How to develop corporate real estate?
A decision support tool for CREM

ERES 28th June to 1st July 2017 Delft
Content

1. Problem and research question

2. Methodology

3. Current state of research

4. Results from case study and questionnaire

5. Development of a decision support tool

6. Next step and open questions
Real estate managers have to decide regularly between different procurement forms

„Many European Companies currently own the freehold interests in most of their properties (e.g. Germany: 70%).“

„Real estate decisions often end up being some of the most complex a company can face.“

Decision-making process for a procurement form

- New space demand
- Project situation
- Budget
- Internal resources
- Internal requirements
- Targets
- Organisation

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Research questions

- What alternatives to property development are open to a company and how do they differ from each other?

- Which determinants have an influence on procurement decisions in companies' CREM?

- How should the corporate decision-making process specific to a project be structured for the selection of a suitable form of procurement?
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After the literature review there are 4 steps to develop a decision support tool

1. Literature review
   - Different forms of procurement
   - Decision-making process in CREM
   - Decision criteria and tools in studies

   Model of decision making

   2. Data analysis
      - Acquisition and analysis of data material like contracts, jour-fixe minutes, transcripts of meetings, project presentation

   3. Interviews
      - Explorative survey focused on objectives and framework of decision making situation
      - 26 semi-structured interviews

   4. Qualitative content-analysis
      - Software based approach for analysing the interviews
      - Formulate decision criteria

   5. Onlinesurvey
      - Online survey with questionnaire for revision of the formulated decision criteria

   Development of a decision support tool for practice

Source: Paper is accepted and will be published in Journal of Construction Engineering and Project Management
Case study: Project development of an office building

**Project details:**
- Office building for an IT-unit of a chemical company
- 1,500 working places
- 38,000 m² total floor area
- Project volume: € 70m
- Project term: 2 years

**Project targets:**
- Life-cycle approach
- Modern, functional and energy-efficient offices

**Stakeholders**
- Principal: Chemical company
- User: IT-unit of the principal
- Total contractor: value-added partner
- Investor
- Town representatives
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There are various differences between the allocation of responsibility in procurement forms.

- **In-sourcing**
  - Implementing the project in-house
  - Analysis and conception
  - Evaluation of variants
  - Financing
  - Property purchase
  - Planning
  - Construction
  - Operation
  - Control

- **Outsourcing**
  - In-house planning with general contractor
  - Analysis and conception
  - Evaluation of variants
  - Financing
  - Property purchase
  - Planning
  - Construction
  - Operation
  - Control

- **Value-added partnership**
  - Analysis and conception
  - Evaluation of variants
  - Financing
  - Property purchase
  - Planning
  - Construction
  - Operation
  - Control

- **Total contractor**
  - Analysis and conception
  - Evaluation of variants
  - Financing
  - Property purchase
  - Planning
  - Construction
  - Operation
  - Control

Legend:
- **Corporate**
- **General/Total contractor**
- **Corporate and contractor**
- **Value-added partners**

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## Objectives and influence factors in property development – an excerpt from literature

<table>
<thead>
<tr>
<th>Source</th>
<th>Objectives</th>
<th>Influence factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asson (2002)</td>
<td>Reducing costs, increasing productivity, high customer satisfaction</td>
<td>Own core competence and core activity</td>
</tr>
<tr>
<td>Bajec (2010)</td>
<td></td>
<td>Limited internal resources, limited availability of in-house technologies, lack of specialist staff, high complexity</td>
</tr>
<tr>
<td>Cánez (2000)</td>
<td>Increasing responsiveness and quality, time certainty, procurement costs</td>
<td></td>
</tr>
<tr>
<td>Cox (1997)</td>
<td>Aspired degree of control</td>
<td>Internal resources, internal skills</td>
</tr>
<tr>
<td>Love (1998)</td>
<td>Speed of planning and construction, certainty of costs and timing, flexibility to requests for changes, quality, risk allocation, clear responsibilities, price competition and resolution of conflicts</td>
<td></td>
</tr>
<tr>
<td>McIvor (2008)</td>
<td>Reducing production and transaction costs</td>
<td>The necessary resources or capabilities internally</td>
</tr>
<tr>
<td>Ng (2002)</td>
<td>Speed, certainty of timing and price, level of quality, flexibility, responsibility and influence, complexity, price competition, risk allocation, design, investment costs/budget</td>
<td>Complexity, special management requirements</td>
</tr>
</tbody>
</table>
The decision for a procurement form depends on different factors

**Targets:**
- Time
- Costs
- Quality
- Flexibility

**Institutionalisation:**
- Resources and competences
- Management requirements
- Organisation

**Project conditions:**
- Complexity
- User requirements

Source: Paper is accepted and will be published in Journal of Construction Engineering and Project Management
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Interview results: 15 decision criteria can be classified in four categories

Control system
- Transfer of time risks to the contractor
- Transfer of cost risks to the contractor
- Transfer of quality risks to the contractor
- Reduction of interfaces
- Creating transparency in the project with clear communication and sufficient information

Target system
- Amount of the investment
- Amount of the life cycle costs
- Intent of a functional proposal
- Intent of a detailed proposal

Organisational structure
- Availability of planning resources
- Availability of control resources
- Planning competence for the specific building

Framework
- Position of the building is onside
- The corporate will be owner of the building
- The corporate will rent the building

Additional input from group discussions
- A consistent BIM process for digitisation
- Transfer of the security risks to the contractor
Questionnaire results: Many criteria are important for decision makers in CREM

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Percentage of Respondents with Relevant or Very Relevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Corporate will rent the building</td>
<td>26.5%</td>
</tr>
<tr>
<td>The Corporate will be the owner of the building</td>
<td>31.6%</td>
</tr>
<tr>
<td>Position on-site</td>
<td>36.8%</td>
</tr>
<tr>
<td>Creating transparency in the project with information and communication</td>
<td>47.4%</td>
</tr>
<tr>
<td>Internal planning competence for the specific building type</td>
<td>47.4%</td>
</tr>
<tr>
<td>Detailed call of tenders</td>
<td>52.6%</td>
</tr>
<tr>
<td>Internal planning resources for the specific building type</td>
<td>52.6%</td>
</tr>
<tr>
<td>Optimising investment costs</td>
<td>52.6%</td>
</tr>
<tr>
<td>Optimising life-cycle costs</td>
<td>68.4%</td>
</tr>
<tr>
<td>Transfer the responsibility for quality risks</td>
<td>68.4%</td>
</tr>
<tr>
<td>Internal control resources</td>
<td>68.4%</td>
</tr>
<tr>
<td>Functional call of tenders</td>
<td>68.4%</td>
</tr>
<tr>
<td>Transfer the responsibility for cost risks</td>
<td>73.7%</td>
</tr>
<tr>
<td>Reduction of interfaces</td>
<td>73.7%</td>
</tr>
<tr>
<td>Transfer the responsibility for time risks</td>
<td>78.9%</td>
</tr>
</tbody>
</table>

Source: Paper is accepted and will be published in Journal of Construction Engineering and Project Management
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The decision making process can be structured hierarchically

Decision problem
Choice of procurement form

Dominance criteria
Long-term programmable usage requirements
Availability of internal resources

Framework
Position on-site

Criteria
Using internal resources
Transfer of the full responsibility for risks
Creating transparency in the project
Optimising cost factors
Determining degree of details

Sub-criteria
Internal planning resources
Internal control resources
Time risks
Cost risks
Quality risks
Safety risks
Reduction of interfaces
Informations and communication
BIM for linked digitisation
Life-cycle costs
Investment costs
Functional call of tenders
Detailed call of tenders

Alternatives
Implementing the project in-house
In-house planning with general contractor
Total contractor
Value-added partnership

Source: Paper is accepted and will be published in Journal of Construction Engineering and Project Management
With which method could the decision-making process be performed?

Decision problem

Choice of procurement form

Dominance criteria

Long-term programmable usage requirements
Availability of internal resources

Framework

Position on-site

Criteria

Using internal resources
Transfer of the full responsibility for risks
Creating transparency in the project
Optimising cost factors
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Sub-criteria

Internal planning resources
Internal control resources
Time risks
Cost risks
Quality risks
Safety risks
Reduction of interfaces
Information and communication
BIM for linked digitisation
Life-cycle costs
Investment costs
Functional call of tenders
Detailed call of tenders

Alternatives

Implementing the project in-house
In-house planning with general contractor
Total contractor
Value-added partnership

Reducing risk of interfaces
Creating transparency in the project
Optimising cost factors
Determining degree of details

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There are different methods for the decision-making process

Specific requirements:

- Multiple criteria decision-making (MCDM) problem
- 15 different criteria need to be considered
- Individual prioritisation of the criteria should be allowed (depending on corporate objectives, etc.)
- The application should be transparent for the user (the CREM)
## The method selection result: a combination of two methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Reason for/against exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple Additive Weighting</td>
<td>Difficult distribution of 100 per cent across the 15 criteria</td>
</tr>
<tr>
<td>Multiplicative Exponent Weighting</td>
<td>Difficult distribution of 100 per cent across the 15 criteria</td>
</tr>
<tr>
<td>Conjoint Measurement</td>
<td>New alternatives can not be created</td>
</tr>
<tr>
<td>Fuzzy Method</td>
<td>Not necessary in this context</td>
</tr>
<tr>
<td>Analytic hierarchy process</td>
<td>Using this method enables a consistent, integrated weighting of all the criteria</td>
</tr>
<tr>
<td>TOPSIS</td>
<td>Using this method for evaluation is transparent and suitable in connection with AHP for prioritisation</td>
</tr>
<tr>
<td>ELECTRE</td>
<td>Lack of transparency for the user</td>
</tr>
<tr>
<td>SMART</td>
<td>Lack of transparency for the user</td>
</tr>
<tr>
<td>Point allocation</td>
<td>Difficult distribution of 100 per cent (100 points) across the 15 criteria</td>
</tr>
<tr>
<td>Scenario Analysis</td>
<td>Highly complex, particularly because of the multiplicity of scenarios required to accord with the different criteria</td>
</tr>
</tbody>
</table>
Three steps for using the decision support tool

1. Dominance criteria
   - Checking if an alternative could be excluded because of such a criteria
   - Are there internal resources?
     - [ ] yes
     - [x] no

2. Prioritisation with AHP
   - Paired comparison of all (sub)criteria
   - Calculation of the relative weights
   - Scale:
     - Criteria A: 9
     - Criteria B: 9
     - A is much more important
     - B is much more important

3. Evaluation of the alternative procurement forms with TOPSIS
   - Technique for Order Preference by Similarity to Ideal Solution
   - The evaluation has to be set up for one time only
   - Scale:
     - 1: low
     - 3: high
1. Some alternatives can be excluded by answering questions regarding dominance criteria

<table>
<thead>
<tr>
<th>Question 1: For procurement of corporate real estate you have to decide between ownership and rental. Is your usage requirement and type of usage predictable for at least 5 years?</th>
<th>yes no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 2: For real estate development there are many different kinds of human resources necessary. Are resources for planning with the required competences available in your company?</td>
<td>yes no</td>
</tr>
<tr>
<td>Question 3: In many companies there are specific restrictions for working on-site. Is your project situated on-site?</td>
<td>yes no</td>
</tr>
</tbody>
</table>

Some alternatives are excluded

(for example if there are no resources for planning in the company the project can not be implemented in-house)
2. The prioritisation takes place in a paired comparison of the criteria

| Use of internal resources | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Use of internal resources | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Use of internal resources | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Use of internal resources | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Use of internal resources | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| Transfer the responsibility for risks | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Creating transparency of procedures | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Optimising costs | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Determining degree of detail | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

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<table>
<thead>
<tr>
<th>Scale</th>
<th>Importance/Relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equally important</td>
</tr>
<tr>
<td>3</td>
<td>Somewhat more important</td>
</tr>
<tr>
<td>5</td>
<td>More important</td>
</tr>
<tr>
<td>7</td>
<td>Much more important</td>
</tr>
<tr>
<td>9</td>
<td>Extremely important</td>
</tr>
<tr>
<td>2,4,6,8</td>
<td>Intermediate values</td>
</tr>
</tbody>
</table>
3. The evaluation of the alternatives by using TOPSIS

<table>
<thead>
<tr>
<th>Use of internal planning resources</th>
<th>Implementing the project in-house</th>
<th>In-house planning with general contractor</th>
<th>Total contractor</th>
<th>Value-added partnership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer the responsibility for time risks</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Optimising the investment costs</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>...</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale</th>
<th>Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not suitable</td>
</tr>
<tr>
<td>2</td>
<td>Rather not suitable</td>
</tr>
<tr>
<td>3</td>
<td>Rather suitable</td>
</tr>
<tr>
<td>4</td>
<td>Suitable</td>
</tr>
<tr>
<td>5</td>
<td>Very good suitable</td>
</tr>
</tbody>
</table>
Finally the alternatives must be weighted up with looking on the efficiency measurements

\[ V = \begin{bmatrix} v_{11} & v_{12} & \cdots & v_{ij} & \cdots & v_{im} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ v_{il} & v_{l2} & \cdots & v_{lj} & \cdots & v_{im} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ v_{n1} & v_{n2} & \cdots & v_{nj} & \cdots & v_{nm} \end{bmatrix} = \begin{bmatrix} w_{11}r_{11} & w_{21}r_{12} & \cdots & w_{1j}r_{ij} & \cdots & w_{mm}r_{im} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ w_{1l}r_{l1} & w_{2l}r_{l2} & \cdots & w_{lj}r_{lj} & \cdots & w_{mm}r_{im} \\ \vdots & \vdots & \ddots & \vdots & \cdots & \vdots \\ w_{nl}r_{n1} & w_{n2}r_{n2} & \cdots & w_{nj}r_{nj} & \cdots & w_{nm}r_{nm} \end{bmatrix} \]

\( w \) = weighting
\( r \) = value for suitability
\( v_j^+ \) = best value for suitability for criteria \( j \)
\( v_j^- \) = worst value for suitability for criteria \( j \)

Distance measure „Best-case“

\[ S_i^+ = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^+)^2} \]

Distance measure „Worst-case“

\[ S_i^- = \sqrt{\sum_{j=1}^{m} (v_{ij} - v_j^-)^2} \]

Efficiency measure

\[ C_i = \frac{S_i}{S_i^+ + S_i^-} \quad \text{with} \quad 0 \leq C_i \leq 1 \quad \forall i = 1, \ldots, n \]

Decision-making by comparing the efficiency measures
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Next step ...

Extended survey to analyse the context and importance of identified criteria in the decision-making process of insourcing or outsourcing
Thank you for your attention!

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Open questions

Information to our research center and other research projects
http://real-estate-research.org/
Sources

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