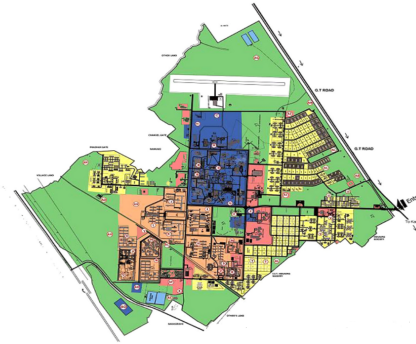


# Affordance-based Design Method: A Case Study of University Campus



**Sustainable Built Environment D-A-CH Conference 2019, Graz**  
**September 2019**

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# Content



- 1. Introduction**
- 2. Literature Review**
- 3. Objective and Methodology**
- 4. Case Study Illustration**
- 5. Proposed Model**
- 6. Research Findings**



# Shifting focus in Construction Research

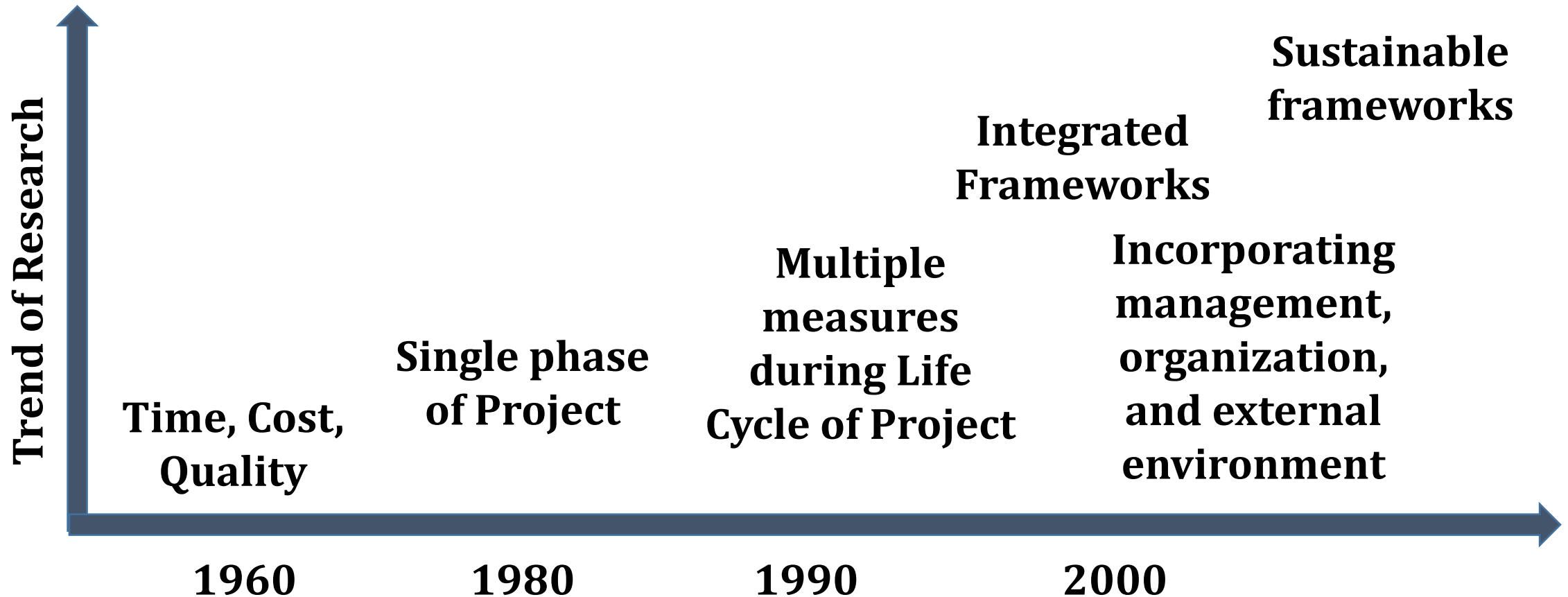
1



**Project thinking**

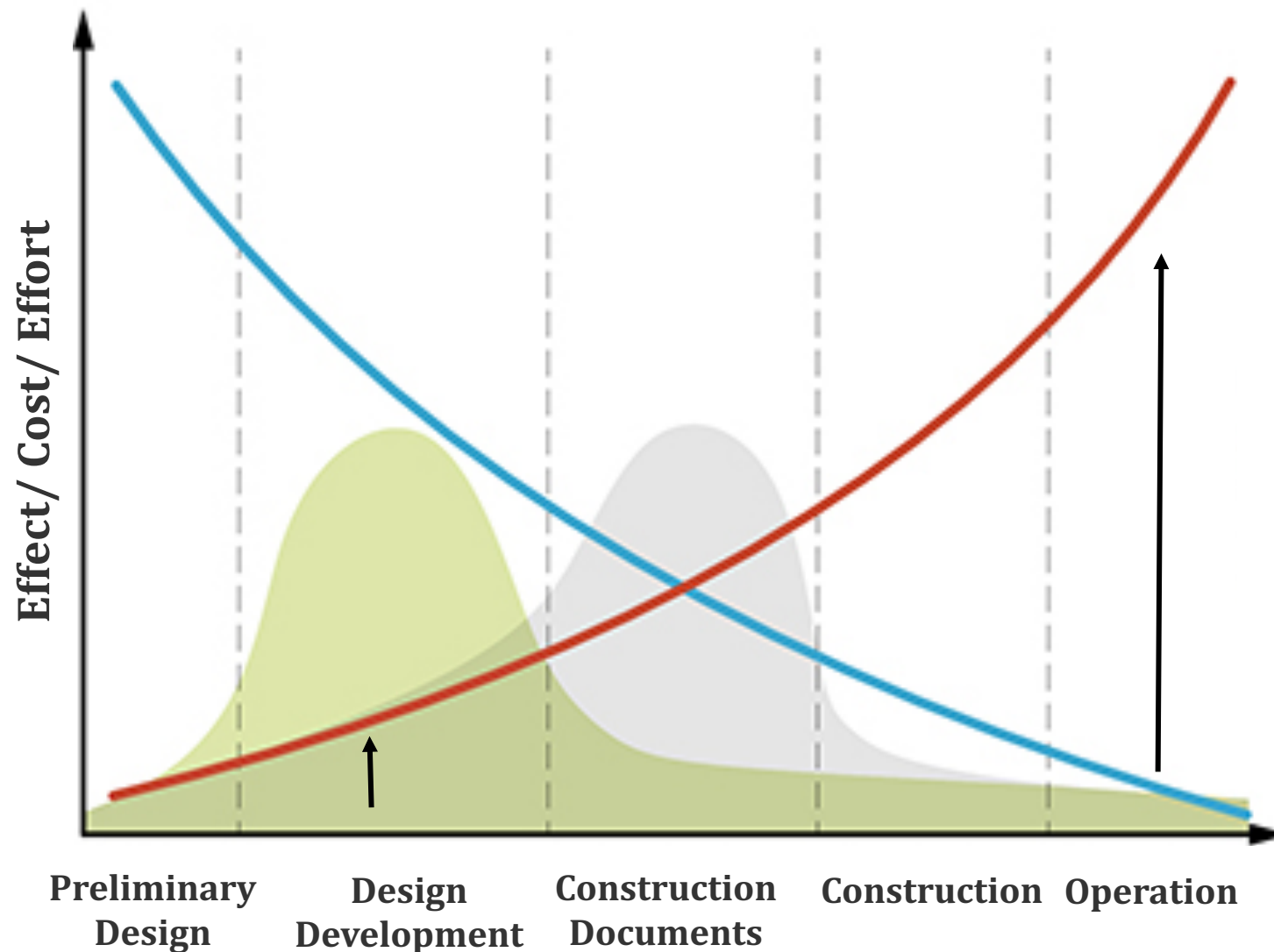
**Implementation phase**

**Life cycle thinking**





# Potential at Design Stage



## MacLeamy Curve

- Ability to impact cost and performance
- Cost of design changes
- Traditional design process
- Integrative design process

Later the changes made in project, the greater the cost of design changes

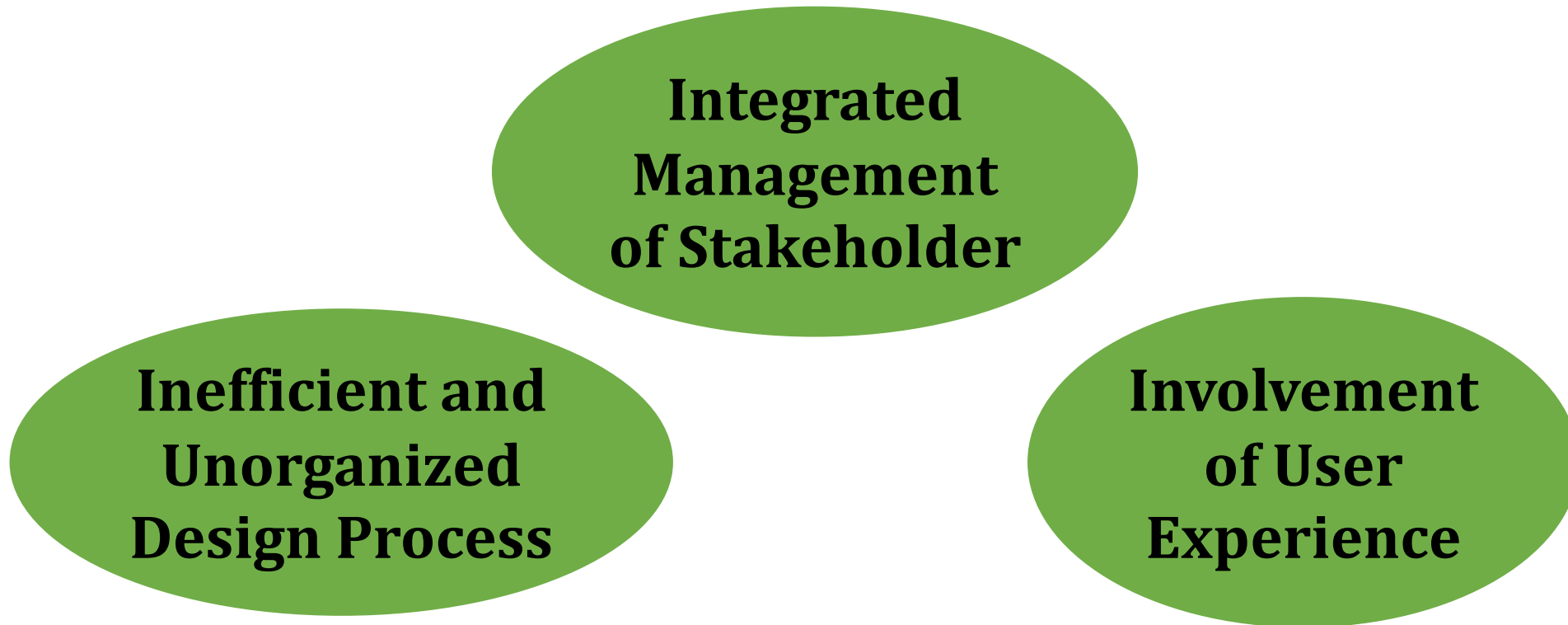


# Need for Research

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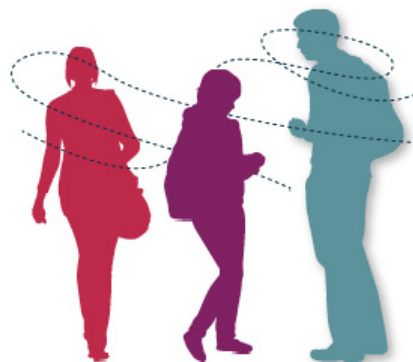


## Focus of Integrated Frameworks



**Need for All-inclusive Approach to Design**

# Research Background



**User groups  
and Client**

**People and  
Organizations**

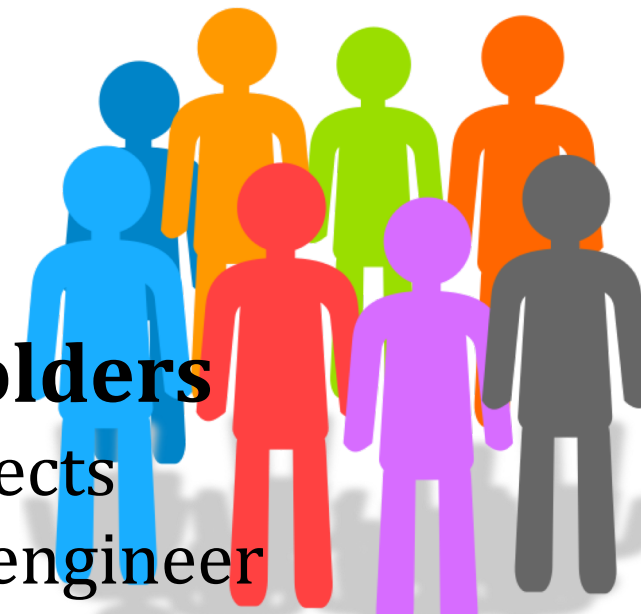


**Built environment**

**Early  
design  
phase of  
project**

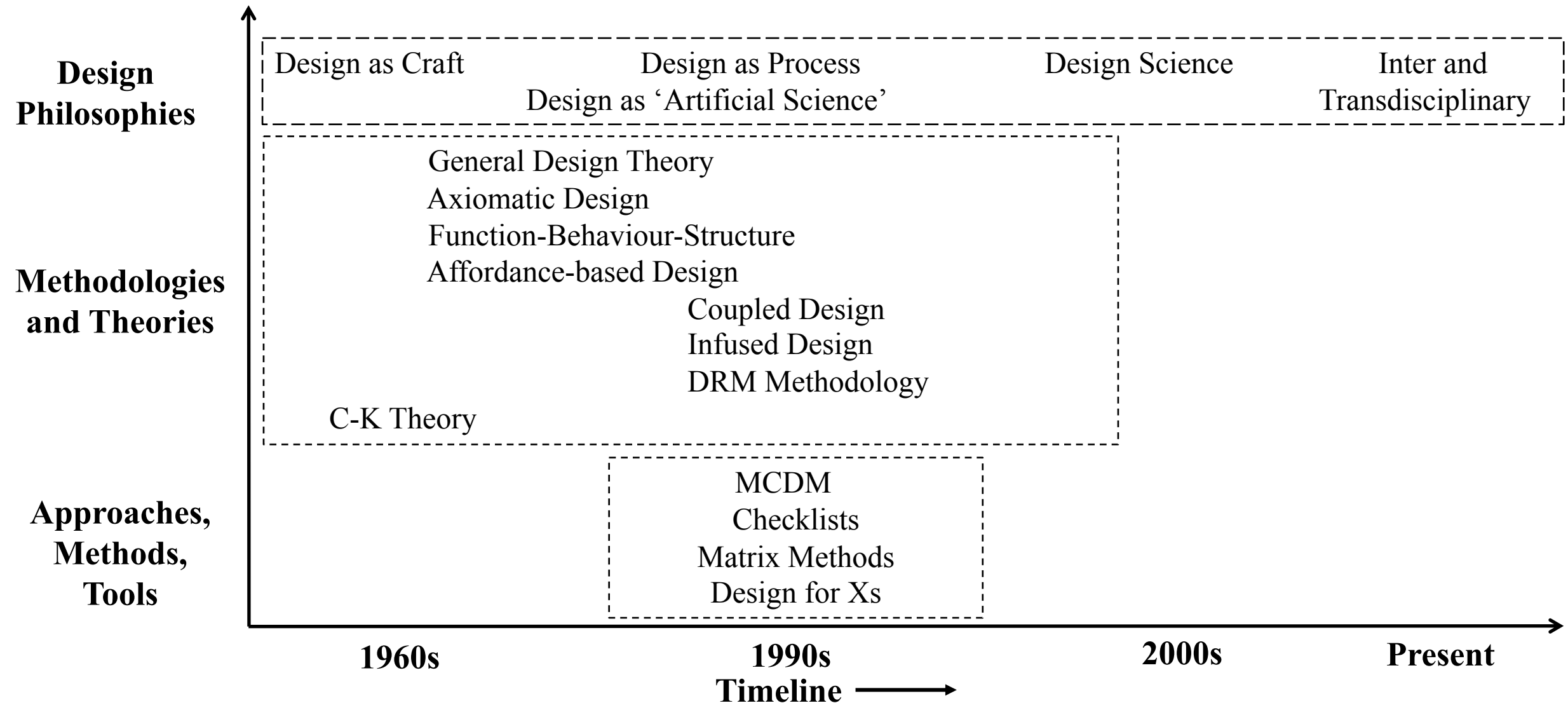
**Stakeholders**

Architects  
Structural engineer  
MEP engineer  
Energy analyst  
Landscape planners





# Evolution of Research in Design





# Affordance-based Design

- **Affordance** of the environment means what it 'offers', 'provides' or 'furnishes', either for good or ill. **Affordance** means 'what one system provides to another subsystem.' Thus requires two interacting subsystems, For example: a road and a car, a keyboard and a person, a building and a occupant.
- Affordance based theory is a **relational theory** and it was first given by Gibson (1977) in perceptual psychology.
- Maier and Fadel (2006) have extended the affordance theory in **engineering design**.
- Authors used affordances to define user needs and allows designers' knowledge to interact with affordances .

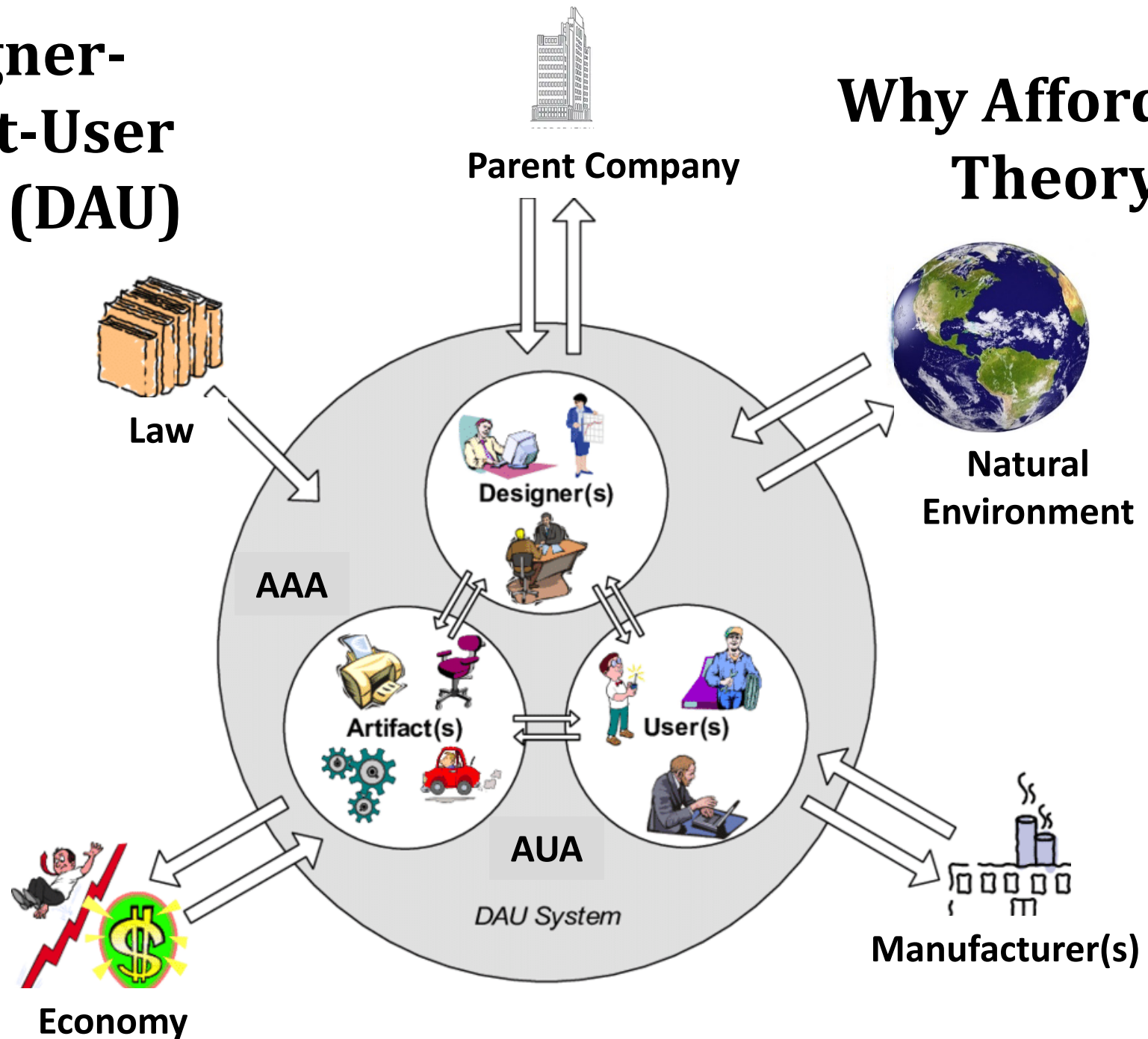
| Author          | Application of ABD theory in Architectural Design Practice                            |
|-----------------|---------------------------------------------------------------------------------------|
| Tweed 2001      | Identifying affordances within computer-aided architectural design (CAAD) software    |
| Koutamanis 2006 | Affordance to individual building elements such as door handles, architectural spaces |
| Kim et al. 2008 | Affordances of a building lobby and how they vary between different users             |



# Designer- Artifact-User System (DAU)

## Why Affordance Theory?

Foundation  
of  
Affordance  
-based  
Design





# Why ABD in Architecture Design?

1. In architecture, affordances can be used as a conceptual framework **to understand the relationship between built environments and humans over time**, especially with respect to the form, function, and meaning of architectural elements.
2. In architectural design, concept of affordance allows a common theoretical basis to improve the design process by offering a **shared language among those involved in a design project, particularly architects and engineers.**
3. In architectural practice, affordances can be used as an **evaluation tool to explore the connection between the initial intentions or objectives of the design with how the artifact is actually used**, leading to archived knowledge for use in future projects, and the potential for avoiding an array of common design failures.





# Objective and Methodology

3



## Objective

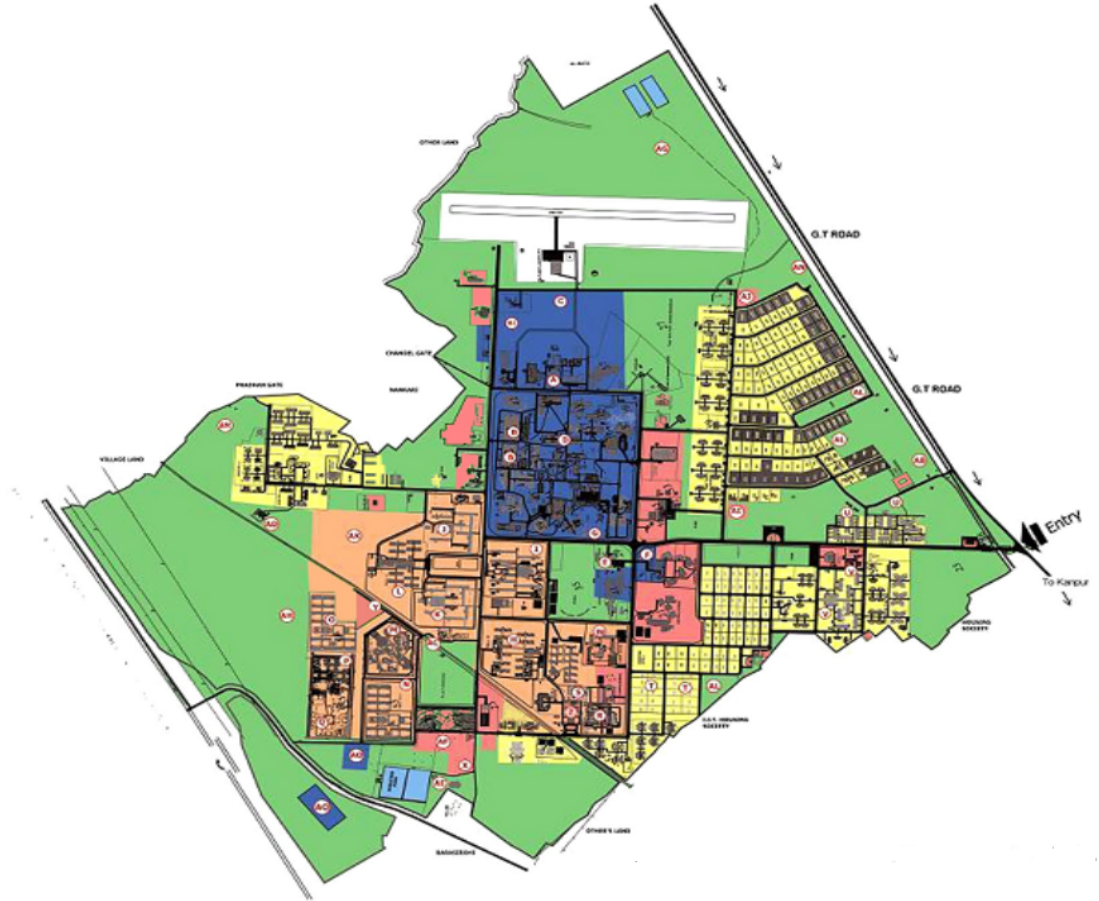
**To extend the potential of affordance-based theory to devise a structured approach for design of built environment.**

## Methodology

- Various systems of built environment can be treated as artefacts and designed by following a set of procedures to fulfil the needs of user. (Maier and Fadel 2006)
- **The proposed Affordance-based Design Method (DM)** aims to incorporate user needs, stakeholder coordination and environmental consideration.
- **The proposed DM** is demonstrated through **a case study on urban design of a university campus.**
- The observations from the case study are discussed in the light of existing literature to emphasize the potential of proposed DM.

# Case Study: University Campus

- Strategize construction for 2035
- Envisaging a residential academic campus for 12000 students along with the requisite faculty, non-teaching staff and their families.
- Building services, utilities and mobility networks to support the target growth of the institute
- Optimal management of available land
- Efficient use of energy and natural resources in an ecologically sustainable manner
- Maintaining the character and ambience of the existing environment



**Development of strategy plan 2035 for  
infrastructure of university campus**

# Data Collection

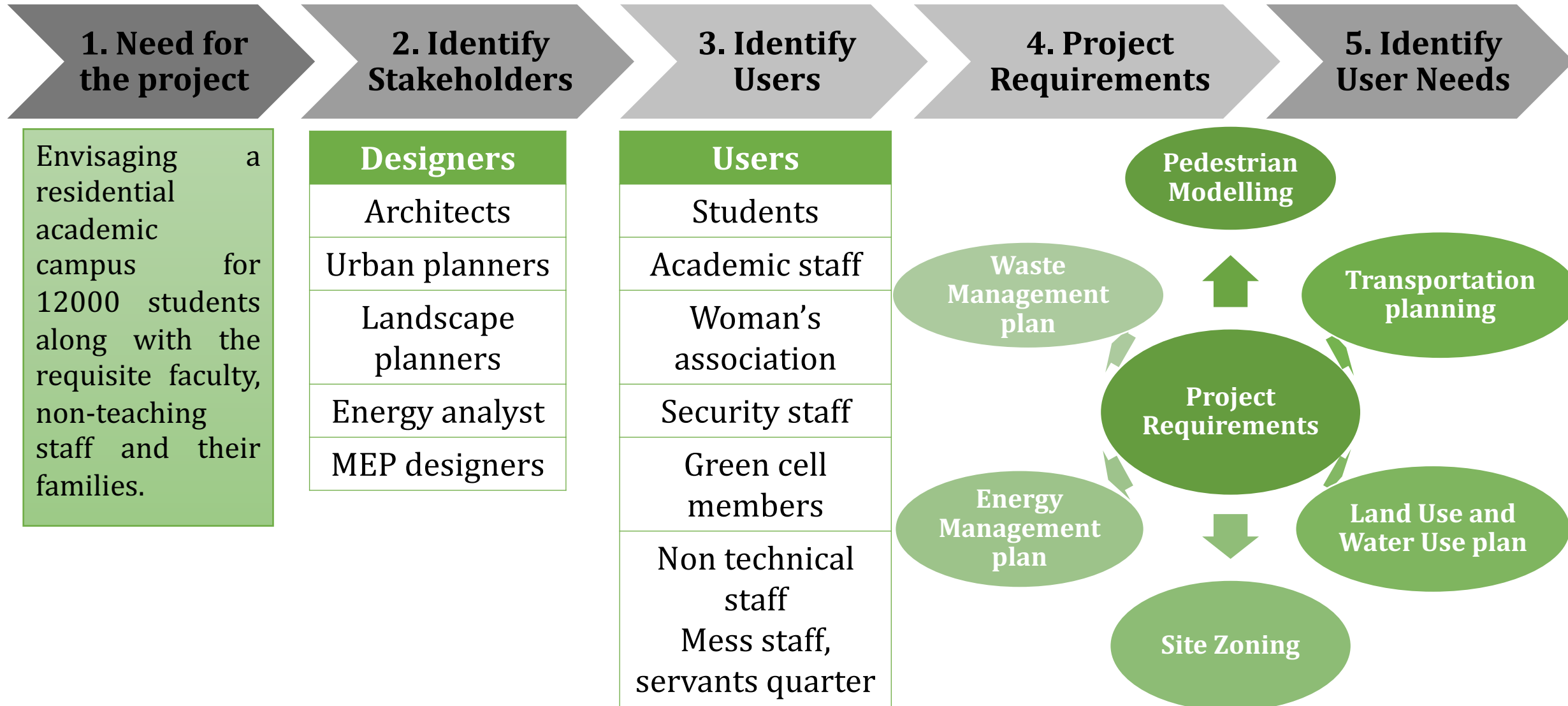
- **Participatory Research Method**

- Participation in series of Design meetings among stakeholders
- Focused interviews of stakeholders involved



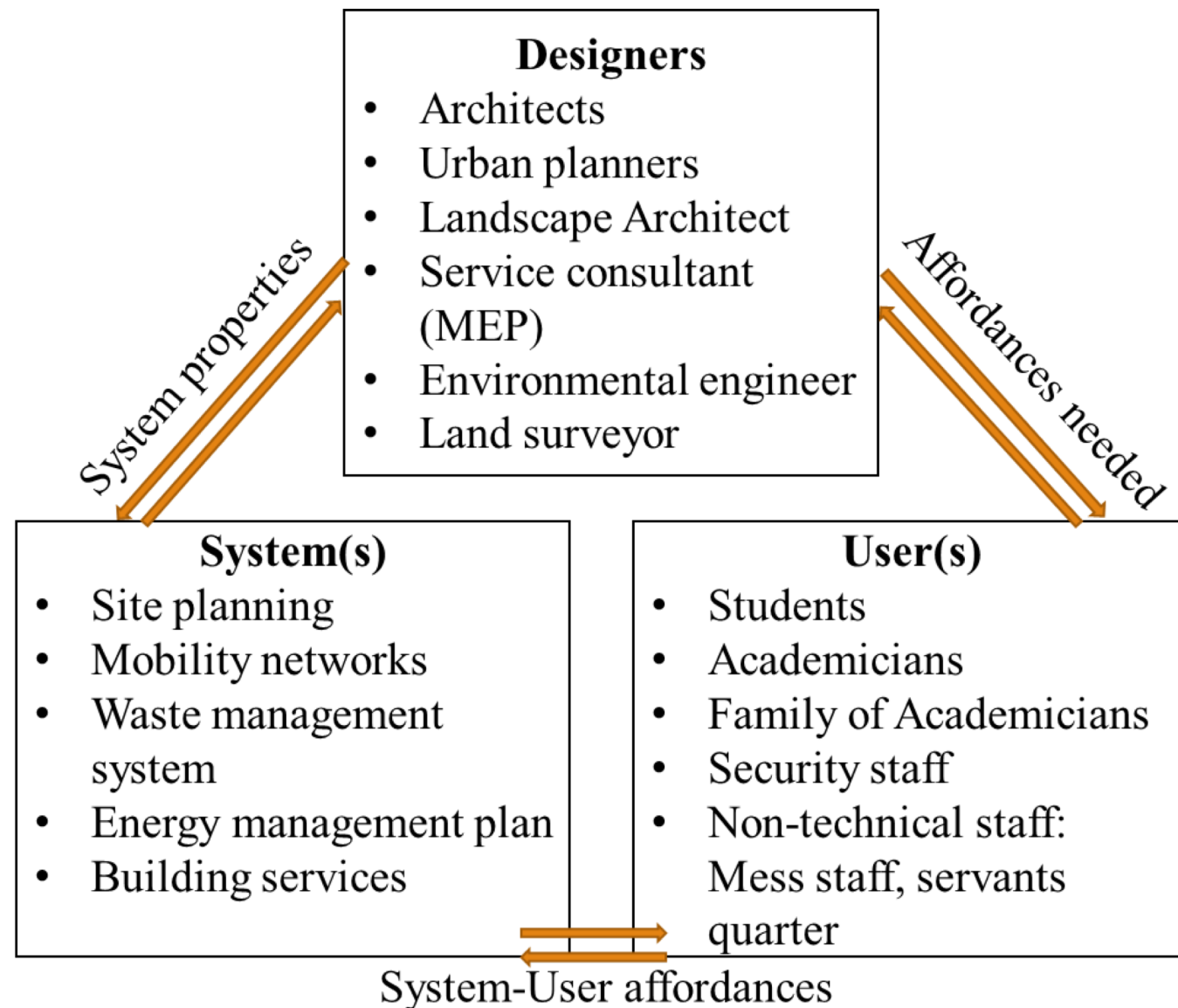
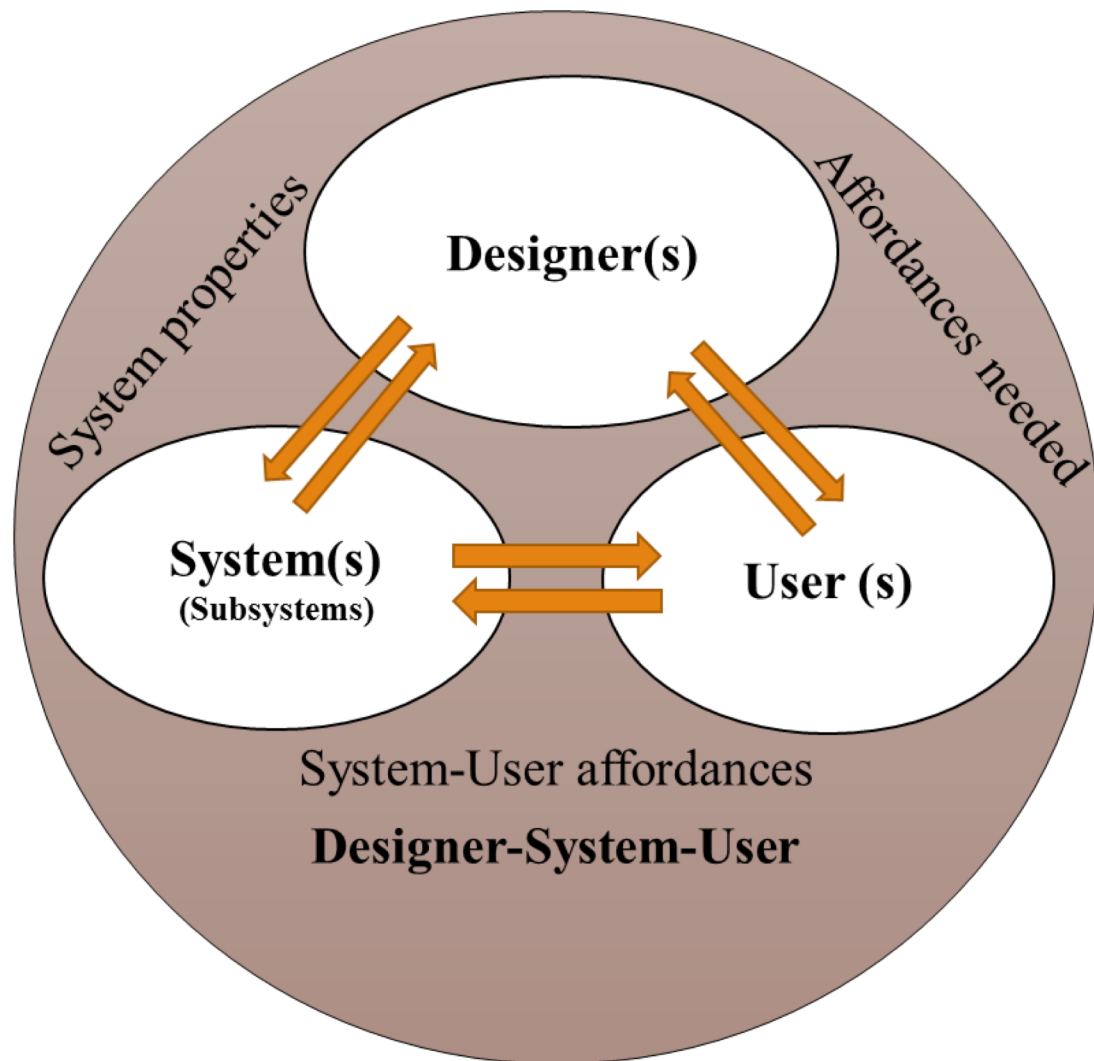


# Case Illustration





# Conceptualization of Proposed DM



## Affordance Interactions within Designer-System-User Structure



# Steps in Proposed Affordance-based (DM)

5



## I. User Information Module

1. Determine the system to be designed
2. Identify and interview the user groups
3. Express the need in terms of affordances
4. Classify the affordances as value adding and non-value adding.

## II. Designer Information Module

5. Identify all the affordance from designers' perspective
6. Assign ranking to affordances based on user and designer information module

## III. Individual Detailed Affordance structure

7. Identify detailed properties/specifications required of systems and sub-systems
8. Identify constraints and targets associated with each property
9. Develop System Design with Desired Affordances





# Step I. User Information Module

| <b>Value adding affordances<br/>(Positive)</b>                                     | <b>Non-value adding affordances<br/>(Negative)</b>       |
|------------------------------------------------------------------------------------|----------------------------------------------------------|
| <b>Provide thorough fare movement within campus to all users</b>                   | <b>Minimize traffic conflicts at some points</b>         |
| <b>Connectivity of campus with the city</b>                                        | <b>Reduce travel time</b>                                |
| <b>Facilitate pedestrian movement to all users</b>                                 | <b>Reduce trip length</b>                                |
| <b>Integration of all modes of transport system</b>                                | <b>No congestion at peak hours</b>                       |
| <b>Incorporate comfortable, energy efficient and sustainable ways of transport</b> | <b>Reduce extent and distribution of roads in campus</b> |
| <b>Provide safe and secure pathways</b>                                            | <b>Reduce urban heat island effect</b>                   |
| <b>Access to visitors/city people</b>                                              |                                                          |
| <b>Maintain and maximize green cover</b>                                           |                                                          |

**Identify user needs**

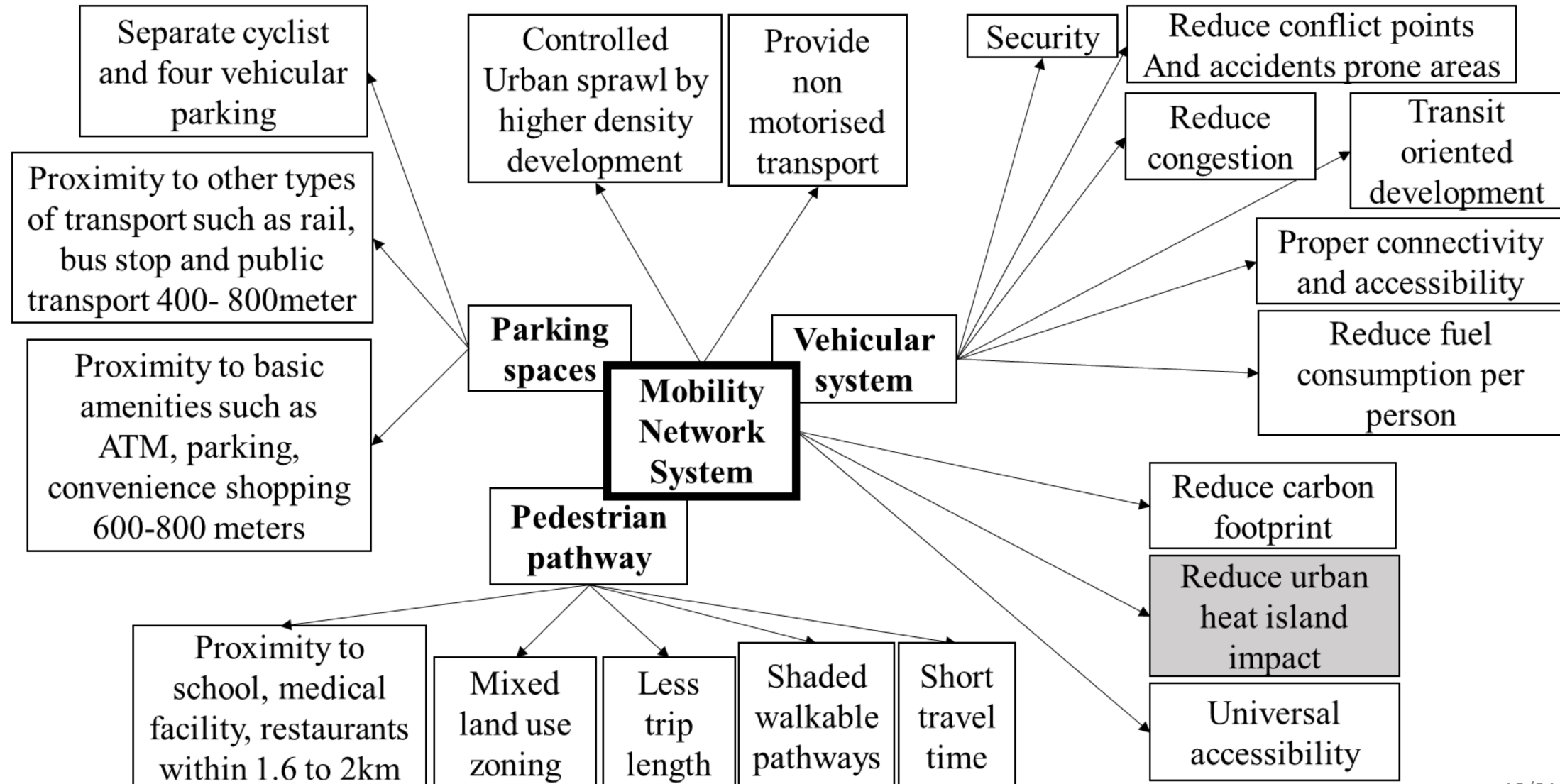
**Needs assessment**

**Identify values to be provided**



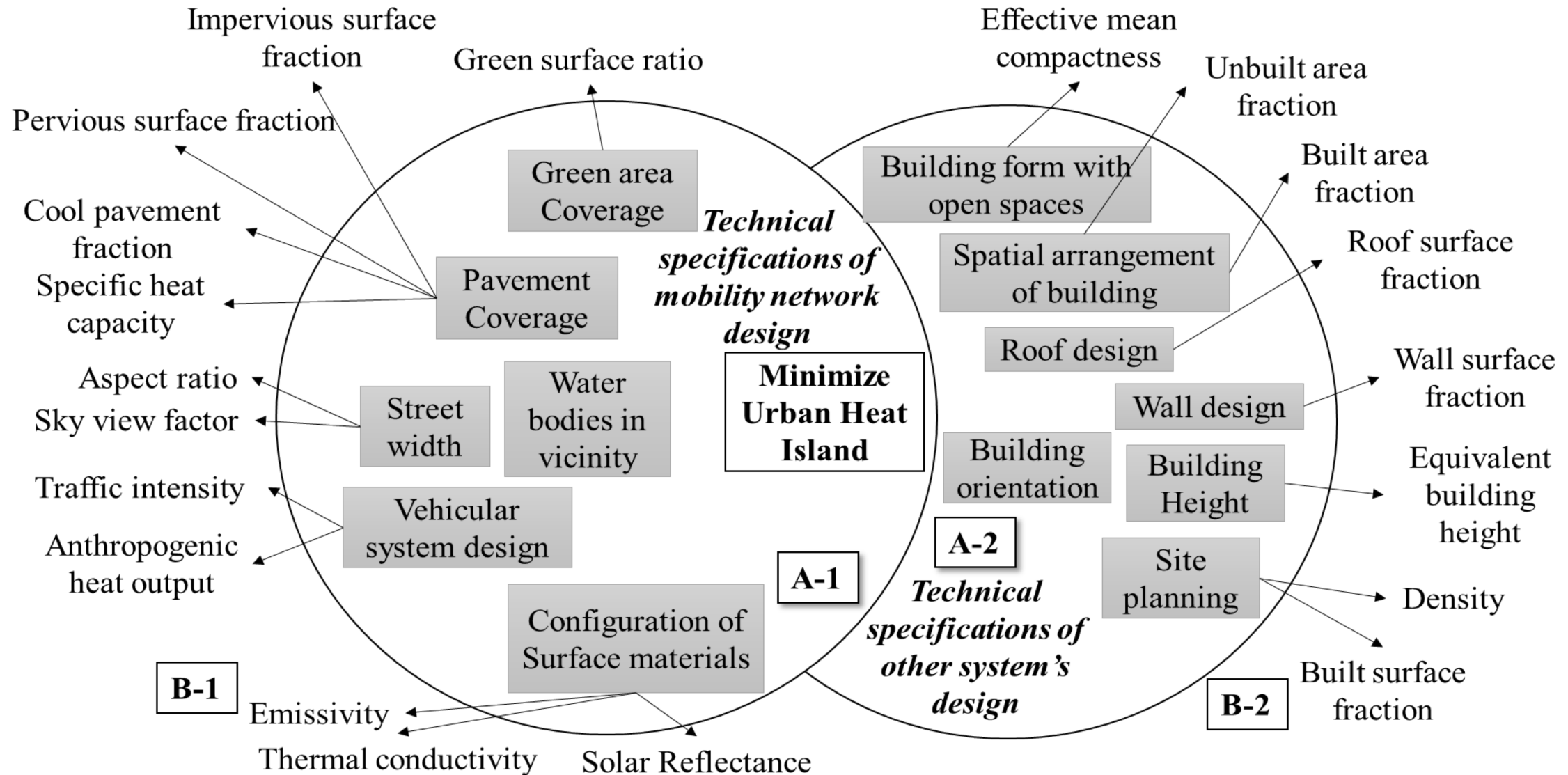


# Step II. Designer Information Module





# Step III. Design Individual Affordances





# Proposed Affordance based Design Method

## Step 1: Create Affordance Structure

### (i) Determine System-User Affordances

- Determine system to be designed
- Determine user groups
- Interview users
- Gather and express user needs in terms of affordances
- Identify value adding and non-value adding affordances

User Information Module

### (ii) Develop Generic Affordance Structure

- (Based on what a system should afford)
- Identify if any important affordance is missed
  - Include all affordances

Designer Information Module

### (iii) Prioritize Affordances

- Assign ranking to affordances (most to least important targets) based on user and designer information module
- Develop a list of affordances in the order of their targets

## Step 2: Design Individual Affordances

### (i) Define and Understand Individual Affordance to be Designed (from priority affordances)

- Value adding or non-value adding
- User groups

### (ii) Identify System Properties that Affect the Affordances

- Identify detailed technical specifications of systems and sub-systems

### (iii) Identify Target and Bounds for each Property

- List the constraints associated with each property
- Quantify the constraints and assign numerical values to each property

### (iv) Develop Detailed Affordance Structure

- Analyse effects of property settings on other affordances
- Determine dependencies, inter-dependencies within system and sub-system (involving all stakeholders)
- Explore trade-offs/Optimize property

System Design with Desired Affordances



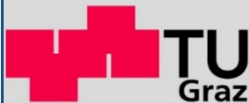
# Research Findings

- Case study demonstrates the **potential application of affordance theory at the stages of problem definition and conceptual design** in built environment.
- **In proposed DM, user needs are represented in the form of affordances** which allow the needs to interact with the designer knowledge and system properties. The study can be extended to subsequent stages of detailed design and technical design.
- Proposed DM provides **flexibility to accommodate sustainable target values**. Multiple sustainable targets can be further analysed using simulation techniques and the DM.
- DM traces the **interactions between systems and subsystems** by formulating multiple affordance structures among multiple stakeholders. Such extensive affordance structure will guide decision making and assist in trade-off analysis during design.
- **Proposed** affordance-based DM provides a **sequential and structured** mechanism to transform the information from users and designers into technical information. This mechanism drives the conceptual design process which is eventually reflected in the **designed built environment**.

# *Thank you*

## *for your Time and Attention*

**Sustainable Built Environment D-A-CH Conference 2019, Graz**



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