SMART REAL ESTATE MANAGEMENT

Developing a Smart Tool for Demand-Supply Alignment

Contents

Introduction

Problem Analysis

Dynamic demand

Digitalisation enables students to study virtually everywhere, demand for study space on the campus remains high and students place higher demands on the quality and availability of facilities (Valks, et al., 2016, p. 15).

Utilization information

Campus management still lacks information about the utilization of the campus, including occupancy and frequency ratings (Den Heijer, 2011, p. 111).

“One of the big challenges in corporate real estate management (CREM) is reducing the gap between the high speed of business and the slow speed of real estate, i.e. between the so-called dynamic real estate demand and the relatively static real estate supply.” (Arkesteijn, 2016)

Problem Analysis

Performance measurement

Universities have little insight of user satisfaction (Algemene Rekenkamer, 2016, p. 27).

Missed opportunity for real estate managers to test and prove the effectiveness of real estate interventions (De Vries, 2007, p. 10).

Study space findability

Campus users lack of information about occupancy and aspects of available study spaces. Large part TU Delft students (70%) experiences shortage study space on weekends (ORAS, 2017, p. 7).

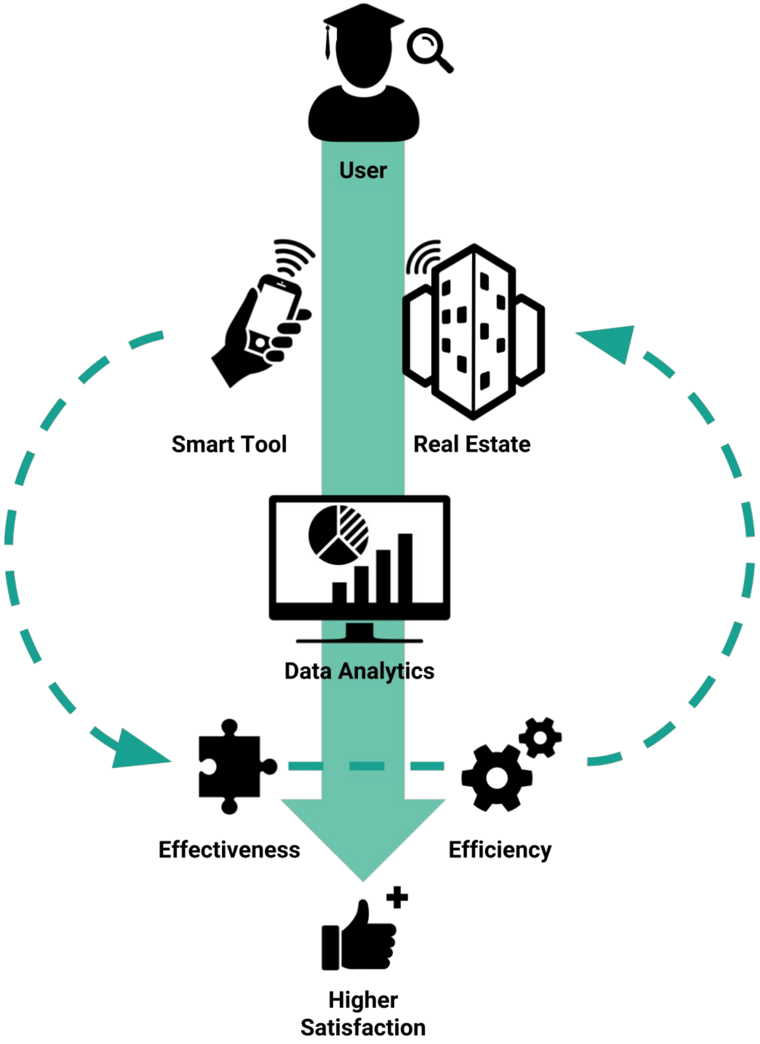
Context

- Increased competitiveness in higher education and more international applications (Algemene Rekenkamer, 2016, p. 21).
- Transference presented universities with opportunities to align their real estate to the organisation's primary processes (Algemene Rekenkamer, 2016, p. 16; den Heijer, 2012, p. 73).
- Dutch universities are planning to invest more than € 3 billion in their real estate (IvhO, 2016).

Hypothesis

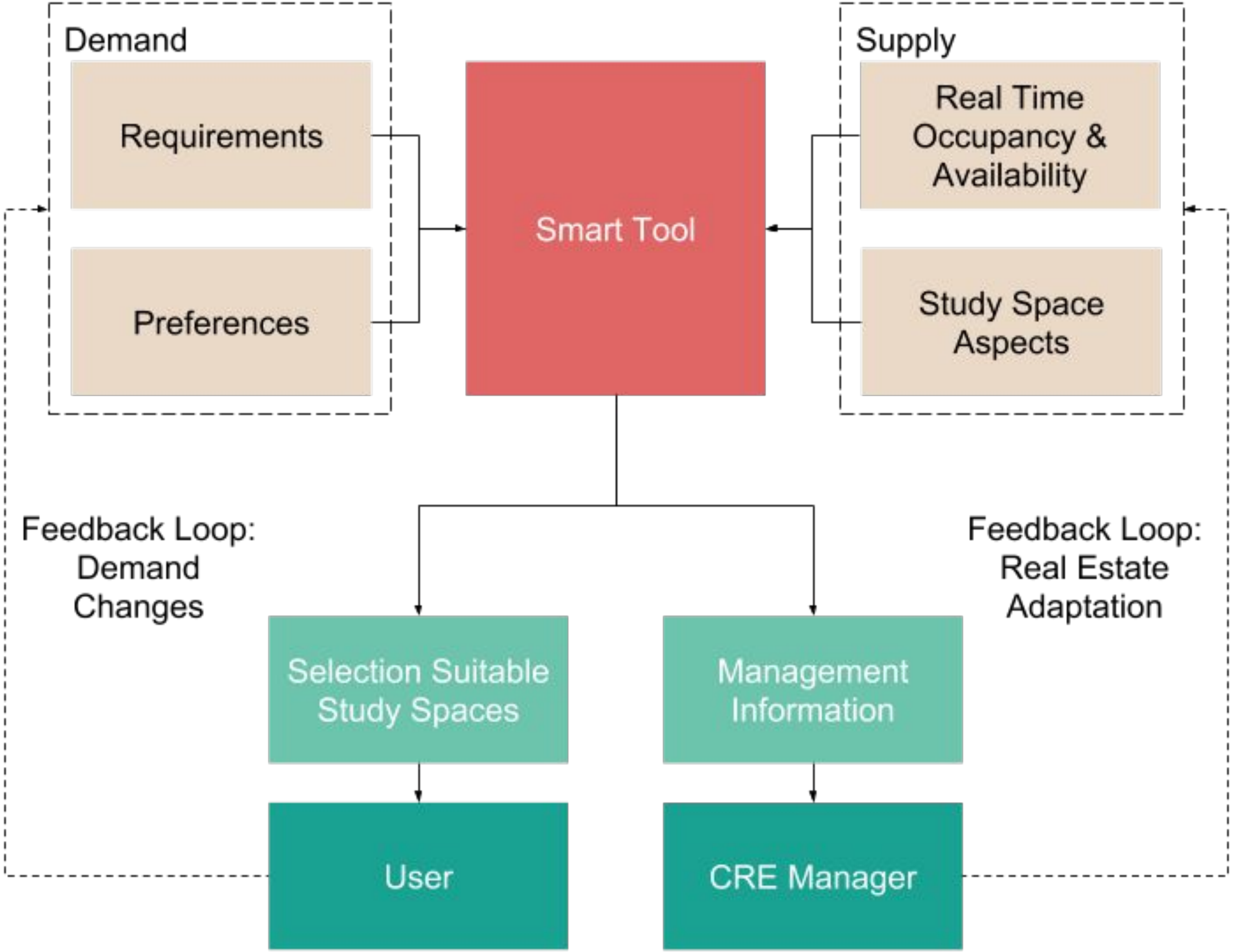
By providing **information** about space **aspects** and **availability** through **smart tools** an improvement in **alignment** between **user** and **real estate** can be achieved both on the *short* and *long* term.

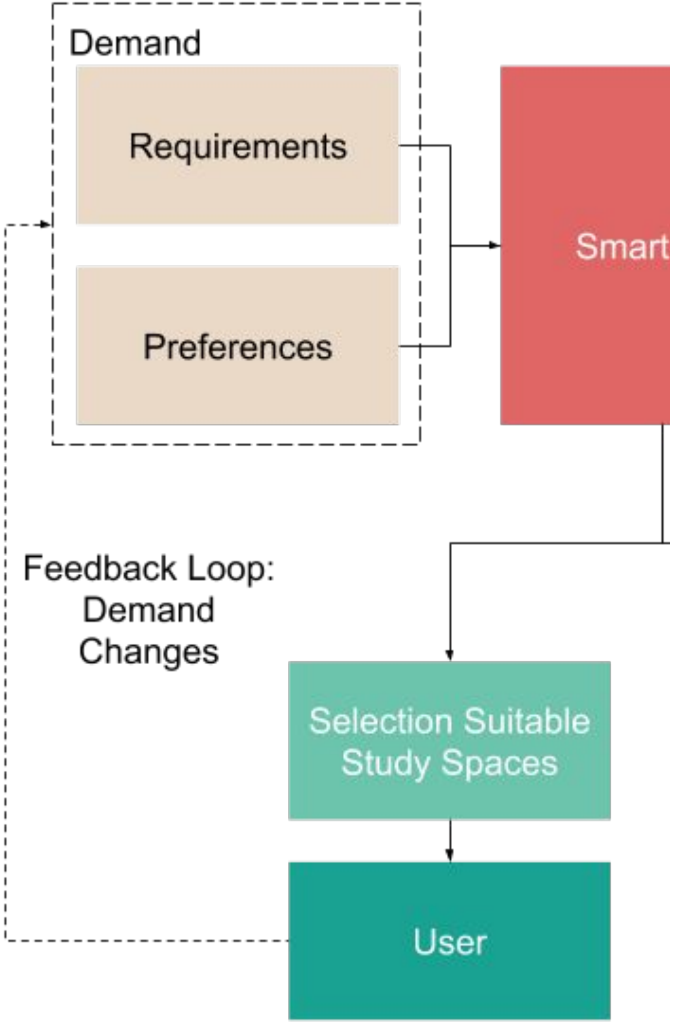
By taking user **preferences** into account, a higher user **satisfaction** can be achieved.



Main Research Question

"How can a **Smart Tool** provide information to support the alignment of dynamic user demand with campus space supply more *effectively* and *efficiently* on both the *long* and *short term*?"


Demand
Requirements
Preferences
Smart Tool
Supply
Real Time Occupancy & Availability
Study Space Aspects
Feedback Loop: Demand Changes
Feedback Loop: Real Estate Adaptation
Selection Suitable Study Spaces
Management Information
User
CRE Manager

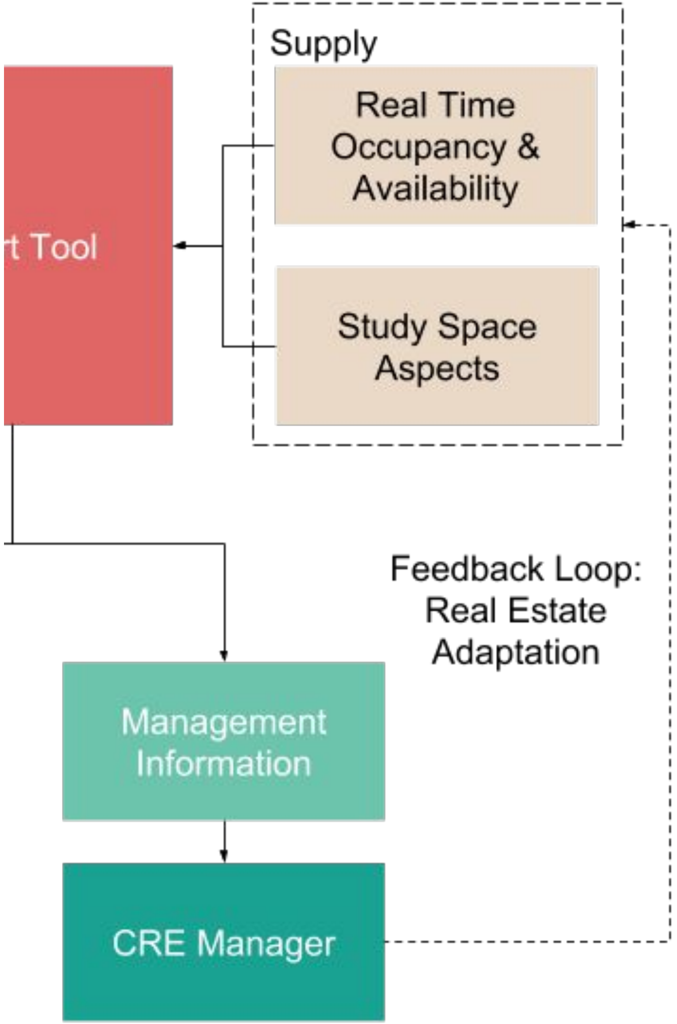


(User) Demand

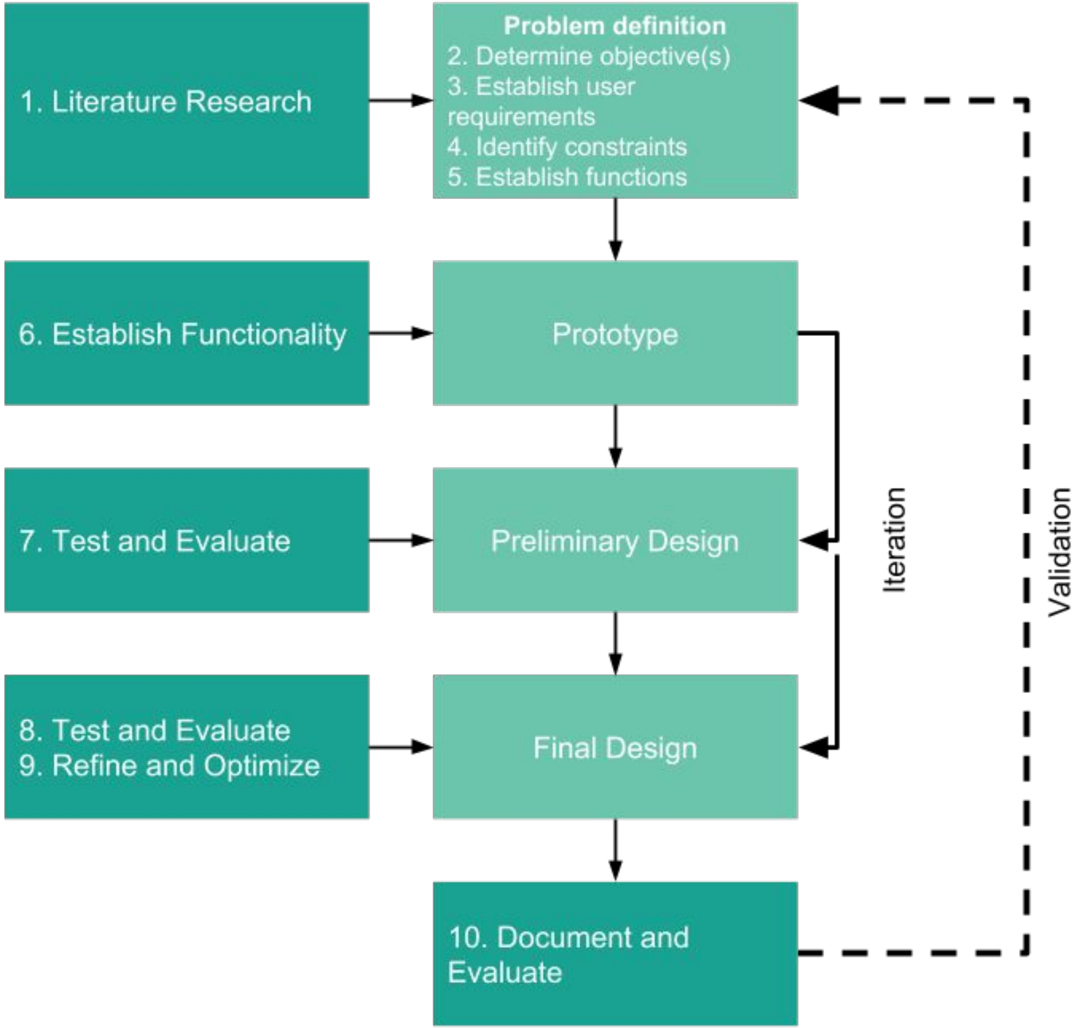
- Find ways to **quantify dynamic demand** through the use of Smart Tools
- Determine **demands** of smart tools/mobile applications for **supporting student activities**

(Real Estate) Supply

- Discover new valuable data sources
- Analysation of long term data to discover patterns
- Optimize Real Estate (portfolio)



Methods


1. Literature Research
Problem definition
2. Determine objective(s)
3. Establish user requirements
4. Identify constraints
5. Establish functions
6. Establish Functionality
Prototype
7. Test and Evaluate
Preliminary Design
8. Test and Evaluate
9. Refine and Optimize
Final Design
10. Document and Evaluate
Iteration
Validation

Data Collection

Literature study	Interviews
The role and needs of CREM	User prototype evaluation (and the establishment of (additional) needs) x2
Current campus management practice	CRE managers (for the establishment of (additional) needs)
Existing smart campus tools	
Business intelligence	
Privacy concerns	
(WiFi) occupancy detection	
Learning space preferences	

Prototype Evaluation for User Involvement

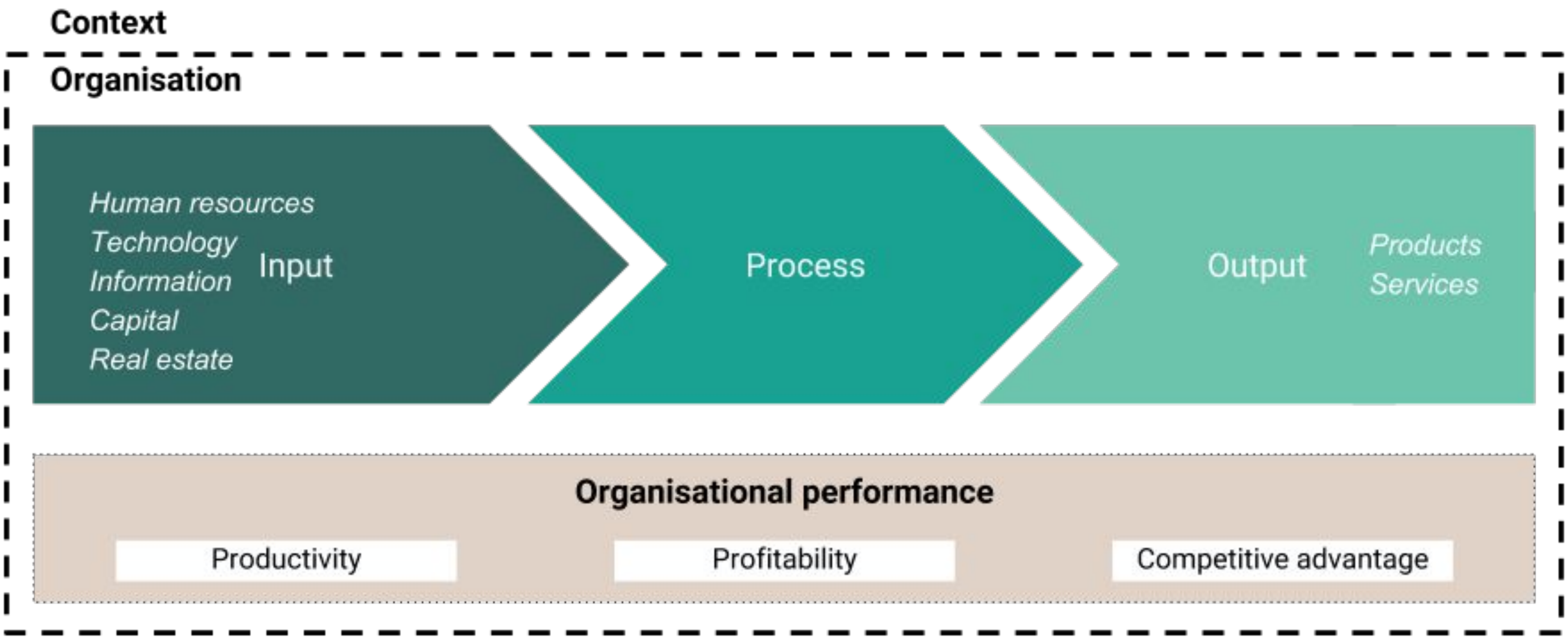
- Prototype Testing (Filmed)
  - PFM in excel
    - Mathematical Function
  - Mockup in Balsamiq
    - Wireframe model
- Evaluation
  - Task Load Index
  - Post Experience Interview

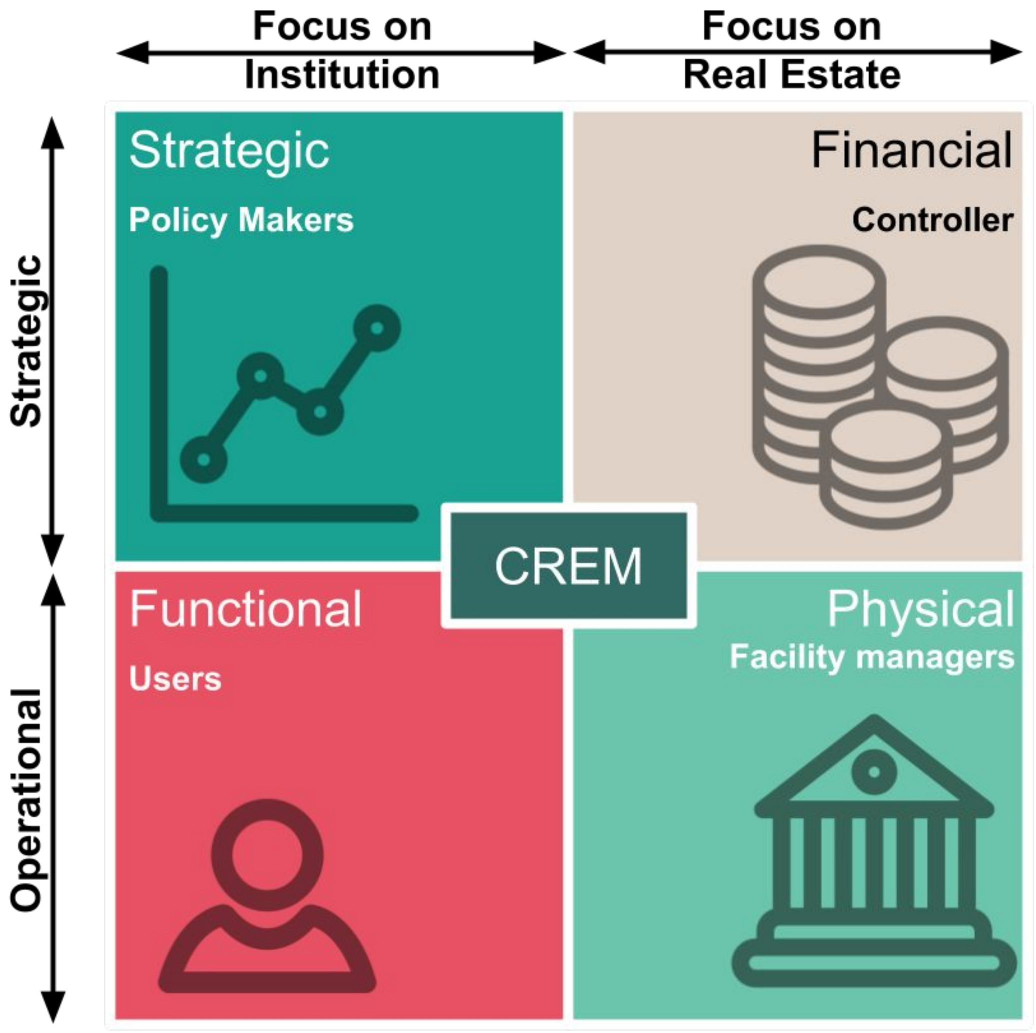
Deliverables

Must-have	Should-have
Selection model based on preferences, requirements (& availability)	Net-id integration (Single sign-on)
Preference match selection	Campus integration (2 or more faculties in the database)
Dashboard for data visualisation	UI design for mobile app
User-bound preferences (saved)	
Nice-to-have	**Forget-about-it**
Live link for occupancy determination	Events
Determination availability studyplace level	Way-finding
Brightspace schedule integration	3D model
Favourites	Mobile app
Booking system	Safety

Literature Study

Organisational Performance

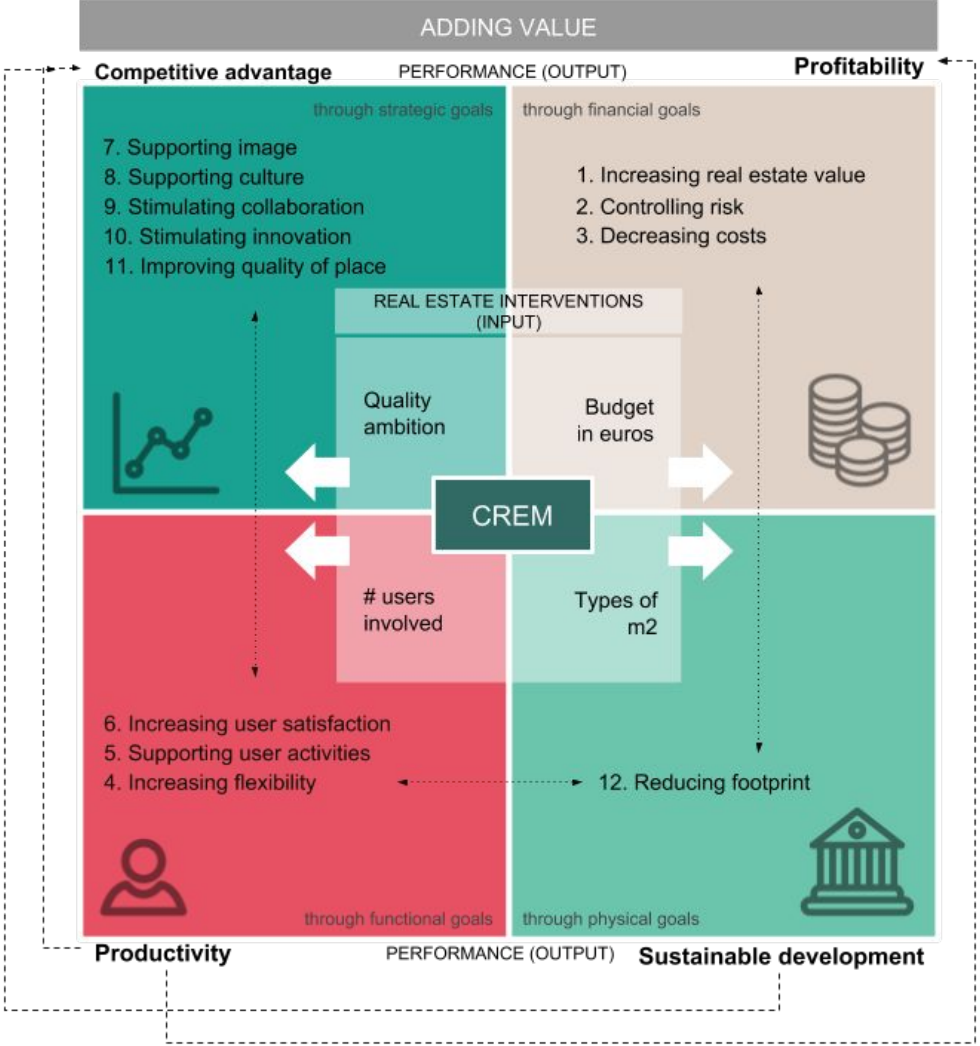



Focus on Institution
Focus on Real Estate
Strategic
Operational
Strategic
Policy Makers
Financial
Controller
CREM
Functional
Users
Physical
Facility managers

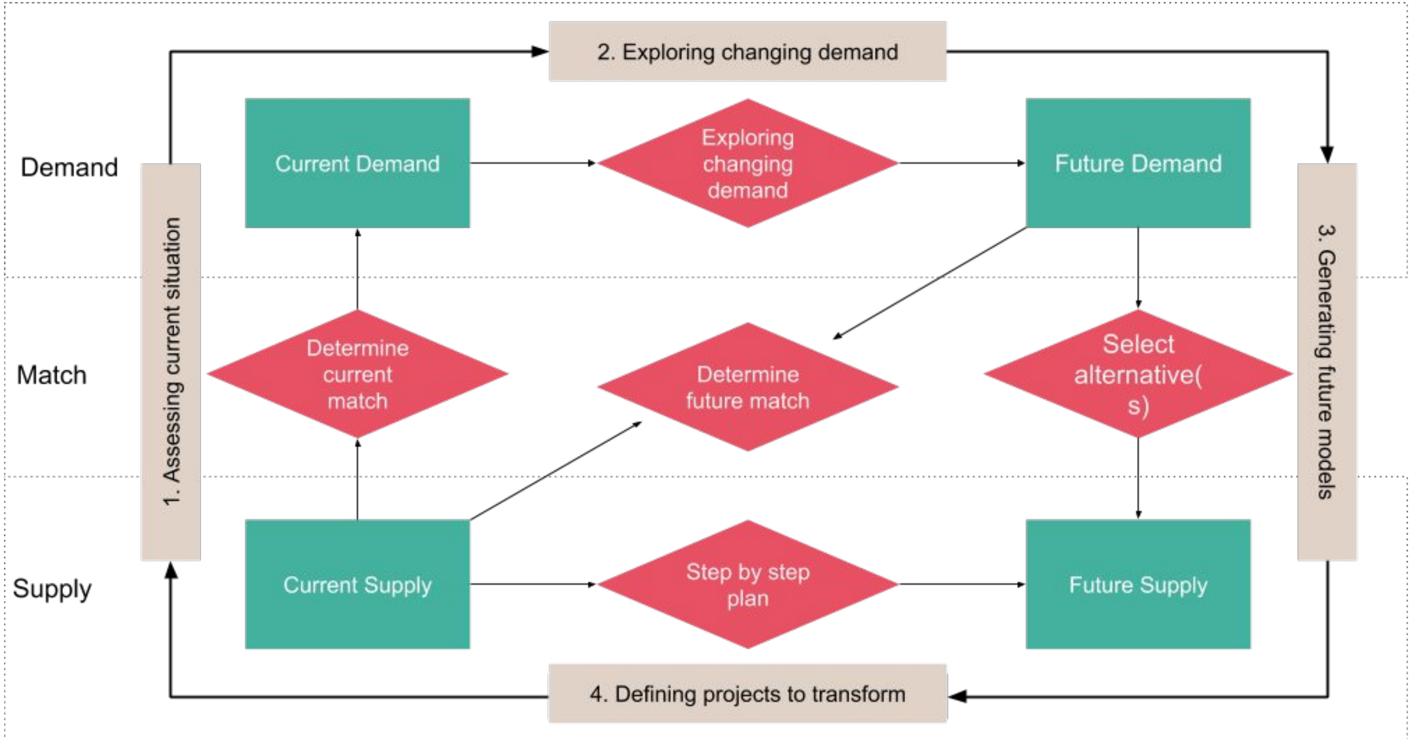
Adding Value

12 ways to add value through real estate	
1. Increasing real estate value	7. Supporting image
2. Controlling risk	8. Supporting culture
3. Decreasing costs	9. Stimulating collaboration
4. Increasing flexibility	10. Stimulating innovation
5. Supporting user activities	11. Improving quality of place
6. Increasing user satisfaction	12. Reducing footprint

Types of real estate interventions		
Maintenance	Functional adjustment	Reshuffling
(partial) Renovation	New building	


ADDING VALUE
Competitive advantage
PERFORMANCE (OUTPUT)
Profitability
through strategic goals
through financial goals
7. Supporting image
8. Supporting culture
9. Stimulating collaboration
10. Stimulating innovation
11. Improving quality of place
1. Increasing real estate value
2. Controlling risk
3. Decreasing costs
REAL ESTATE INTERVENTIONS (INPUT)
Quality ambition
Budget in euros
CREM
users involved
Types of m2
6. Increasing user satisfaction
5. Supporting user activities
4. Increasing flexibility
12. Reducing footprint
through functional goals
through physical goals
Productivity
PERFORMANCE (OUTPUT)
Sustainable development

DAS Frame


2. Exploring changing demand
Demand
Current Demand
Exploring changing demand
Future Demand
1. Assessing current situation
3. Generating future models
Match
Determine current match
Determine future match
Select alternative(s)
Supply
Current Supply
Step by step plan
Future Supply
4. Defining projects to transform

Current Campus Goals

Goals scoring the highest, thus on average having the highest priority were (Den Heijer, 2011, p. 144):

1. Support user goals more effectively

2. Support identity university/ attract more students & staff members

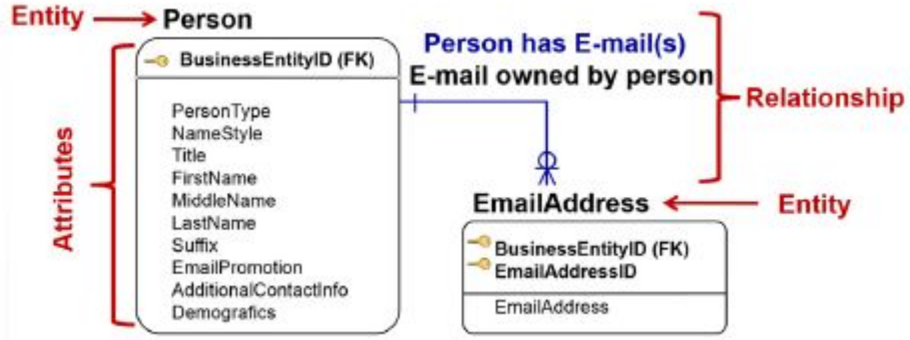
3. Achieve minimum quality for use permit

4. Accommodating growth

5. Increase occupancy and frequency rates

Smart Tool Development

ER Model



Entity
Person
BusinessEntityID (FK)
PersonType
NameStyle
Title
FirstName
MiddleName
LastName
Suffix
EmailPromotion
AdditionalContactInfo
Demografics
Attributes
Person has E-mail(s)
E-mail owned by person
Relationship
EmailAddress
Entity
BusinessEntityID (FK)
EmailAddressID
EmailAddress

Mission Statement

1. The Proposed Smart Tool will help students/users find an available study space meeting their requirements and selecting based on the highest match with their preferences.

2. Simultaneously this search data is stored to inform management with the actual dynamic demand (after analysation).

Design Objectives

- Provide the user with match based on the highest match with preferences
  - By adding weight to each preference criteria
- Store study space search information
  - (incl a timestamp)
- Allow search iteration
  - (if the match does not comply allow changes to search input and show which preferences were not met)
- Store user preferences (settings)

Internship LoneRooftop

- Good technical basis for further development
  - Occupancy detection
- Many similarities
- Understanding of problems, opportunities & objectives
- 1-on-1's e.g. Privacy, UX Design, Database Modelling

Smart Tool Progression

- Preference Function Modelling (PFM) Tool in Excel
- Mobile application mockup in Balsamiq
- Database modelled in MySQL Workbench

Models

Evaluation

Prototype Testing (Version 1)

- Difficult to understand initially
    - Lot of guidance required
- Long duration input (approximately 15 min.)
- Results seemed to be satisfactory
    - Stimulated iteration

Prototype Testing (Version 2)

- Difficult to understand initially
    - Guidance provided improved understandability
- Decreased duration input (approximately 8 min.)
- Results easier to understand

Findings

- High mental demand PFM
- High levels of frustration
  - Will lead to users abandoning the tool
- By informing users on the purpose of the data, willingness (to give feedback) might be increased
- PFM is most likely not suitable for daily use
  - Strain
  - Users will ‘learn’ spaces

Findings

- Enough ways to communicate their demands, but daunting and difficult to find
  - Integration for leaving feedback FM
- Occupancy and distance to current location most important factors for choosing where to study (functionality)
  - E.g. an interactive map with filters
- Higher levels of granularity is required

CRE Management (DAS Frame)

1. Assess the current situation:

Better representation of demand

Can give indication user satisfaction

Supports current methods

2. Explore the future demand:

Accumulation of quantitative data

Discover patterns for the long term

DAS Frame

3. Generate future models:

Generated with information former steps

Can provide inherent suggestions

Pilots and innovative projects can act as experimentations

4. Define projects:

Problems and Popularity can be determined among spaces

Business cases can be supported with the quantitative data

Verdict

- PFM is capable of executing the function
    - Not Ideal
- Differences bike between non-bike
- Profiles can be distinguished

Conclusion

Answer Research Question

“How can a **Smart Tool** provide information to support the alignment of dynamic user demand with campus space supply more *effectively* and *efficiently* on both the *long* and *short term*?”

- **Effective alignment**
  - Short term findability of preferred space
  - Accumulated data to find patterns
- **Efficient alignment**
  - Shorter time to find study spaces
  - Increased findability is needed for more efficient use

Conclusions

- Better representation of demand
  - Supports current methods
  - More user involvement
- Provides a new way to passively generate data
- Smart Tool promises improved findability
  - Higher efficiency requires higher findability
- Modular (i.e. if other criteria become more relevant they can be implemented)

Discussion

- Cognitive effort
- Data is dependent on smart tool use
- Smart tool use is dependent on usability
    - Some functionalities dependent on technologies (occupancy detection, localisation, wayfinding etc.)
- Data use still depends on competence and behaviour campus management
    - Including the transformation from data to information (e.g. data visualization/mining)

Discussion

- Possibility Online learning
- Distribution of students across campus
- Feedback (Dissatisfier)
- No solution on ‘reserved’ study places

Reflection

- Good to approach as if actually realizing
- LoneRooftop provided helpful insights
- Usability can be tricky
- Conclusion takes longer than expected

Feedback

Only give feedback when the space is:

- below par or;
- if the space exceeds expectations.

If a space meets the expectations he wouldn’t give feedback.

Resulting in feedback approximately 10% of the time.

Like/dislike preferred over rating (0/5 stars)

Thank you!

Back-up Slides

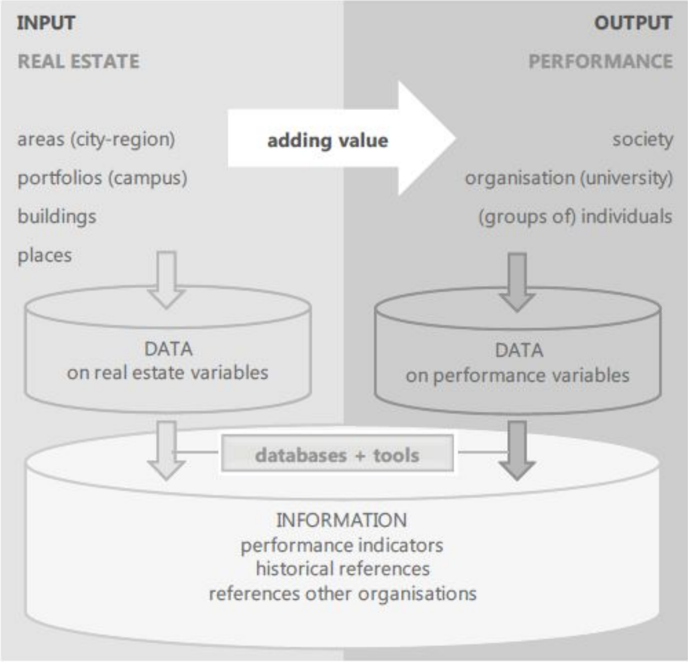
Definitions

A “**campus**” is defined as all the land and buildings that are in use by university functions or functions related to the campus, whether leased or owned by the university, and not bound to a single location. A “campus” can thus also refer to a collection of buildings that are scattered across a city, and is not limited to isolated areas.

Campus management is defined as the process of attuning the campus on the changing context of the university, the demands of the different stakeholder groups and contributing to the performance of the university. The campus manager – being in charge of facilities management and/or estates management is responsible for this process.

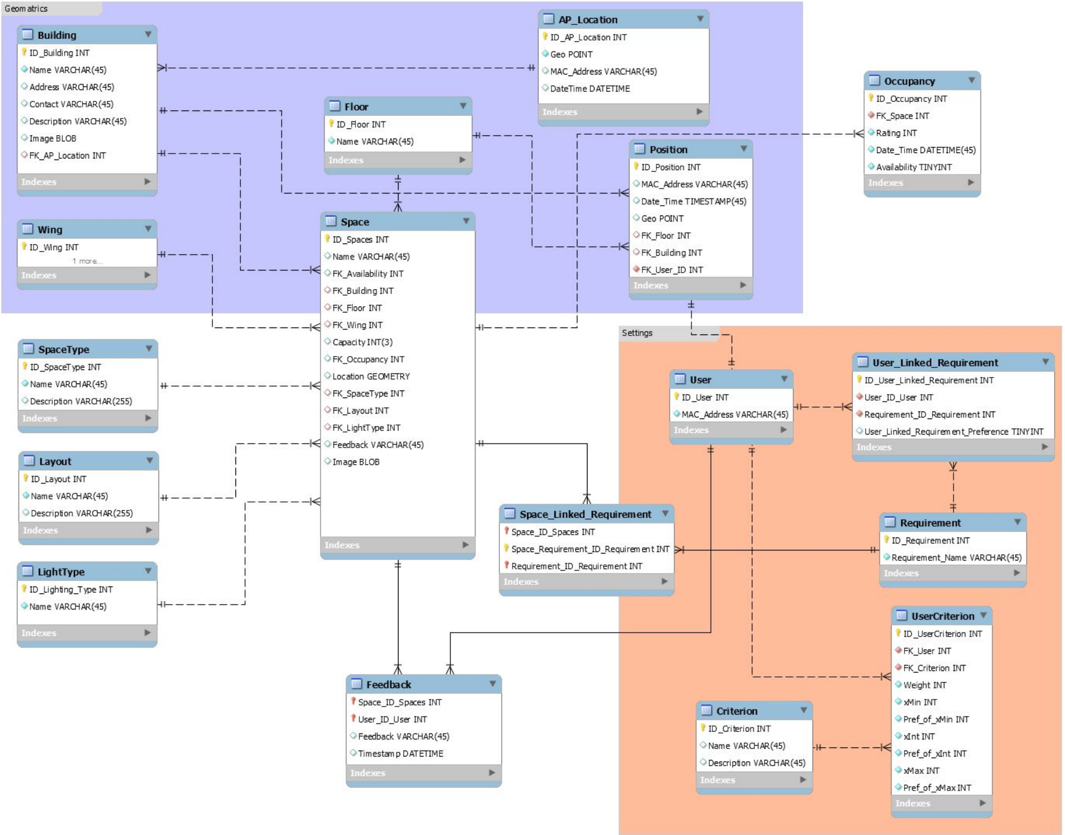
A **smart campus tool** is defined as a service or product which collects real-time information on space use to improve the space use on the current campus on the one hand, whilst supporting decision making on the future space use on the other hand.

Adding Value + KPIs

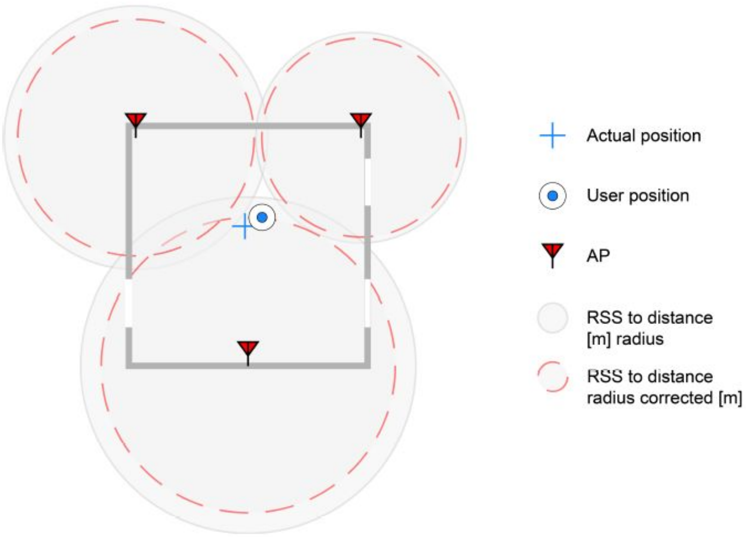


Key performance indicators (KPIs) to measure a university's performance			
productivity	**profitability**	**competitive advantage**	**sustainable development**
• publications per academic fte • output per m^2 • students per m^2 • employees per m^2 • energy costs per m^2 • total costs of ownership as % of total costs (or turnover) • etc.	• revenue minus costs • solvency • liquidity • environmental goals • position on innovation index • citation score • (economic) value of alumni • increased real estate value	• international rankings • market share of students • quality of alumni • student satisfaction • alumni satisfaction • employee satisfaction	• energy use per m^2 • energy use per user • CO_2 emission per m^2 • CO_2 emission per user • energy labels of buildings • footprint in m^2 per user

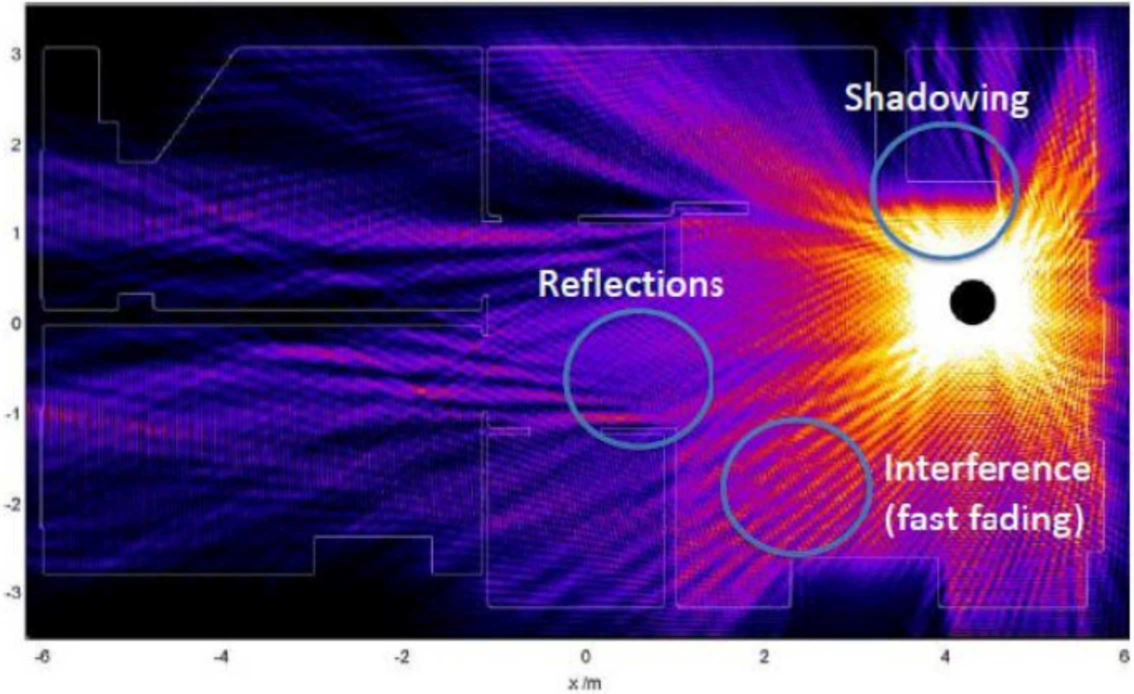
Database Structure



Principle of (Tri)lateration

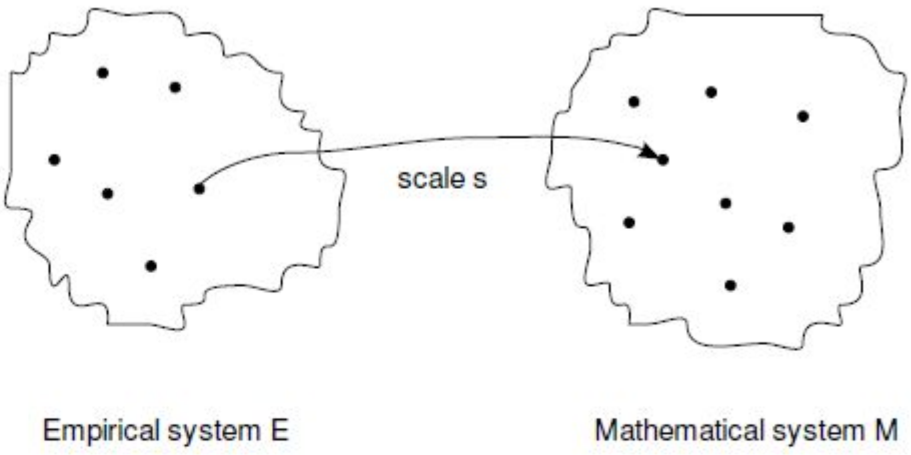


Effects on WiFi Signals



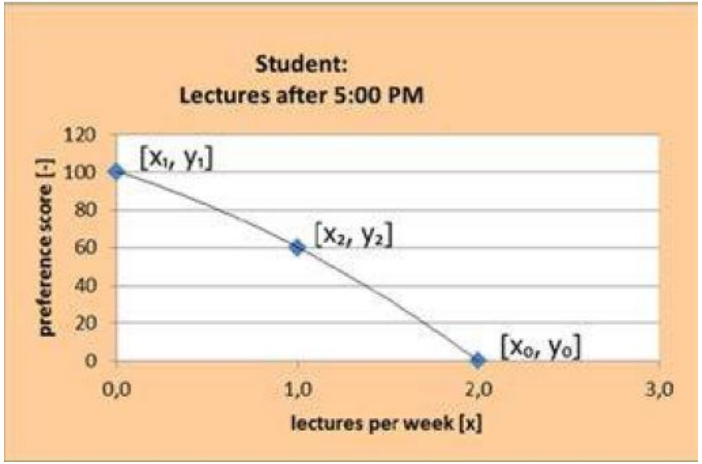
Anonymisation

Preference Measurement



Lagrange function

$$P(x) = \frac{(x-x_2)(x-x_3)}{(x_1-x_2)(x_1-x_3)}y_1 + \frac{(x-x_1)(x-x_3)}{(x_2-x_1)(x_2-x_3)}y_2 + \frac{(x-x_1)(x-x_2)}{(x_3-x_1)(x_3-x_2)}y_3$$



Process PFM

(1) Each decision-maker specifies the decision variable(s) they he/she is interested in.

(2) Each decision-maker rates his/her preferences for each decision variable as follows:

• The decision-maker establishes (synthetic) reference alternatives which define two points of a Lagrange curve.

– A “bottom” reference alternative is defined, which is the alternative associated with the value for the decision variable that is least preferred, rated at 0. This defines the first point of the curve (x0, y0).

– A “top” reference alternative is defined, which is the alternative associated with the value for the decision variable that is most preferred, rated at 100. This defines the second point of the curve (x1, y1).

• The preference for an alternative associated with an intermediate decision variable value relative to the reference alternatives is rated. This defines the third point of the curve (x2, y2).

(3) Each decision-makers assigns weights to his/her decision variable. The subject owner assigns weights to each decision-maker.

(4) Each decision-maker determines the design constraints he/she is interested in.

(5) The decision-makers generate design alternatives group wise and use the design constraints to test the feasibility of the design alternatives. The objective is to try to maximise the overall preference score by finding a design alternative with a higher overall preference score than in the current situation.

(6) The decision-makers select the design alternative with the highest overall preference score from the set of generated design alternatives.