous and minimal effort
- Non-probability sampling
  - Convenience sampling
  - Snowball sampling

Groves et al., 2009; Bryman, 2012
Information during process
Information existing building
Building characteristics
Unforeseen interventions
Design changes
Design brief
Time limits
Information during process
Design development
Design team performance
People / project team
Estimations / calculations
Organisation
Legal factors
Commercial pressure
Psychological factors
External factors
Site conditions
Contractual factors
Strategic behaviour
Project management
External factors
EFFECT (E)
PROBABILITY (P)
Survey research
ACCURACY INITIAL BUDGET

Survey research

Histograms showing the accuracy of budget predictions for different categories:

- Construction costs: Avg. ±14.0%, Min. -16.0%, Max. 39.0%
- Income: Avg. ±9.0%, Min. -16.0%, Max. 31.0%
- LFA: Avg. ±1.4%, Min. -10.0%, Max. 10.0%
- GFA: Avg. ±3.3%, Min. -10.0%, Max. 10.0%
- Unforeseen: Avg. ±11.8%, Min. -4.0%, Max. 25.0%
Case study research
CASE STUDIES

• Aim: deeper understanding

• Data collection
  • Semi-structured interviews
  • Content analysis
  • Questionnaire

• 3 cases

• Case criteria and units of analysis
CASE 1
‘LEMON BUILDINGS’
RANDSTAD

CASE 2
‘SECOND BUILDING’
RANDSTAD

CASE 3
ZUSTERFLAT
DELT
CASE 1

‘LEMON BUILDINGS’

LOCATION: RANDSTAD
ACQUISITION: 2014 Q3
SIZE: 6.300 M2 AND 14.800 M2

<table>
<thead>
<tr>
<th>Building 1</th>
<th>Initial budget</th>
<th>Last budget</th>
<th>Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction costs</td>
<td>€ 7,3 mil.</td>
<td>€15,6 mil.</td>
<td>+114%</td>
</tr>
<tr>
<td>Total investment</td>
<td>€ 20,7 mil.</td>
<td>€ 26,5 mil.</td>
<td>+28%</td>
</tr>
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Case 1

‘LEMON BUILDINGS’

Location: Randstad
Acquisition: 2014 Q3
Size: 6,300 M2 and 14,800 M2

Design Changes

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Delays

- Strategic Behaviour & Psychological Factors

Unforeseen Situations

Due to Missing Building Information
### Case 1

**‘Lemon Buildings’**

- **Location:** Randstad
- **Acquisition:** 2014 Q3
- **Size:** 6,300 M2 and 14,800 M2

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<td>+28%</td>
</tr>
<tr>
<td>Rental income / year</td>
<td>€ 1,4 mil.</td>
<td>€ 2,8 mil.</td>
<td>+100%</td>
</tr>
<tr>
<td>Exit value</td>
<td>€ 20,1 mil.</td>
<td>€ 47 mil.</td>
<td>+134%</td>
</tr>
</tbody>
</table>

**Increased Market Demand**

**Lower Market Risk**

**Higher Rental Income**

**Higher Quality & More Floor Area**
# Case 1

**‘LEMON BUILDINGS’**

**Location:** Randstad  
**Acquisition:** 2014 Q3  
**Size:** 6,300 M2 and 14,800 M2

---

## Case Study Research

### Budget Development

#### Budget Development Building 1

- **2014 Q1:** Initiation: developer X and investor Y  
- **2014 Q2:** Initial plan  
- **2015 Q1:** Establishment of initial budget: based on sketch design  
- **2015 Q2:** Establishment of second budget: based on preliminary design  
- **2015 Q3:** Tender: won: acquisition of 2 buildings  
- **2015 Q4:** Selection of architect (new sketch designs)

#### Budget Development Building 2

- **2016 Q1:** Establishment of total budget: based on sketch design  
- **2016 Q2:** Establishment of second budget: based on preliminary design  
- **2016 Q3:** Tender: won: acquisition of 2 buildings  
- **2016 Q4:** Selection of architect (new sketch designs)

### Development Process (in Quarters)

- **2014 Q1:** Error in estimation of construction period: 16 months instead of 9 months  
- **2014 Q2:** Additional asbestos found in window sealant: 2 months delay  
- **2015 Q3:** Demolition works and removal of asbestos  
- **2016 Q4:** Negotiations and agreement contractor  
- **2017 Q1:** Permits requested  
- **2017 Q2:** Permits granted and irrevocable  
- **2018 Q1:** Market analysis: increasing demand and agreements with tenants

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**Graph:**

- **Development process (in quarters)**

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**Diagram:**

- **Budget Development Building 1**
  - **Construction costs**
  - **Limit: construction costs + unforeseen costs**
  - **Rental income**

- **Budget Development Building 2**
  - **Construction costs**
  - **Limit: construction costs + unforeseen costs**
  - **Rental income**
Case study research

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<td>Construction costs</td>
<td>€ 1,16 mil.</td>
<td>€ 0,95 mil.</td>
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<td>Total investment</td>
<td>€ 1,72 mil.</td>
<td>€ 1,22 mil.</td>
<td>-29,3%</td>
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**Case 3**

Zusterflat

Location: Delft
Lease agreement: 2013 Q4
Size: 5,973 M2
**Case 3**

**Zusterflat**

**Location:** Delft  
**Lease Agreement:** 2013 Q4  
**Size:** 5,973 M2

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**Design Optimisations**

**Project Management**

**Time Limits**

**Estimations / Calculations**

**Lower Quality / More Reuse**

**Case Study Research**

**Lower Quality / More Reuse**
### Case 3: Zusterflat

**Location:** Delft  
**Lease Agreement:** 2013 Q4  
**Size:** 5973 M2

#### Design Optimisations

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</tr>
<tr>
<td>Rental income / year</td>
<td>€ 352,500</td>
<td>€ 430,300</td>
<td>+22%</td>
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**Attitude Towards Risks**

**Estimations / Calculations**
## Case 3
### Zusterflat

**Location:** Delft  
**Lease Agreement:** 2013 Q4  
**Size:** 5,973 M2

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2012</td>
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<td></td>
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</tr>
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<td>2014</td>
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<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Acquisition:** Letter of intent between Bouwteamovereenkomst SHS and property owner signed  
**Location:** Lease agreement signed for a period of 10 years

**Design:** Initial plan  
**Size:** Visual building inspections by contractors, SHS and investor

**Entitlement:** Establishment of initial budget; based on calculations of contractor  
**Permits granted:** Required change in legislation

**Financing:** Second budget, before construction works  
**Construction:** Permits requested

**Construction:** Demolition works  
**Mock-up room**

**Leasing:** Rental income  
**Agreements with tenants**

**Budget development**

- **Construction costs**
- **Rental income**
- **Development process (in quarters)**

- **Limit construction costs + unforeseen costs**
CASE 1

‘LEMON BUILDINGS’
RANDSTAD

CASE 2

‘SECOND BUILDING’
RANDSTAD

CASE 3

ZUSTERFLAT
DELT
Conclusion
## Accuracy Initial Budget

<table>
<thead>
<tr>
<th></th>
<th>Literature</th>
<th>Survey (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction costs</td>
<td>Underestimated</td>
<td>+14%</td>
</tr>
<tr>
<td>CC / m²</td>
<td>Underestimated</td>
<td>-</td>
</tr>
<tr>
<td>Income</td>
<td>-</td>
<td>+9%</td>
</tr>
<tr>
<td>Floor area (lettable)</td>
<td>-</td>
<td>+1.4%</td>
</tr>
<tr>
<td>Floor area (gross)</td>
<td>-</td>
<td>+3.3%</td>
</tr>
<tr>
<td>Unforeseen</td>
<td>Higher than new-built</td>
<td>11.8%</td>
</tr>
</tbody>
</table>
# Accuracy Initial Budget

<table>
<thead>
<tr>
<th></th>
<th>Literature</th>
<th>Survey (n=26)</th>
<th>Case 1-1</th>
<th>Case 1-2</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction costs</td>
<td>Underestimated</td>
<td>+14%</td>
<td>+114%</td>
<td>+50%</td>
<td>-39%</td>
<td>-18%</td>
</tr>
<tr>
<td>CC / m2</td>
<td>Underestimated</td>
<td>-</td>
<td>+65%</td>
<td>+47%</td>
<td>-14%</td>
<td>-18%</td>
</tr>
<tr>
<td>Income</td>
<td>-</td>
<td>+9%</td>
<td>+100%</td>
<td>+31%</td>
<td>-33%</td>
<td>+22%</td>
</tr>
<tr>
<td>Floor area (lettable)</td>
<td>-</td>
<td>+1,4%</td>
<td>+14%</td>
<td>+2%</td>
<td>-25%</td>
<td>0%</td>
</tr>
<tr>
<td>Floor area (gross)</td>
<td>-</td>
<td>+3,3%</td>
<td>+29%</td>
<td>+3%</td>
<td>-28%</td>
<td>+11%</td>
</tr>
<tr>
<td>Unforeseen</td>
<td>Higher than new-built</td>
<td>11,8%</td>
<td>10%</td>
<td>10%</td>
<td>3%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Conclusion**
## Causes for Inaccuracies

<table>
<thead>
<tr>
<th>Variables</th>
<th>Literature</th>
<th>Survey (n=37)</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main reasons</strong></td>
<td>Various, unranked</td>
<td></td>
<td>Design changes / brief</td>
<td>Design changes / brief</td>
<td>Design changes</td>
</tr>
<tr>
<td>1. <strong>Design changes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. <strong>Design development</strong></td>
<td></td>
<td></td>
<td>Strategic behaviour / psychological reasons</td>
<td>Unforeseen interventions due to:</td>
<td>Project management</td>
</tr>
<tr>
<td>3. <strong>Unforeseen interventions</strong></td>
<td></td>
<td></td>
<td>Unforeseen interventions due to missing building information</td>
<td>Legal aspects</td>
<td>Time limits</td>
</tr>
<tr>
<td>4. <strong>Building characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td>External</td>
<td></td>
</tr>
<tr>
<td>5. <strong>Missing building information</strong></td>
<td></td>
<td></td>
<td>Estimations / calculations</td>
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<tr>
<td></td>
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</table>

- External factors
Jackson, 2002

Commercial developments
114 respondents

Main reason:
Design changes

Flyvbjerg et al., 2007

Public works (infrastructure)
181 projects

Main reason:
Strategic behaviour
Jackson, 2002
Commercial developments
114 respondents

Survey results
37 respondents

Main reason:
Design changes

Except from 2 respondents
Working for housing association

Flyvbjerg et al., 2007
Public works (infrastructure)
181 projects

Main reason:
Strategic behaviour
INTERNAL FACTORS
- Building characteristics
- Calculations
- Organisation
- Project management
- Information
- Strategic behaviour

EXTERNAL FACTORS
- Price development
- Market demand / supply
- Economic development
- Location characteristics
- Legal

Changes in plan
Changes in budget
Balance
IMPROVEMENTS

Building investigations in initial phase
Early (sub-)contractor involvement
Unforeseen: at least 5%, average of 12% during construction phase
IMPROVEMENTS

Building investigations in initial phase

Early (sub-)contractor involvement

Unforeseen: at least 5%, average of 12% during construction phase

FLEXIBLE ATTITUDE
DURING THE ENTIRE PROCESS!
ACCURACY OF THE INITIAL BUDGET OF REDEVELOPMENT PROJECTS

Thank you for your attention!
UNBALANCED DUTCH REAL ESTATE MARKET

- High vacancy in the office (and retail) market
- Investors: consolidation
- Transformation
  - Sustainability targets
  - Shortage in housing market
  - Preservation of existing stock
  - Risks and uncertainty

Dutch office stock in 2016: vacant vs. in-use

Vacant 15%
Occupied 85%

Douglas, 2006; Mackay, 2008; Remøy, 2010; Shapiro et al., 2013; UNEP, 2015; JLL, 2015; DTZ, 2016
## Sub Questions

1. What is the (average) **accuracy** of the initial budget and percentage **unforeseen** in redevelopment projects?

2. Which factors within the redevelopment process are the main **causes** for cost inaccuracies and what are the perceived probability and effect of these factors on the development of the costs?

3. How does the **development strategy** in the redevelopment process, and in particular in the initial phase, affect the development of the budget?

4. Which **improvements** can be made in the redevelopment process to increase the accuracy of the initial budget and decrease the risks?
Uncertainty in the initial phase of redevelopment projects

Characteristics redevelopment process

Building investigation
Budget estimations
Actors
Risk management
Development strategy
Causes of inaccuracies

Problem analysis

Theoretical framework

Empirical research

Research methodology

Conclusions and recommendations
Causes of budget inaccuracies in redevelopment projects

Survey analysis
Case analysis

Survey
Case study

Expert interviews
RELEVANCE
Theoretical framework

(RE)DEVELOPMENT PROCESS

Gehner, 2008; BOSS, 2017
**Theoretical Framework**

**BOSS, 2017**

### Development Process

1. **Preparation**
   - Acquisition
   - Design
   - Entitlement
   - Acquisition of 4 buildings
   - New, re-modeled
   - Final design

2. **Realisation**
   - Financing
   - Establishment of initial budget
   - Feasibility study of hotel and office combination
   - Establishment of second budget
   - Negotiation and agreement with contractor
   - Market analysis
   - Leasing
   - Market analysis
   - Establishment of various contracts
   - Demolishment + asbestos
   - Lease agreement with hotel exploitant: tenant of floors 2 until 7

3. **Exploitation**
   - Leasing
   - Market analysis
   - Establishment of second budget
   - Negotiation and agreement with contractor
   - Final design

**Budget Development**

- Construction costs
- Limit construction costs + unforeseen costs
- Rental income

**Timeline**

- Q1 2008
- Q2 2008
- Q3 2008
- Q4 2008
- Q1 2009
- Q2 2009
- Q3 2009
- Q4 2009
- Q1 2010
- Q2 2010
- Q3 2010
- Q4 2010
- Q1 2011
- Q2 2011
- Q3 2011
- Q4 2011
- Q1 2012
- Q2 2012
- Q3 2012
- Q4 2012
- Q1 2013
- Q2 2013
- Q3 2013
- Q4 2013
- Q1 2014
- Q2 2014
- Q3 2014
- Q4 2014
- Q1 2015
- Q2 2015
- Q3 2015
- Q4 2015
- Q1 2016
- Q2 2016
- Q3 2016
- Q4 2016
- Q1 2017
- Q2 2017
- Q3 2017
- Q4 2017
**INITIAL BUDGET: CLASSIFICATION**

<table>
<thead>
<tr>
<th>A. Land costs</th>
<th>B. Construction costs</th>
<th>C. Equipment costs</th>
<th>D. Additional costs</th>
<th>E. Unforeseen costs</th>
<th>F. Taxes</th>
<th>G. Financing costs</th>
<th>X. Exploitation costs</th>
</tr>
</thead>
</table>

### Investment costs (NEN 2699)

- **A. Land costs**: key figures
- **B. Construction costs**: % of cc
- **C. Equipment costs**: % of cc
- **D. Additional costs**: % of cc
- **E. Unforeseen costs**: % of cc
- **F. Taxes**: key figures
- **G. Financing costs**: key figures
- **X. Exploitation costs**: key figures

De Vrij, 2004; Mackay, 2008; Schmidt, 2012; NEN2699, 2013; Mensing, 2014
RISK ANALYSIS

• Identification
  • Based on experience (subjective)

• Quantification
  • Risk premium / scenario analyses (subjective)

• Risk behaviour
  • Different perceptions of risk

Raftery, 1994; Gehner, 2006; Gehner, 2008; Cretu et al., 2011
Survey respondents

Type of actor

- Developer (independent): 27%
- Developer (delegated): 8%
- Developer (contractor): 16%
- Developer (investor): 11%
- Project manager: 8%
- Housing ass.: 5%
- Cost advisor: 11%
- Architect: 14%

n = 37

Type of projects

- Housing, starters: 18%
- Housing, mid segment: 14%
- Other functions: 14%
- Office, co-working/creative: 5%
- Hotel: 9%
- Housing, other: 7%
- Care homes: 6%
- Housing, luxurious: 12%
- Housing, students: 15%

n = 37
## Survey Findings, Budget Accuracy

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Average</th>
<th>Std. dev.</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction costs</strong></td>
<td>-10 %</td>
<td>39 %</td>
<td>14,04 %</td>
<td>9,24</td>
<td>26</td>
</tr>
<tr>
<td><strong>Revenues</strong></td>
<td>-16 %</td>
<td>31 %</td>
<td>9,00 %</td>
<td>12,25</td>
<td>26</td>
</tr>
<tr>
<td><strong>LFA</strong></td>
<td>-10 %</td>
<td>10 %</td>
<td>1,42 %</td>
<td>6,42</td>
<td>26</td>
</tr>
<tr>
<td><strong>GFA</strong></td>
<td>-4 %</td>
<td>10 %</td>
<td>3,27 %</td>
<td>3,91</td>
<td>26</td>
</tr>
<tr>
<td><strong>Unforeseen (% of construction costs)</strong></td>
<td>0 %</td>
<td>25 %</td>
<td>11,77 %</td>
<td>6,69</td>
<td>26</td>
</tr>
</tbody>
</table>
SURVEY FINDINGS
## Survey Findings, Per Actor

<table>
<thead>
<tr>
<th>Rank</th>
<th>n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>37</td>
<td>Design changes</td>
<td>Design development</td>
<td>Unforeseen interventions</td>
<td>Building characteristics</td>
<td>Missing information existing building</td>
</tr>
<tr>
<td>Developer independent</td>
<td>10</td>
<td>Design changes</td>
<td>Building characteristics</td>
<td>Missing information existing building</td>
<td>Design development</td>
<td>Unforeseen interventions</td>
</tr>
<tr>
<td>Developer delegated</td>
<td>3</td>
<td>Missing information during process</td>
<td>External factors</td>
<td>Design changes</td>
<td>Estimations / calculations</td>
<td>Unforeseen interventions</td>
</tr>
<tr>
<td>Developer contractor</td>
<td>6</td>
<td>Design changes</td>
<td>Building characteristics</td>
<td>Design brief</td>
<td>Unforeseen interventions</td>
<td>Design team performance</td>
</tr>
<tr>
<td>Developer investor</td>
<td>4</td>
<td>Unforeseen interventions</td>
<td>Building characteristics</td>
<td>Legal factors</td>
<td>Missing information during process</td>
<td>Design changes</td>
</tr>
<tr>
<td>Project manager</td>
<td>3</td>
<td>Missing information during process</td>
<td>Design development</td>
<td>Unforeseen interventions</td>
<td>Time limits</td>
<td>Design brief</td>
</tr>
<tr>
<td>PM – housing association</td>
<td>2</td>
<td>Strategic behaviour</td>
<td>Building characteristics</td>
<td>Time limits</td>
<td>Organisation</td>
<td>Estimations / calculations</td>
</tr>
<tr>
<td>Cost advisor</td>
<td>4</td>
<td>Design changes</td>
<td>Design development</td>
<td>Commercial pressure</td>
<td>Design brief</td>
<td>Design team performance</td>
</tr>
<tr>
<td>Architect</td>
<td>5</td>
<td>Missing information existing building</td>
<td>Building characteristics</td>
<td>Project management</td>
<td>People / project team</td>
<td>Design changes</td>
</tr>
</tbody>
</table>
## Sub Question 2: Causes for Inaccuracies

<table>
<thead>
<tr>
<th>Variables</th>
<th>Literature</th>
<th>Survey (n=37)</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main reason for design changes</td>
<td>Various, unranked</td>
<td>-</td>
<td>Market demand</td>
<td>Mismatch market vs. initial plan</td>
<td>Risk behaviour of investor and delay in change of legislation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Higher rent</td>
<td>• Less floor area</td>
<td>• More reused materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• More floor area</td>
<td>• Lower costs</td>
<td>• Lower investment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Higher quality</td>
<td></td>
<td>• Own coordination</td>
</tr>
</tbody>
</table>
### Sub Question 3: Process vs. Budget

<table>
<thead>
<tr>
<th>Variables</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of initial budget</td>
<td>✔️</td>
<td>✔️</td>
<td>Contractor involvement Based on quantities</td>
</tr>
<tr>
<td>Risk analysis</td>
<td>✔️</td>
<td>✔️</td>
<td>+ contractor</td>
</tr>
<tr>
<td>Risk distribution</td>
<td>✔️</td>
<td>Contractor: asbestos</td>
<td>✔️</td>
</tr>
<tr>
<td>Building investigation</td>
<td>✔️</td>
<td>Contractor (late)</td>
<td>✔️</td>
</tr>
</tbody>
</table>