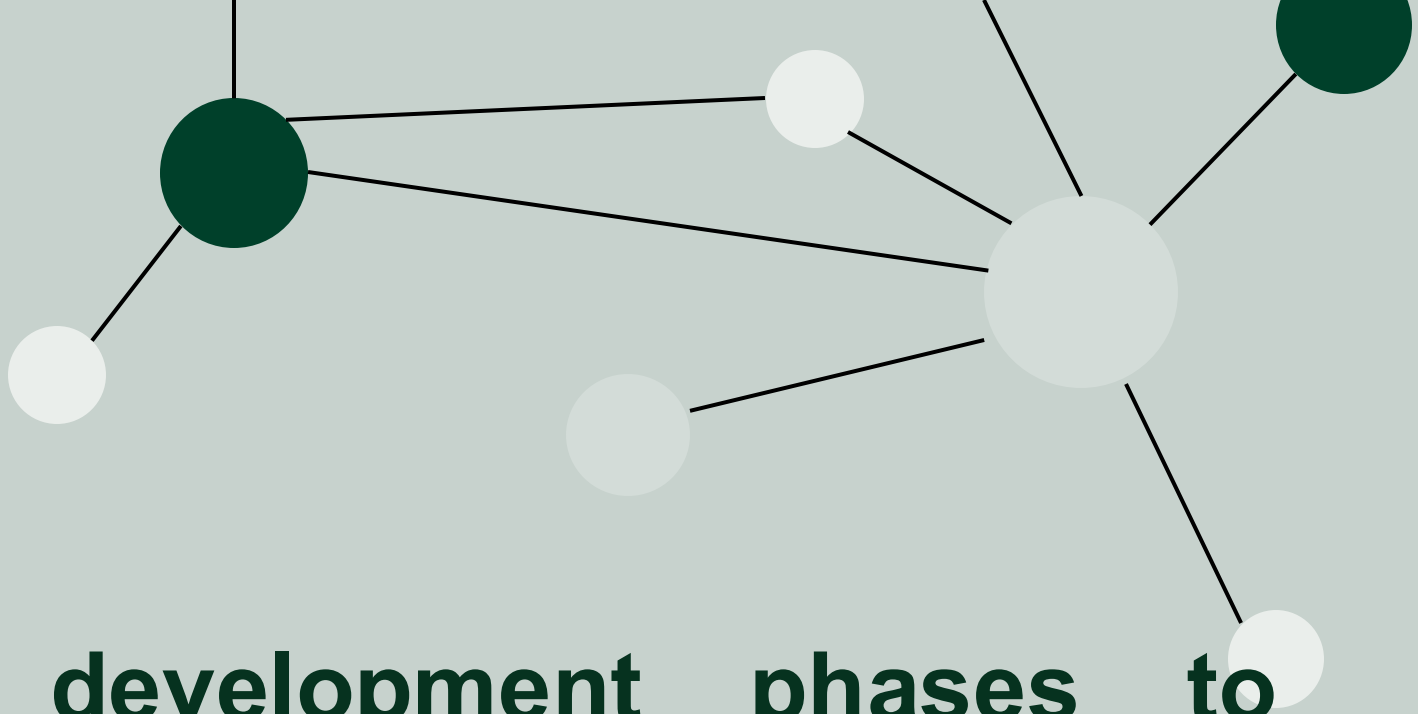


Organising early development phases to integrate circular strategies in adaptive reuse projects

Charlotte Mussert

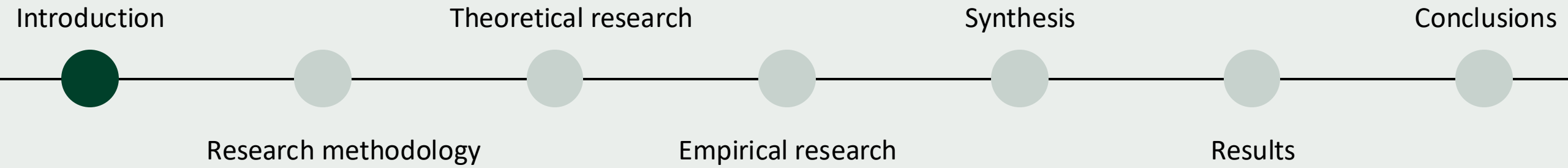
4878523

P5 Management in the Built Environment

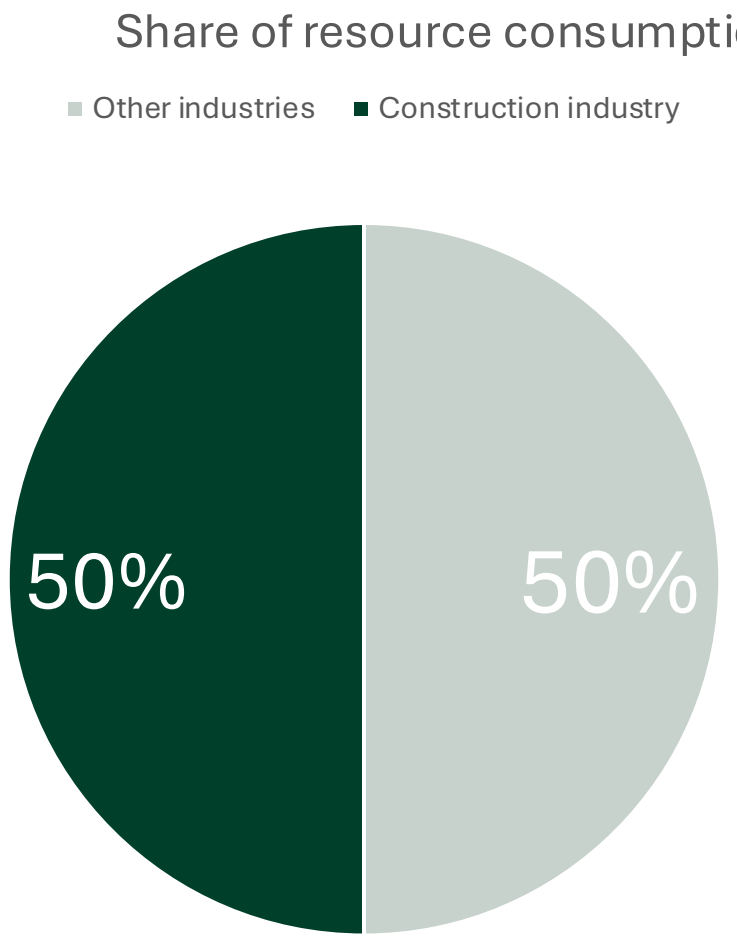
NEOO TU Delft

TABLE OF CONTENT

1 INTRODUCTION

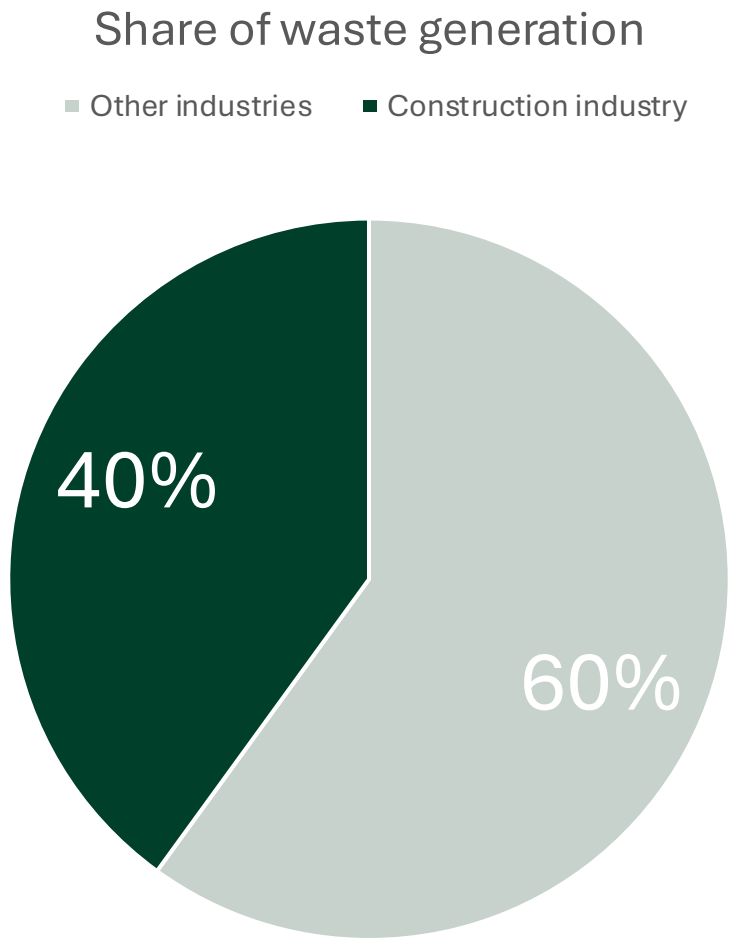


Large consumptions of resources in construction industry



(Dijksma & Kamp, 2016)

The construction industry is a major contributor to waste production



(Circle Economy & Metabolic, 2022)

Consequences of current processes

Resource depletion

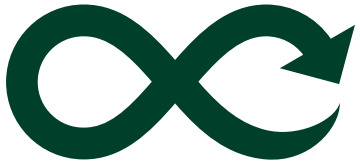
Acceleration of environmental degradation

Inflation of material costs

(Eberhardt et al., 2022)
(Jeyanthan & Ilankumaran, 2019)
(Morseletto, 2023)

Circular economy (CE)

Eliminate waste & pollution



Circulate products & materials

Regenerate nature

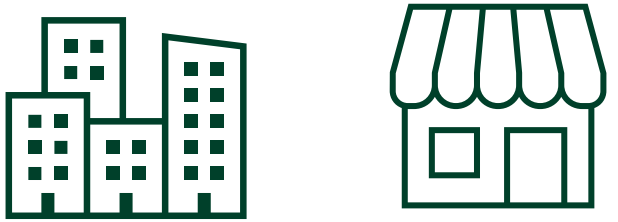
(Ellen MacArthur Foundation, 2024)

High building vacancy rates

- Buildings do no longer meet demand
  - Outdated designs and quality
  - Different ways of working and living

- Driving need for adequate buildings
  - Rising population
  - Increasing number of outdated buildings

Vacancy rates in the Netherlands



> 8% in 2024 | 6% in 2023

(CBRE, 2023)
(Cushman & Wakefield, 2024)
(De Graaf & Schuitenmaker, 2022)

Adaptive reuse (AR) as a solution

*"**Adaptive reuse** is the process of **extending the lifespan** of the building by **changing the building** for a **purpose other** than the initial function it was designed for"*

- Solution for addressing outdated and vacant buildings

- Aligns with CE principles
  - Reduces waste by preventing demolition
  - Extends lifespan
  - Avoids the need for new construction

- Developers' perspective
  - AR located at scarce land in inner-city areas
  - Higher house prices

(CIRCulT Project, 2023)
(Remøy, 2010)

Problem statement

While **circular strategies** in **adaptive reuse** offer great potential, however, their integration remains limited due to a lack of practical guidance on how to **organise the development process**.

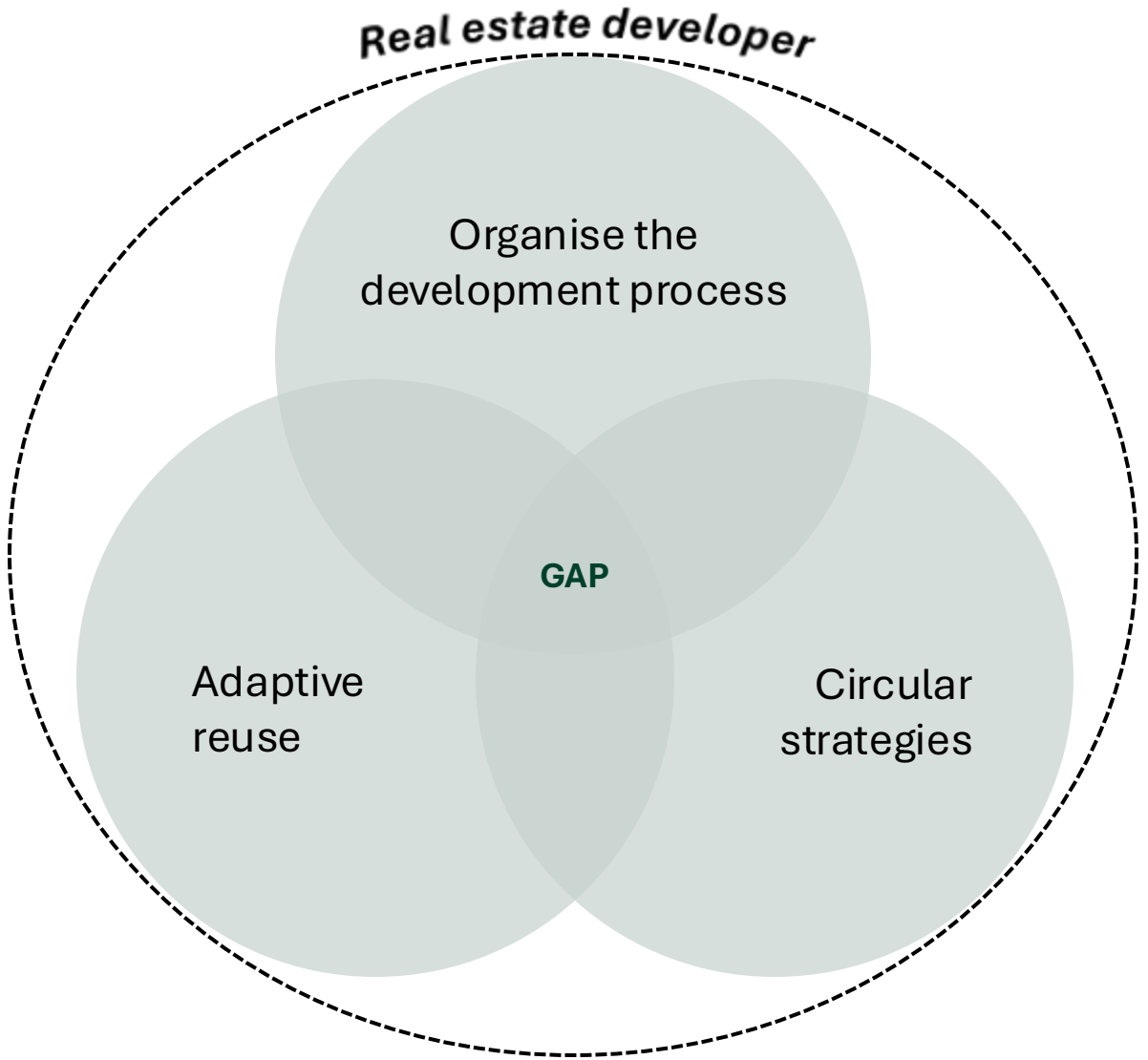
Problem statement

While **circular strategies** in **adaptive reuse** offer great potential, however, their integration remains limited due to a lack of practical guidance on how to **organise the development process**. This includes limited insights into collaboration and a lack of attention to the **real estate developer's** role.

Problem statement

While **circular strategies** in **adaptive reuse** offer great potential, however, their integration remains limited due to a lack of practical guidance on how to **organise the development process**. This includes limited insights into collaboration and a lack of attention to the **real estate developer's** role. Moreover, literature often focuses on isolated phases, hindering a holistic understanding of **early-phase** implementation of the strategies.

Literature gap

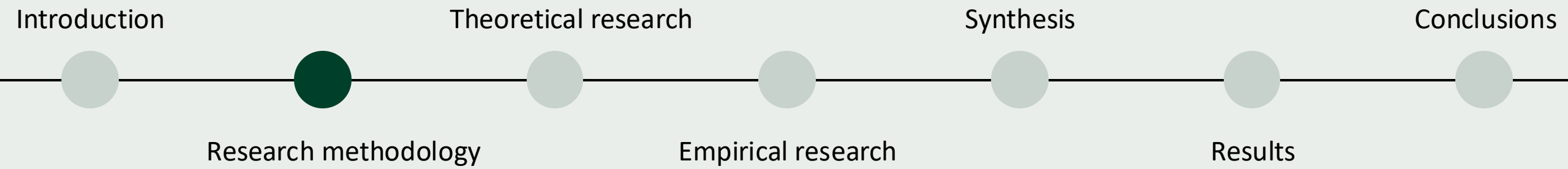


Research questions

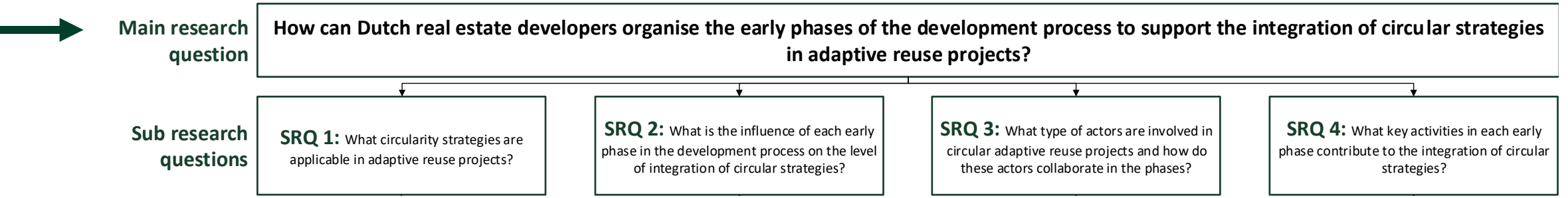
How can Dutch real estate developers organise the early phases of the development process to support the integration of circular strategies in adaptive reuse projects?

- **SRQ 1:** What circular strategies are applicable in adaptive reuse projects?
- **SRQ 2:** What is the influence of each early phase in the development process on the level of integration of circular strategies?
- **SRQ 3:** What type of actors are involved in circular adaptive reuse projects and how do these actors collaborate in the phases?
- **SRQ 4:** What key activities in each early phase contribute to the integration of circular strategies?

2 RESEARCH METHODOLOGY



Research design



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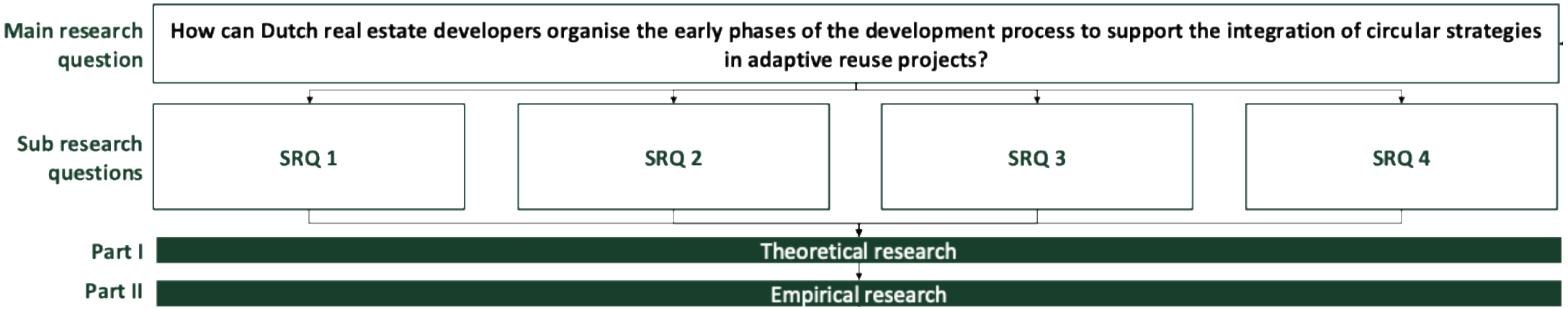
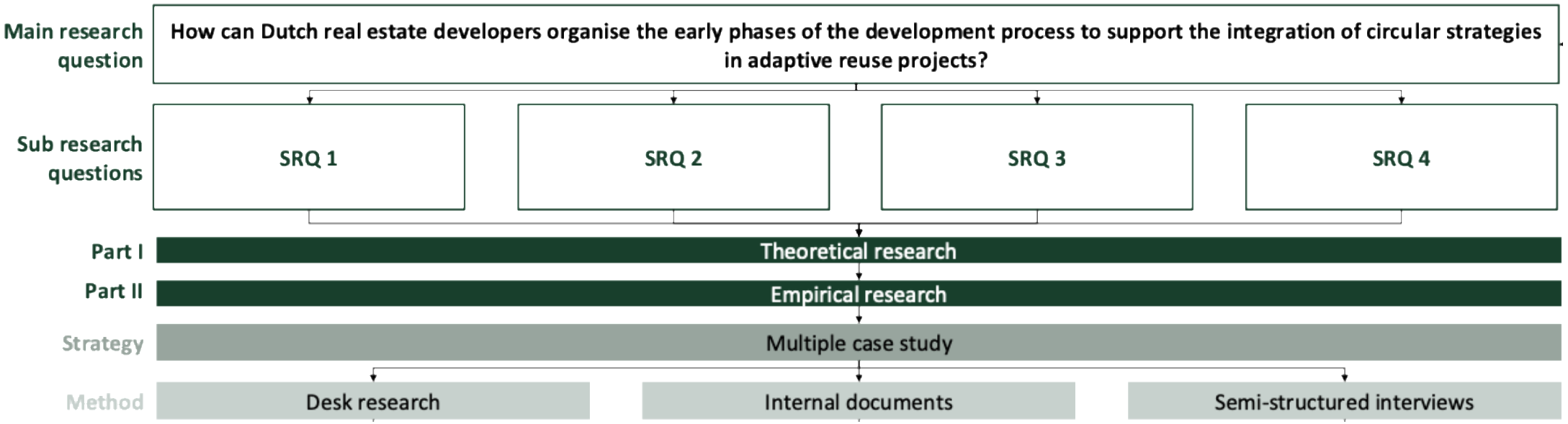


Research design



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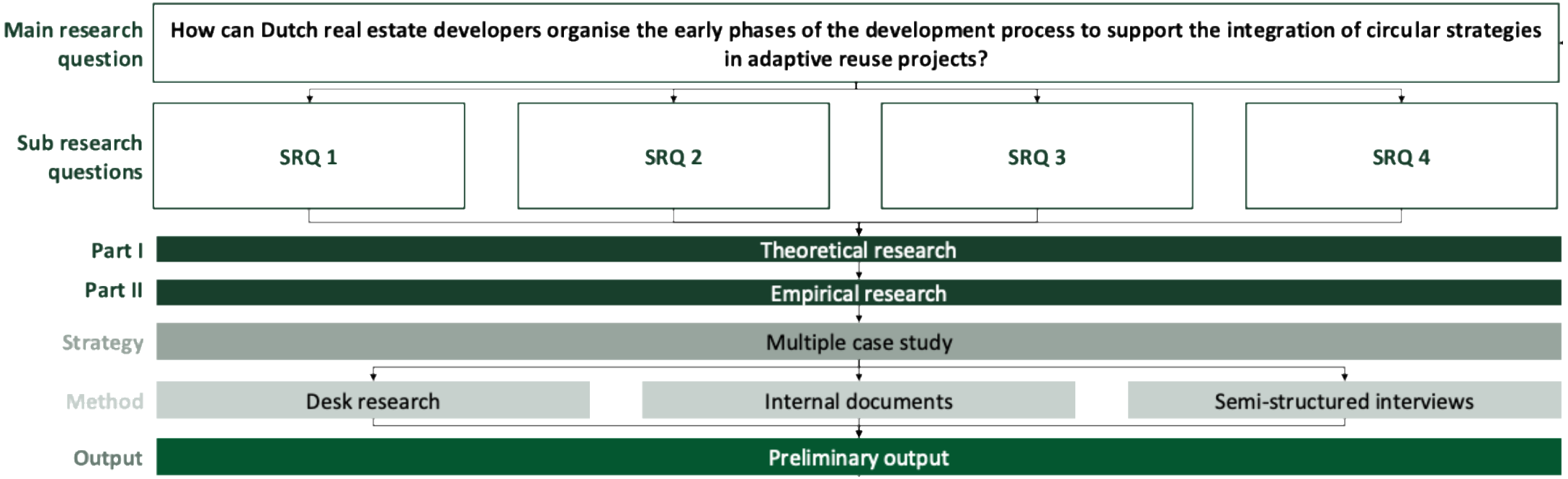

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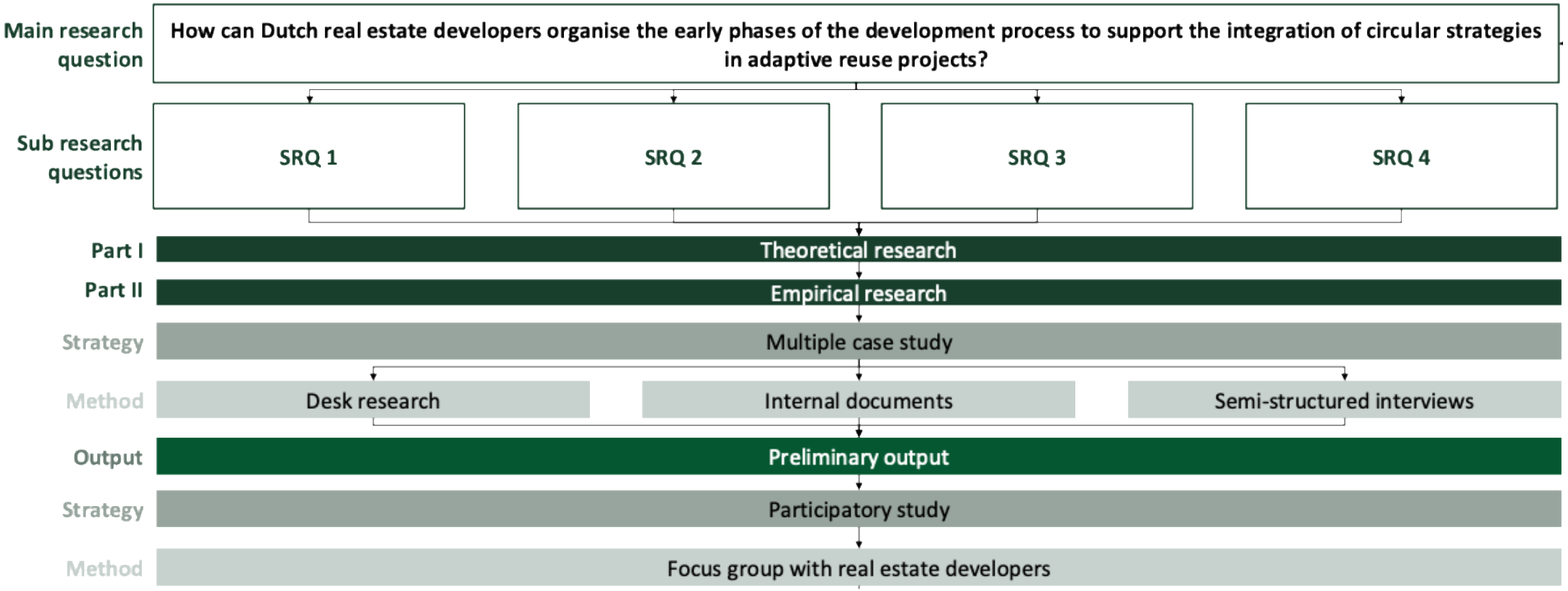
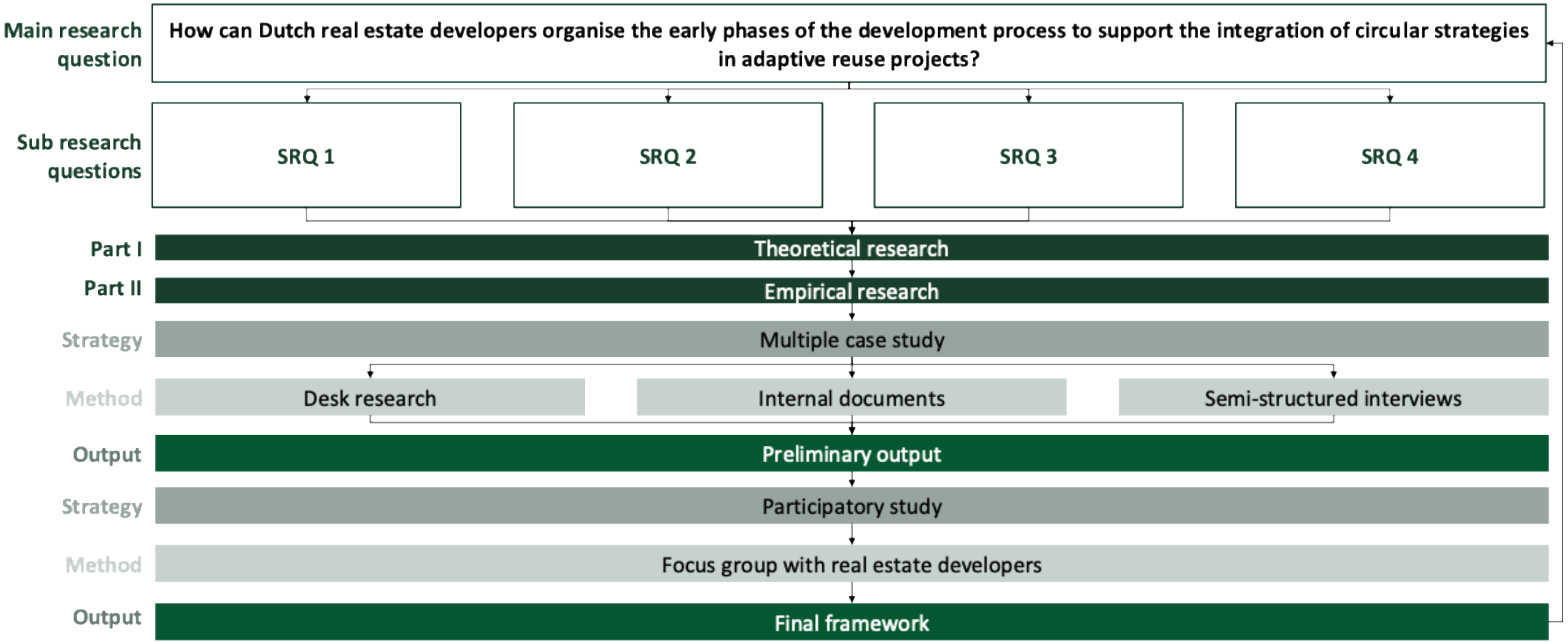
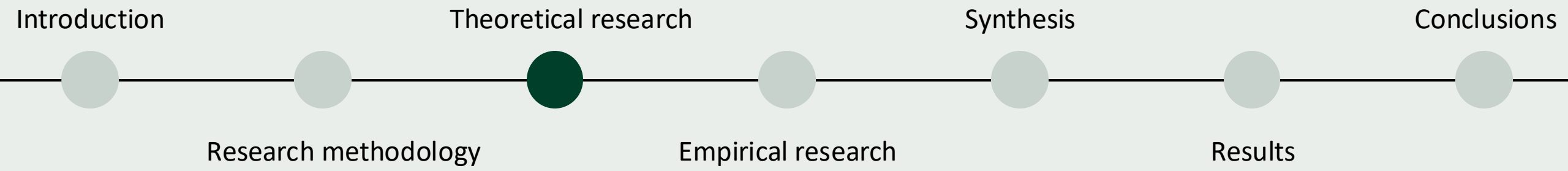


Research design



3 THEORETICAL BACKGROUND



What = Circular strategies

Narrow

Use less

Slow

Use longer

Close

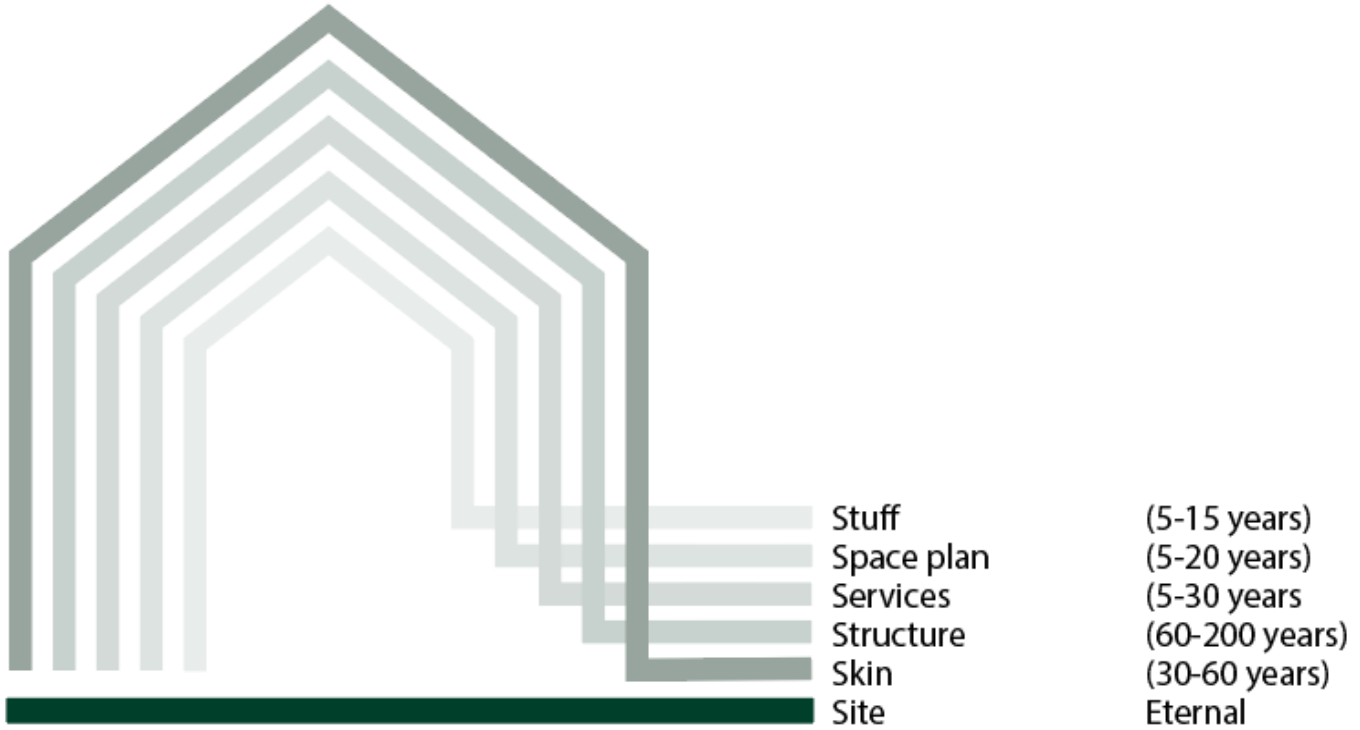
Use again

Regenerate

Make clean

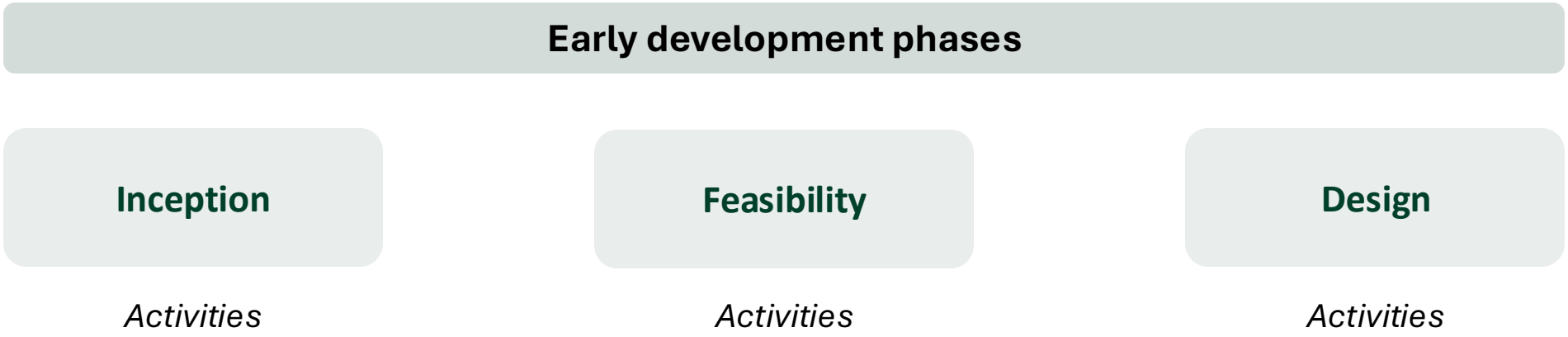
(Circle Economy & Metabolic, 2022)

Where = Shearing layers



(Brand, 1994)
(Transitieteam Circulaire Bouweconomie, 2020)

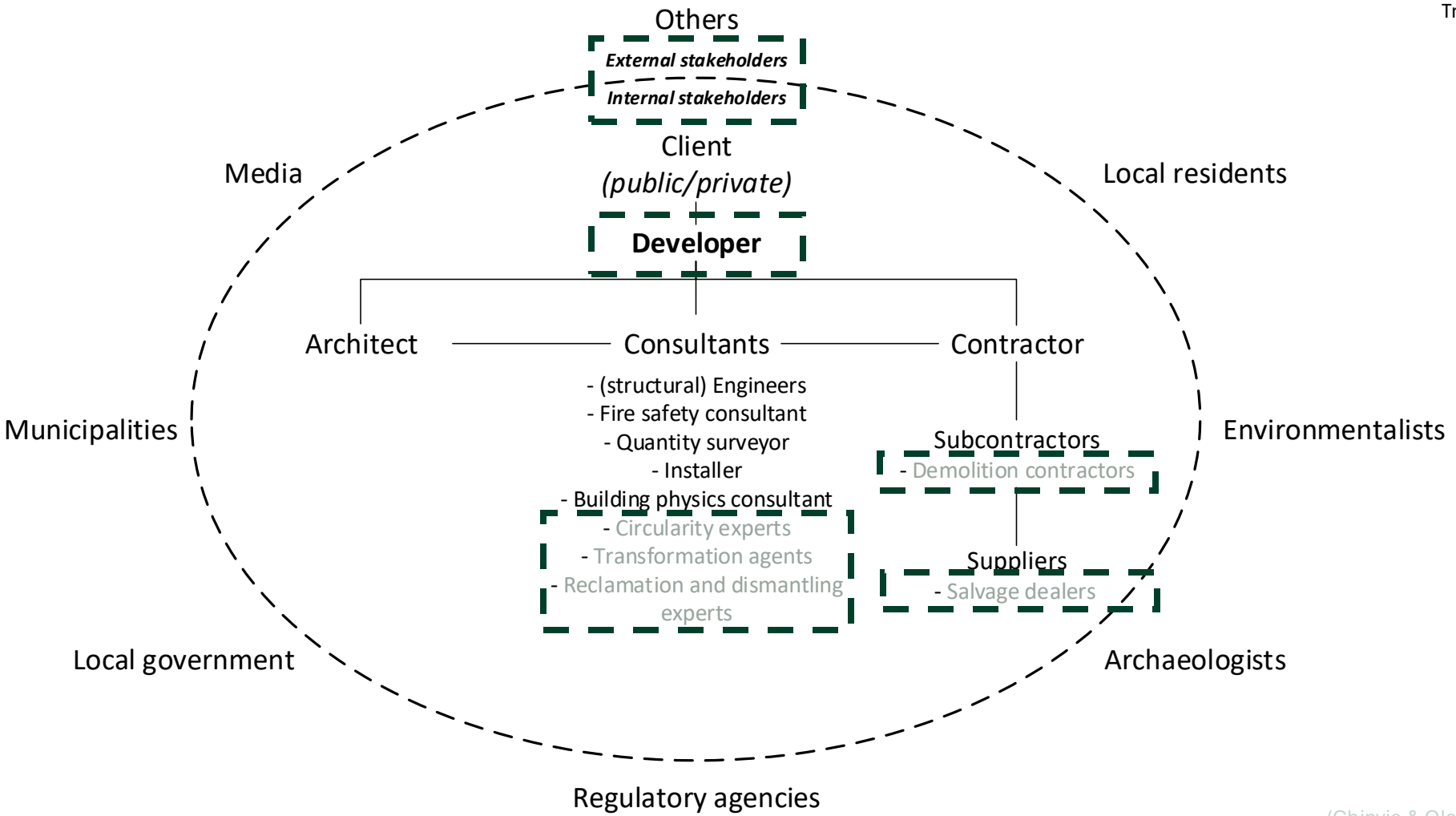
When & how = Development process



(Çimen, 2023)
(Gerding et al., 2021)
(Szafranko & Harasymiuk, 2022)

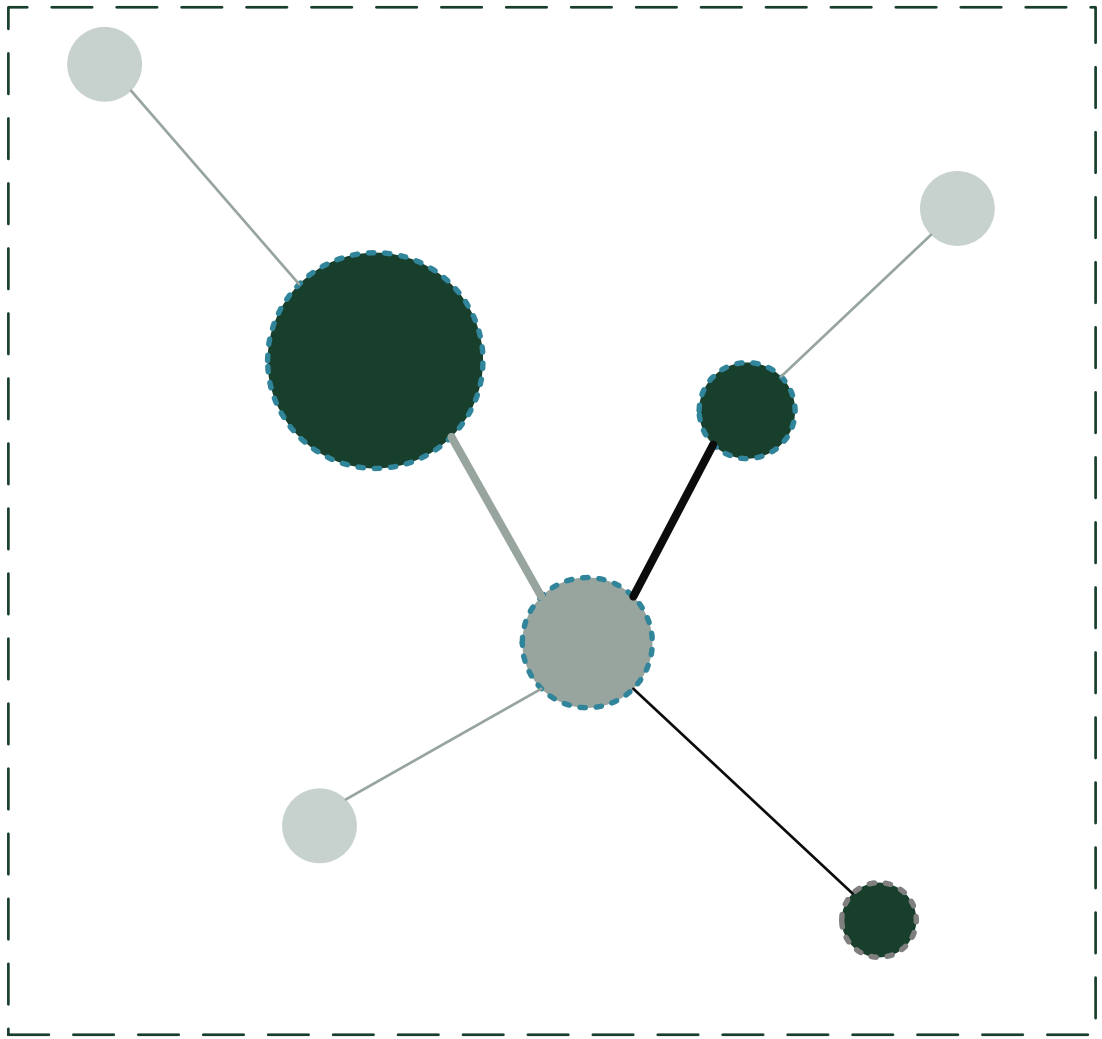
Who = Actors

Circularity actor
Traditional actor



(Chinyio & Olomolaiye, 2009)

Method - Multi-actor network analysis



Actor with knowledge on CS

Actor that acquired knowledge on CS

Actor with no knowledge on CS

Project team

Formal relation

Informal relation

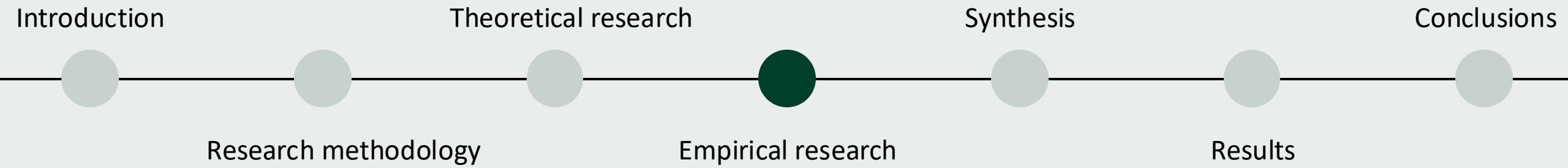
Infrequent meeting

Frequent meeting

Influence of actor on project

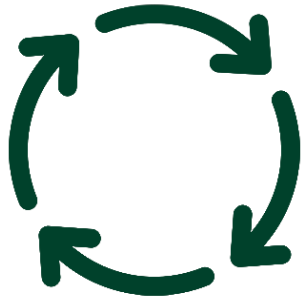
(Gerding et al., 2021)

4 EMPIRICAL RESEARCH

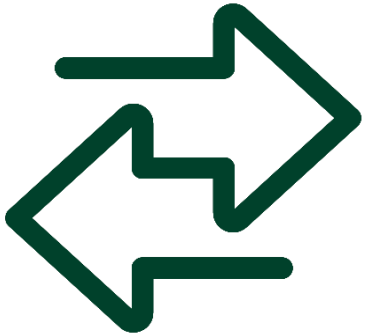


Case study selection

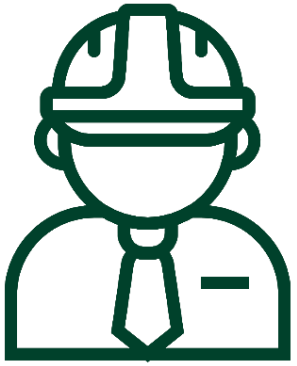
Netherlands



Circular strategies



Adaptive reuse



Real estate developer

Zandkasteel

Former function	Office
New function	School
Start inception	2018
Start design	2019
Start construction	2021
Delivery	2023

Edge Olympic

Former function	Sorting centre
New function	Multi-tenant offices
Start inception	2014
Start design	2015
Start construction	2016
Delivery	2018

Amsterdam

AIR Offices

Former function	Shopping center
New function	Retail & offices
Start inception	2019
Start design	2020
Start construction	2021
Delivery	2024

Rotterdam

Interview participants

Zandkasteel	Edge Olympic	AIR Offices
Project manager	Developer	Developer
Architect	Architect	Architect
Circularity advisor	Sustainability advisor	Sustainability advisor
Contractor		
Circularity advisor contractor		
Employers agent		

12 interviews

Individual analysis

Part I

What + **Where** = **Circular strategies** in the building

Part II

When + **Who** = **Collaboration** in the development process

Part III

When + **How** = **Activities** in the development process

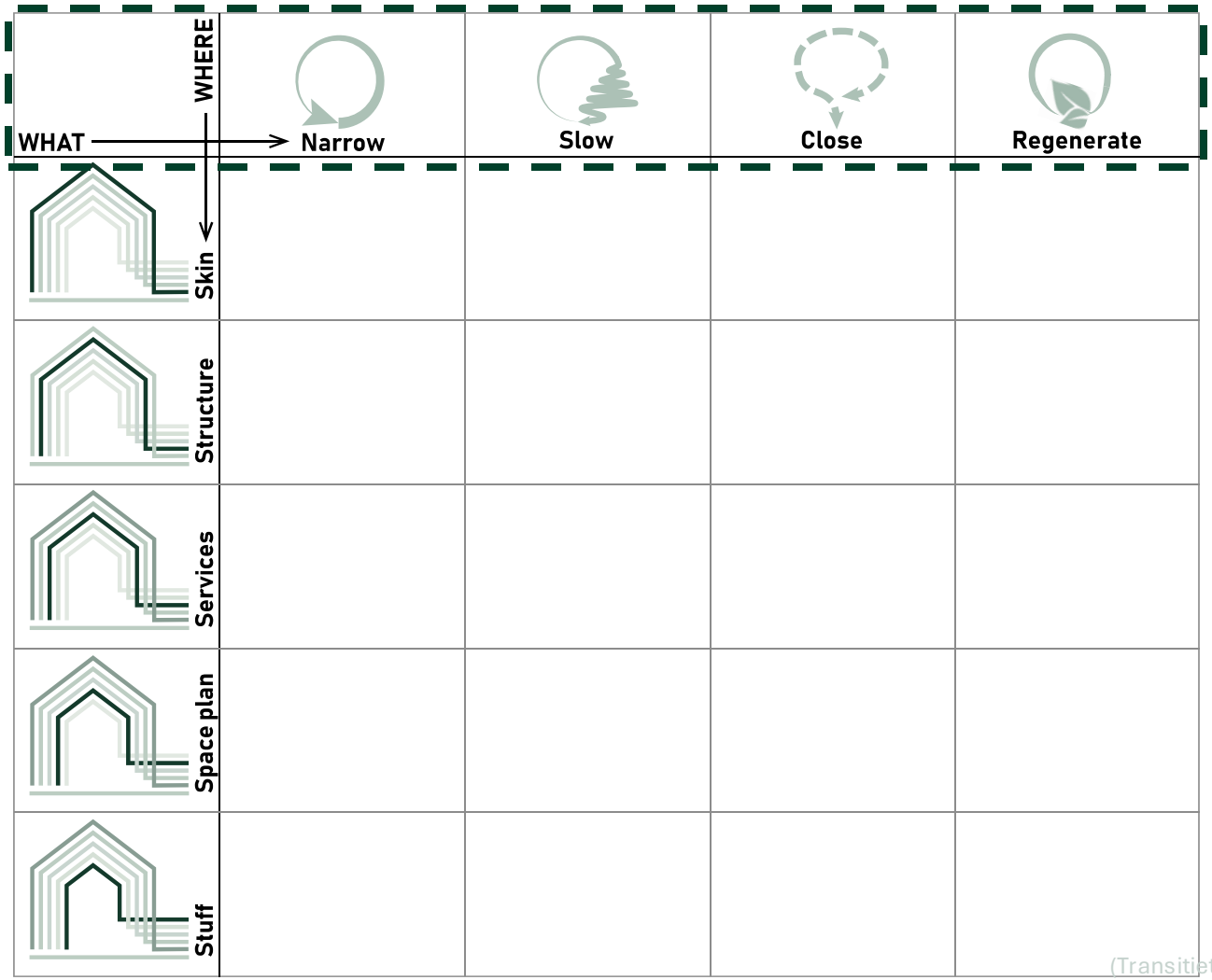
Part I – What & Where

WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin				
Structure				
Services				
Space plan				
Stuff				

(Brand, 1994)
(Circle Economy & Metabolic, 2022)
(Transitieteam Circulaire Bouweconomie, 2020)

Part I – What & Where

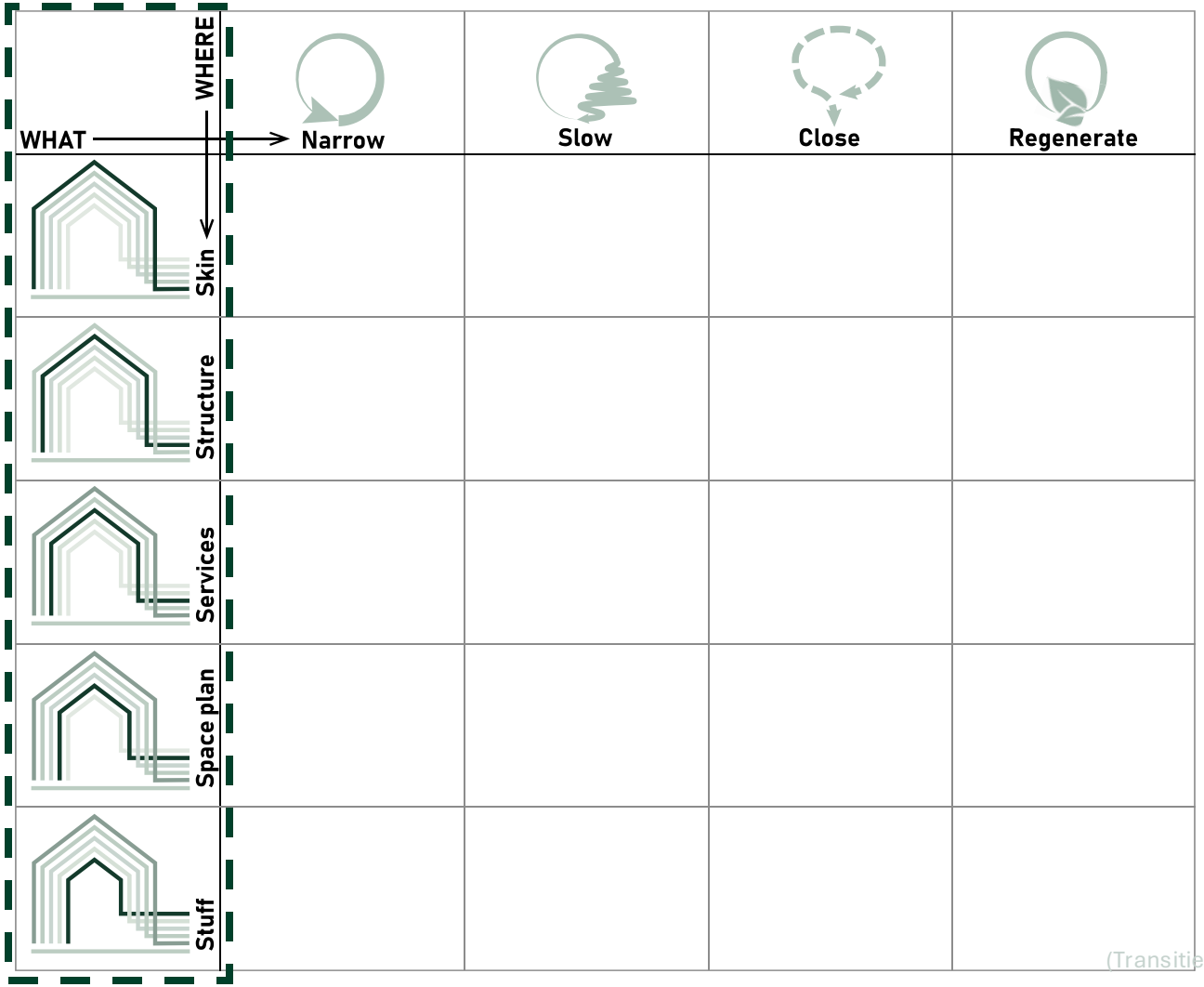
What



(Brand, 1994)
(Circle Economy & Metabolic, 2022)
(Transitieteam Circulaire Bouweconomie, 2020)

Part I – What & Where

Where



(Brand, 1994)
(Circle Economy & Metabolic, 2022)
(Transitieteam Circulaire Bouweconomie, 2020)

Individual case analysis – part I - Zandkasteel

Reuse of ventilation grilles

WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin				
Structure				
Services		✓		
Space plan				
Stuff				

Individual case analysis – part I – Edge Olympic

Reuse of facade tiles

WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin		✓		
Structure				
Services				
Space plan				
Stuff				

Individual case analysis – part I – Edge Olympic

Wooden demountable structure

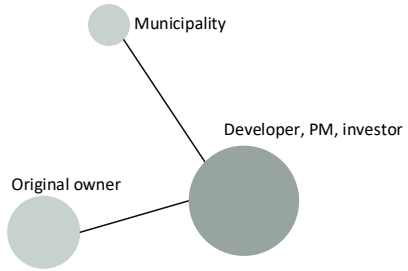
WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin				
Structure		✓		✓
Services				
Space plan				
Stuff				

Individual case analysis – part I – AIR Offices

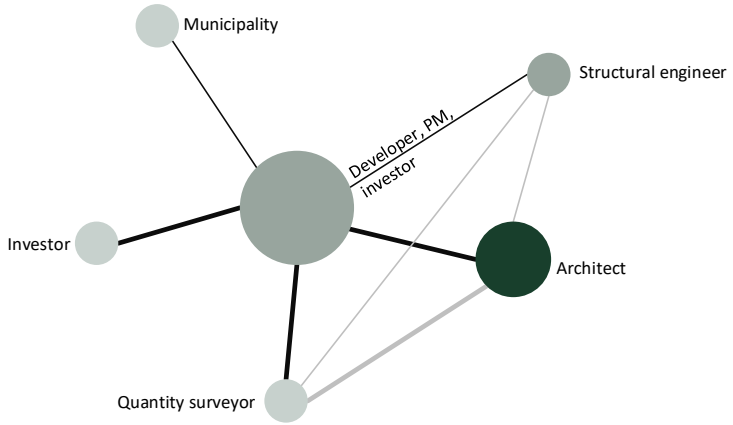
Reuse of facade tiles

WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin		✓		
Structure				
Services				
Space plan				
Stuff				

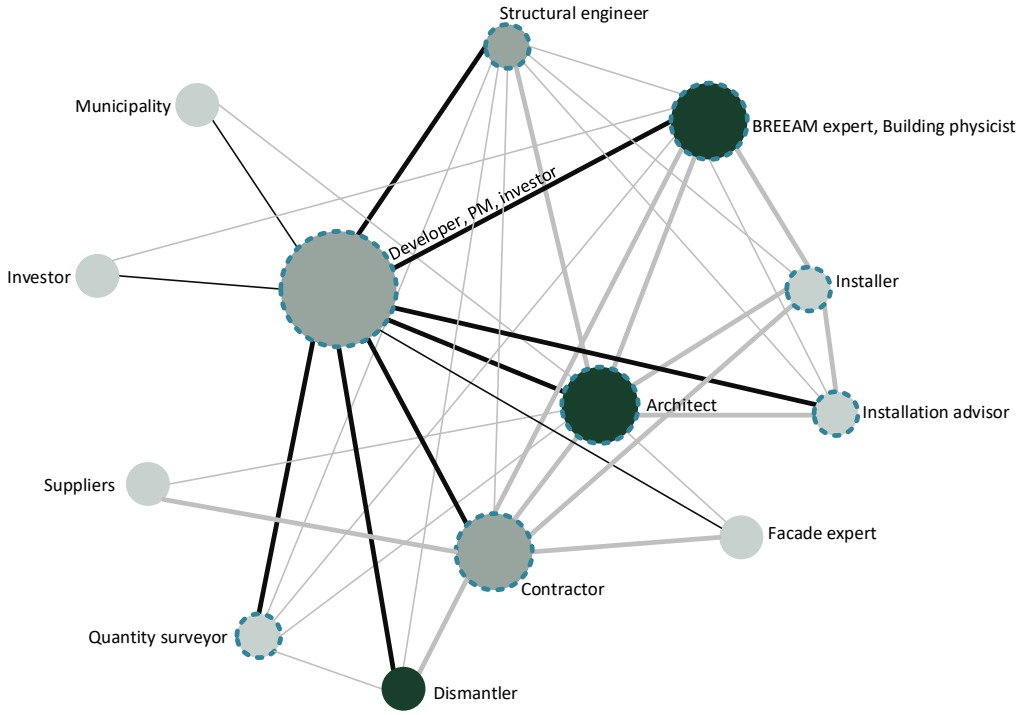
Part II – When & Who



Inception phase



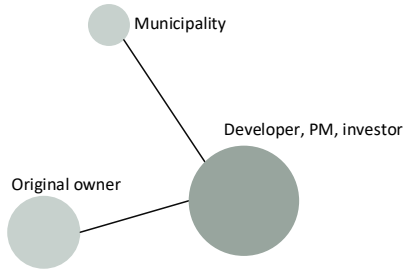
Feasibility phase

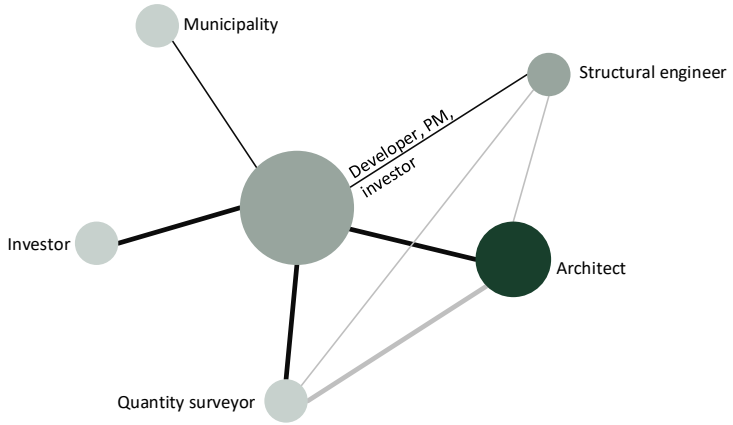


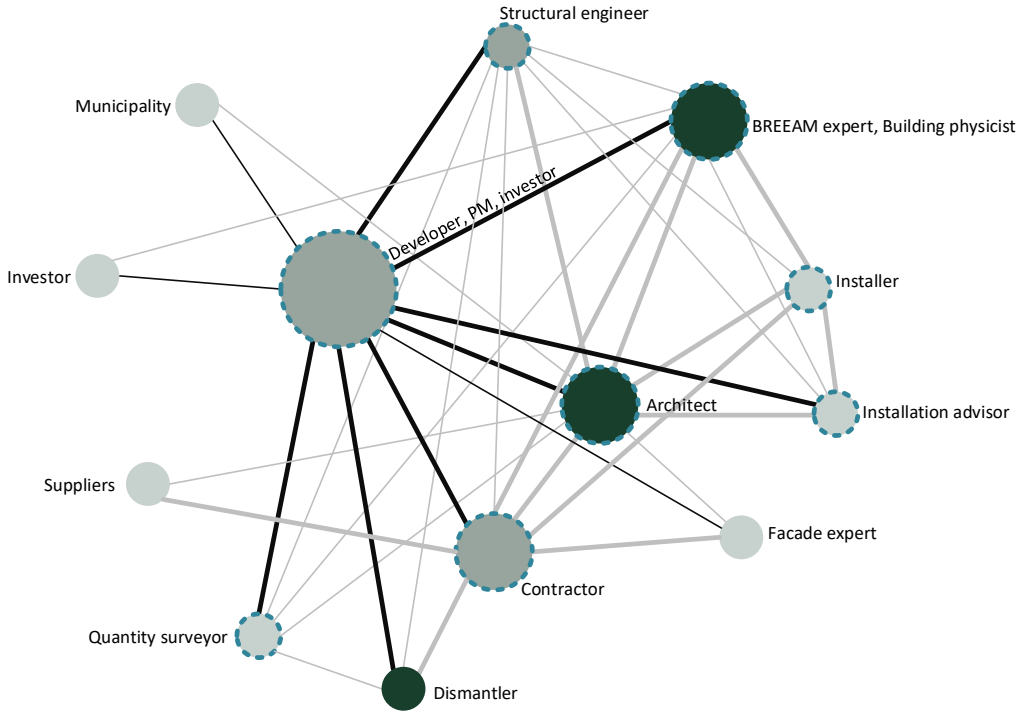
Design phase

(Gerding et al., 2021)

Part II – When & Who





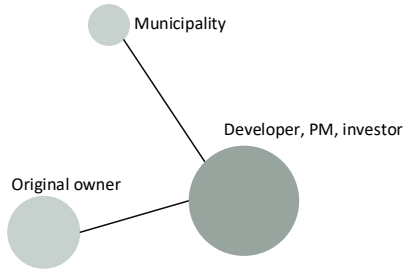


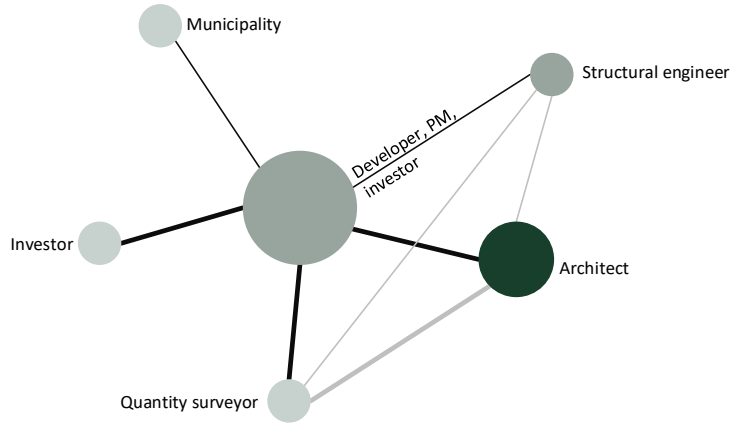
Inception phase | Feasibility phase | Design phase

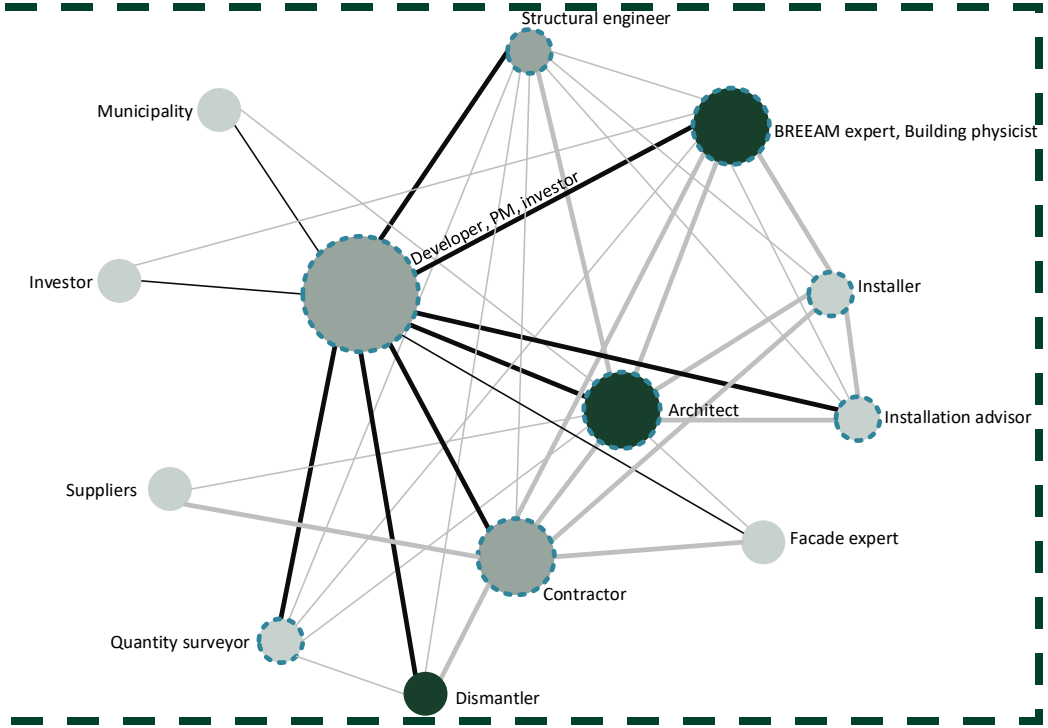
When

(Gerding et al., 2021)

Part II – When & Who







Inception phase

Feasibility phase

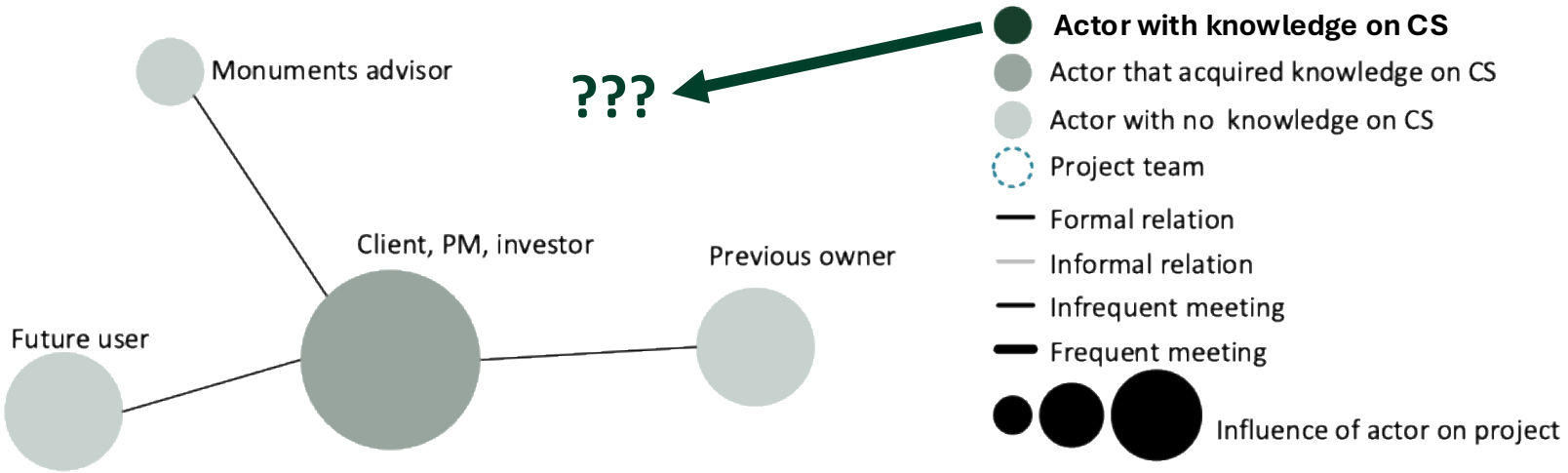
Design phase

Who

(Gerding et al., 2021)

Individual case analysis – part II - Zandkasteel

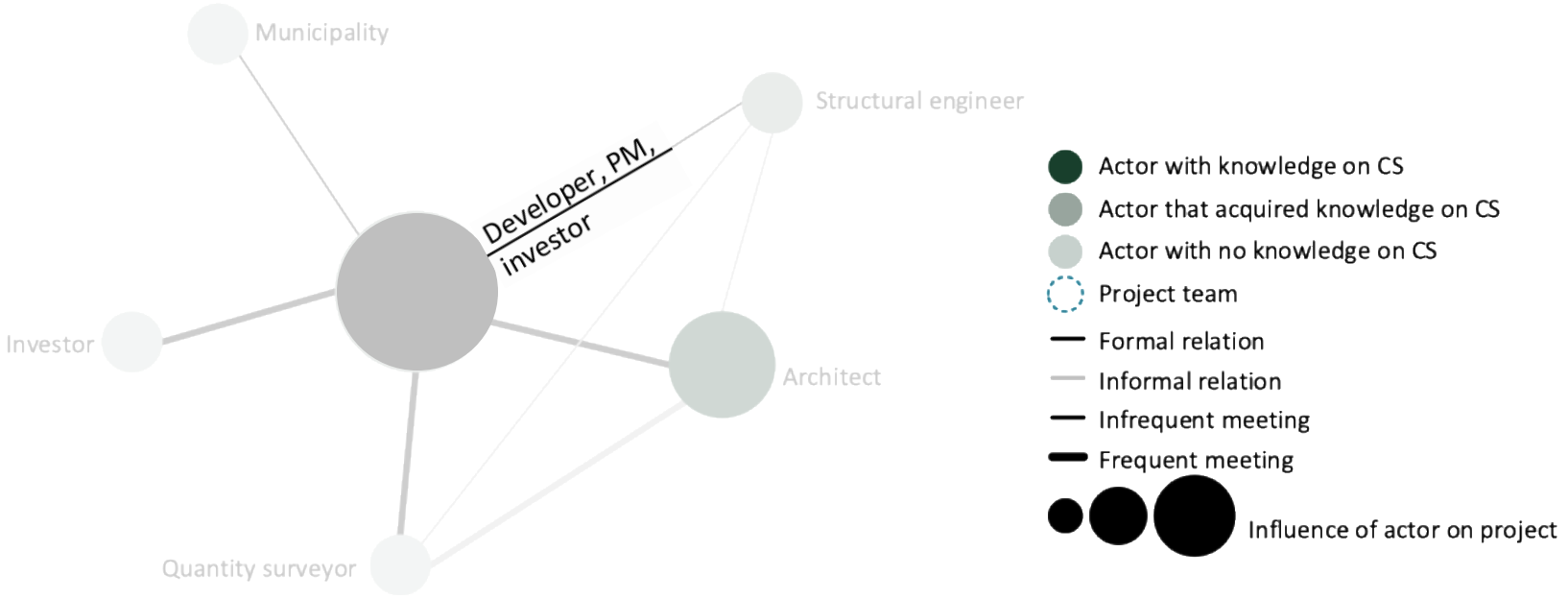
Inception phase



(Gerding et al., 2021)

Individual case analysis – part II – Edge Olympic

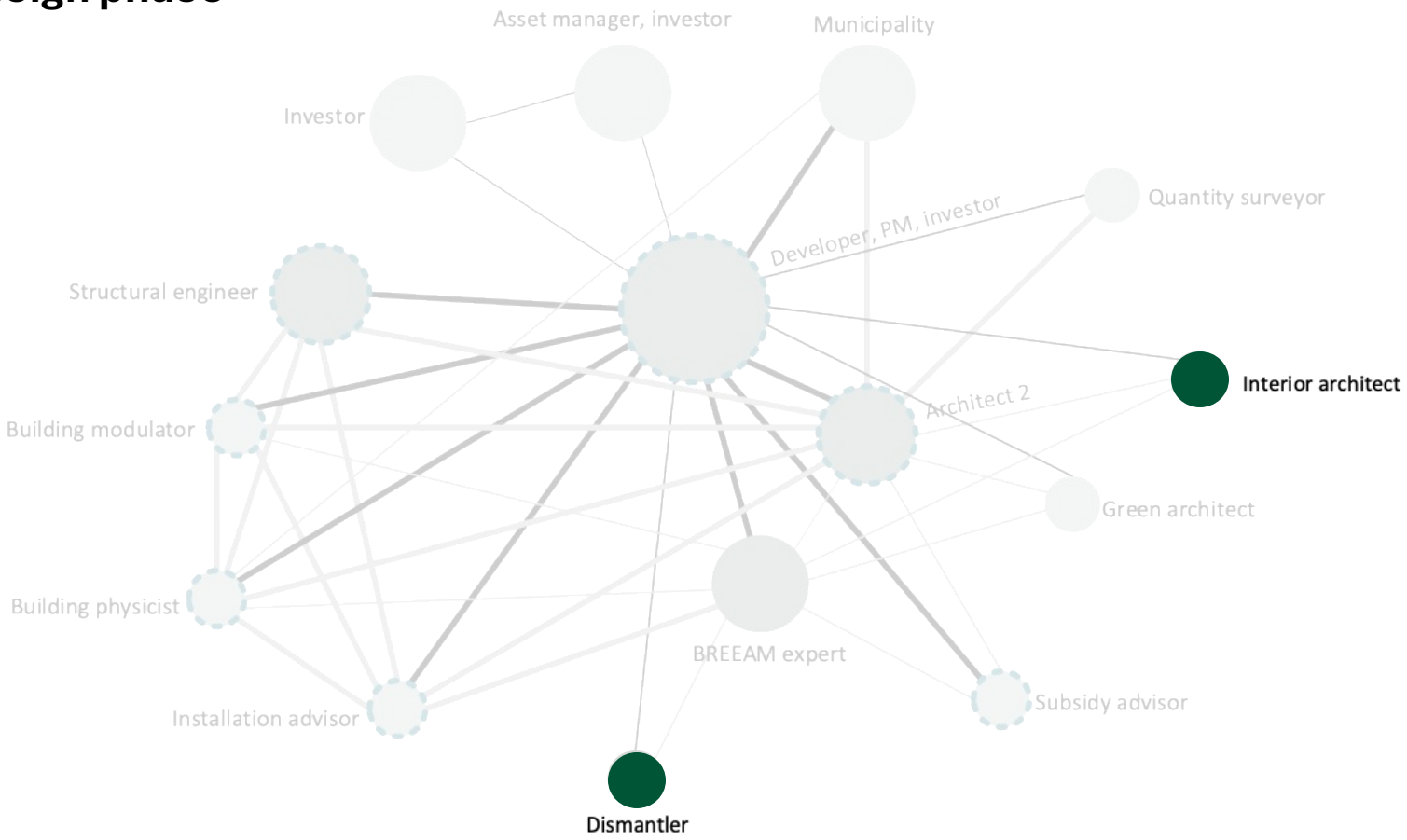
Feasibility phase

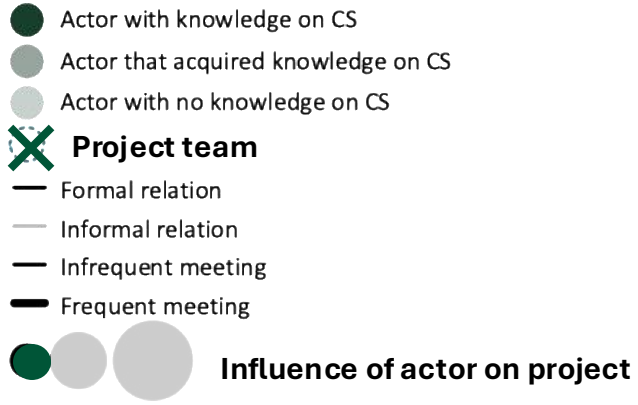


(Gerding et al., 2021)

Individual case analysis – part II – AIR Offices

Design phase

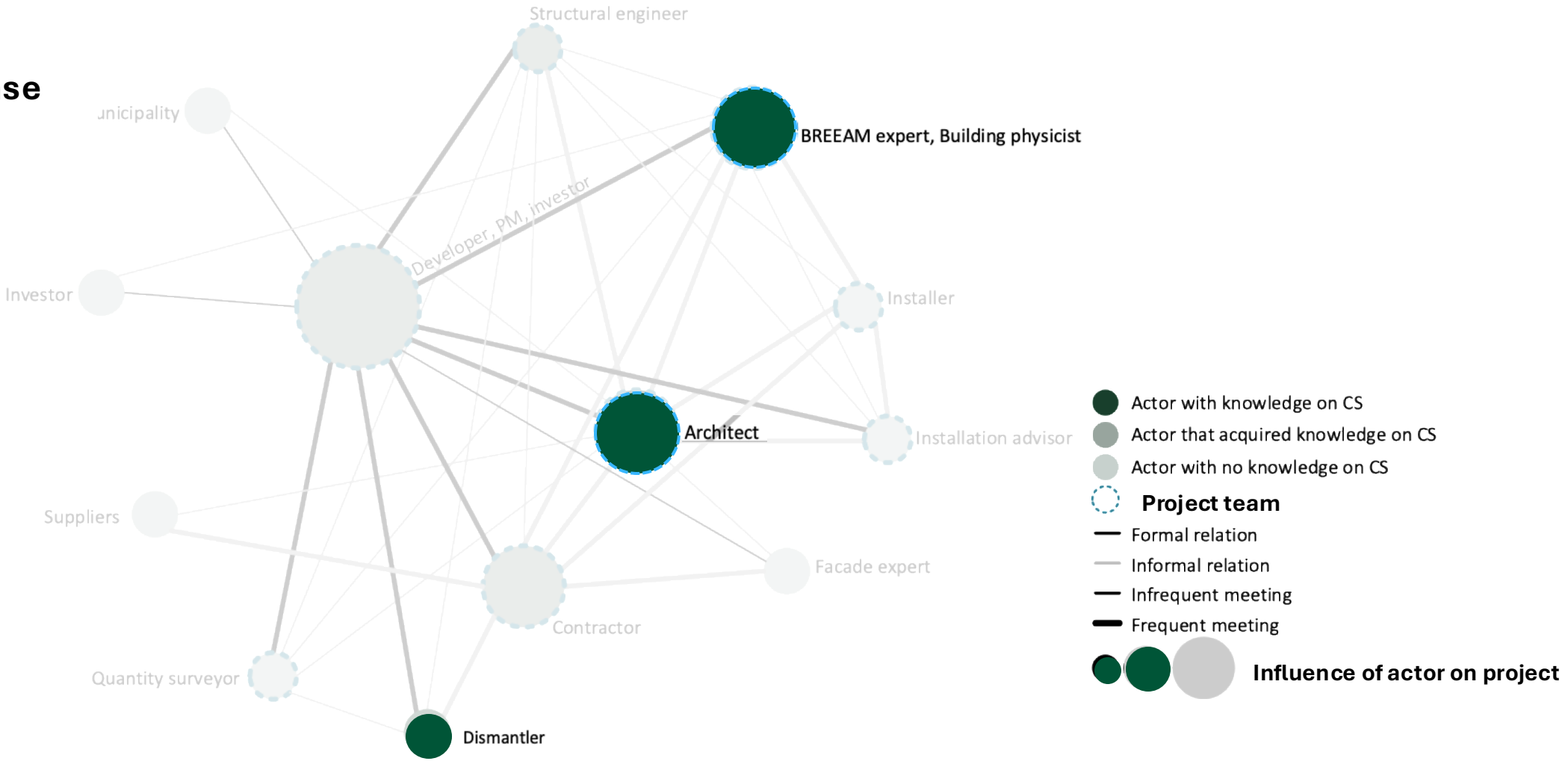




(Gerding et al., 2021)

Individual case analysis – part II – Edge Olympic

Design phase



(Gerding et al., 2021)

Part III – When & How

Inception phase

Define a circular ambition
Assess spatial and functional feasibility for AR
Assess technical condition
Investigate legal requirements for AR
Assess the economic feasibility for the project
Acquire the building

Feasibility phase

Align future user and investor with circular goal and conduct expectation management
Establish clear boundaries, prioritization list and qualitative requirements for circularity in program of requirements
Establish quantative and measurable targets in program of requirements
Establish a program of requirements
Assess reuse potential of materials and components in detail
Conduct destructive research
Explore available reclaimed materials in the market
Experiment with materials
Establish an circular procurement strategy with circular selection and award criteria
Allocate financial reserves & risks

Design phase

Establish a project team
Propose design alternatives
Consult suppliers in assessing reuse opportunities
Develop technical program of requirements
Develop detailed design
Include experienced contractor early for technical feasibility of design
Develop technical specification
Include salvage dealer and dismantler
Obtain municipal permits

Part III – When & How

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When

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How

Individual case analysis – part III – AIR Offices

Inception phase

Quote

'From day one, you really need to set the goal of building as circularly as possible. But then that has to be a goal in itself.'
- Developer

Activity

Define a circular ambition

Individual case analysis – part III – Zandkasteel

Feasibility phase

Quote

'The longer you wait [to do research], the harder [reuse] becomes. … You need a research report detailing quantities, the condition of the product, its technical state, perhaps assigning a specific rating. That way, you can make the best decisions about what has the highest chance of success.'
– Circularity expert

Activity

Assess reuse potential of materials and components in detail

Individual case analysis – part III – Edge Olympic

Design phase

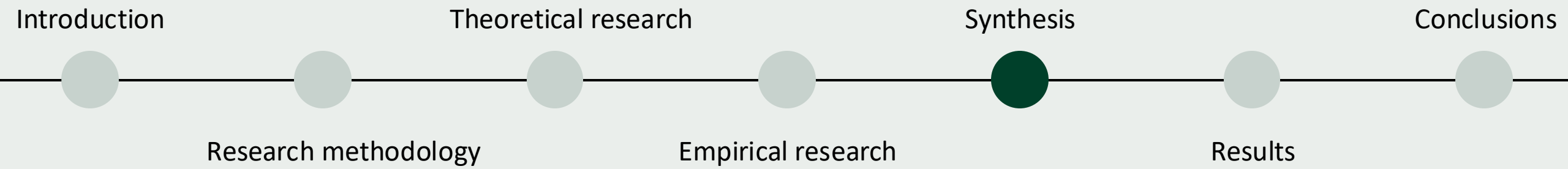
Quote

‘Ideally you would involve a contractor as early as possible in the process, especially if you want to work circularly. Because if certainty is important, then you need the contractor at the table early on. They have to deliver products, and you need to check whether it is feasible.’
– Architect

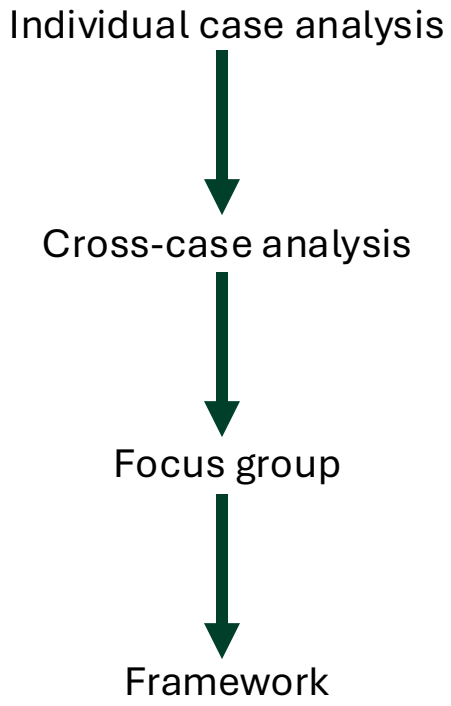
Activity

Include experienced contractor early for technical feasibility of design

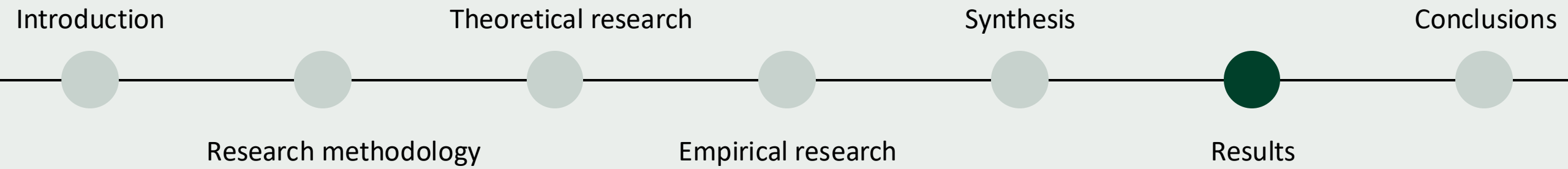
5 Synthesis


Introduction
Research methodology
Theoretical research
Empirical research
Synthesis
Results
Conclusions

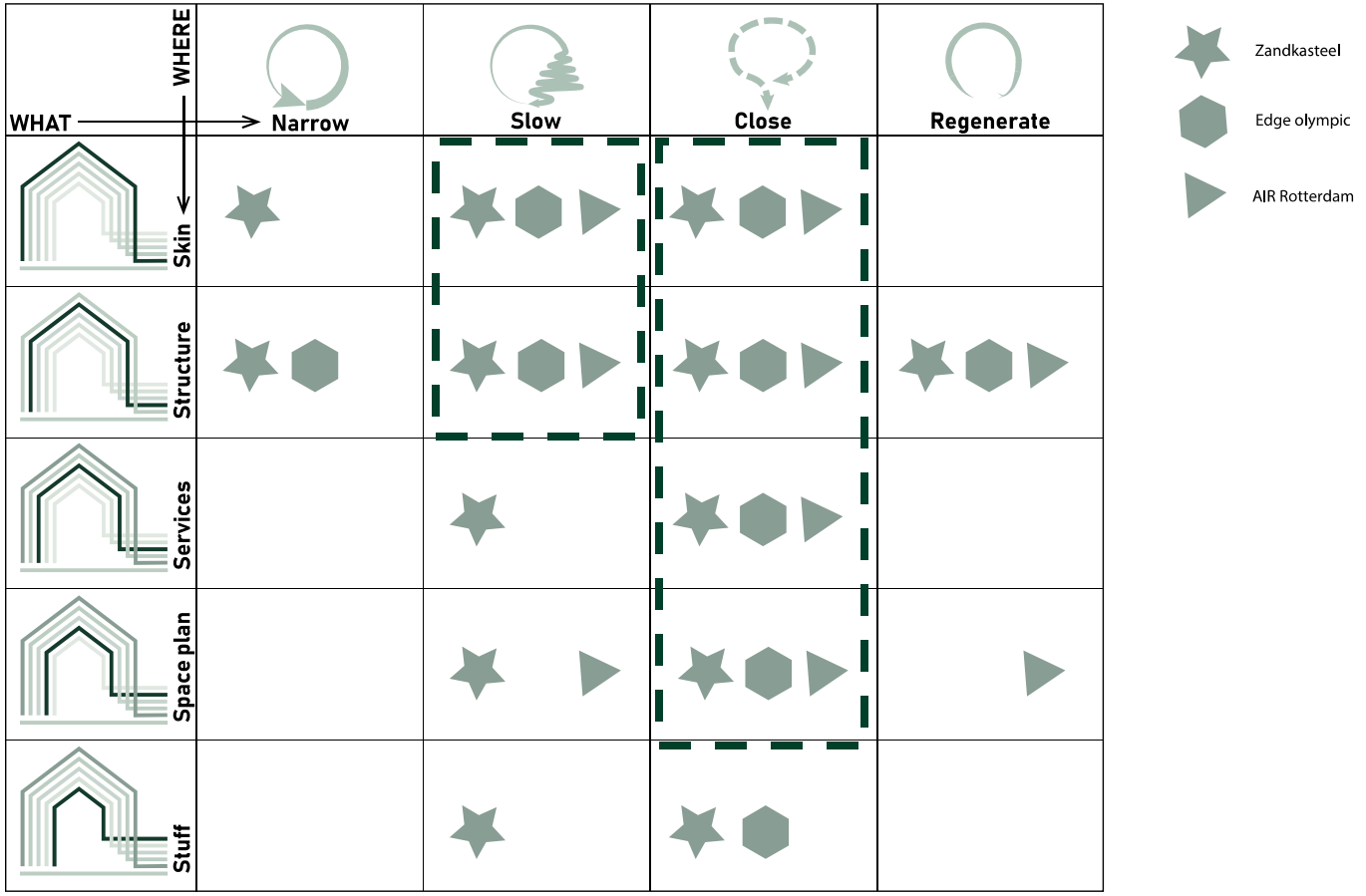
Synthesis of results



6 Results

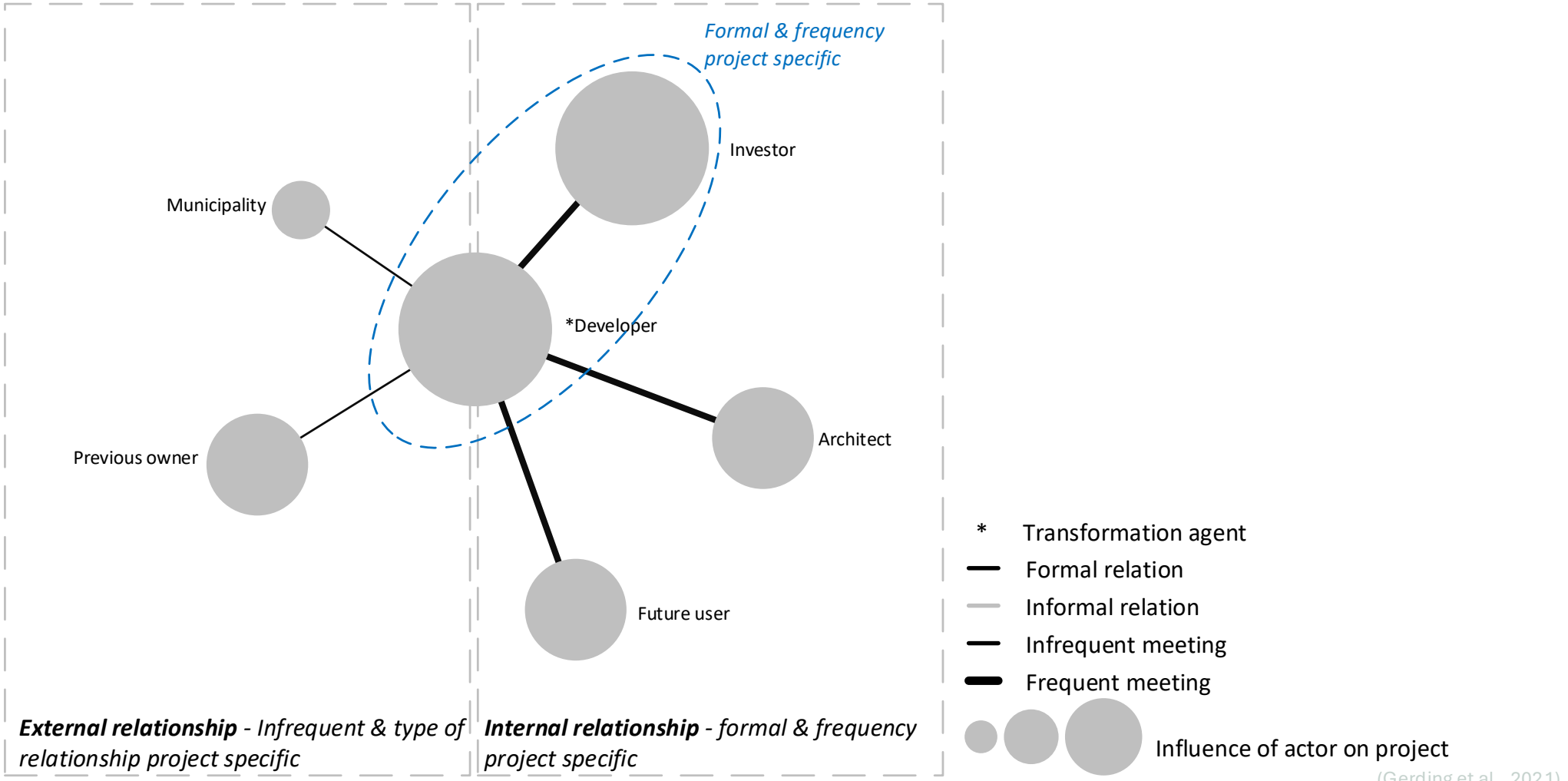

Introduction
Research methodology
Theoretical research
Empirical research
Synthesis
Results
Conclusions

What & where



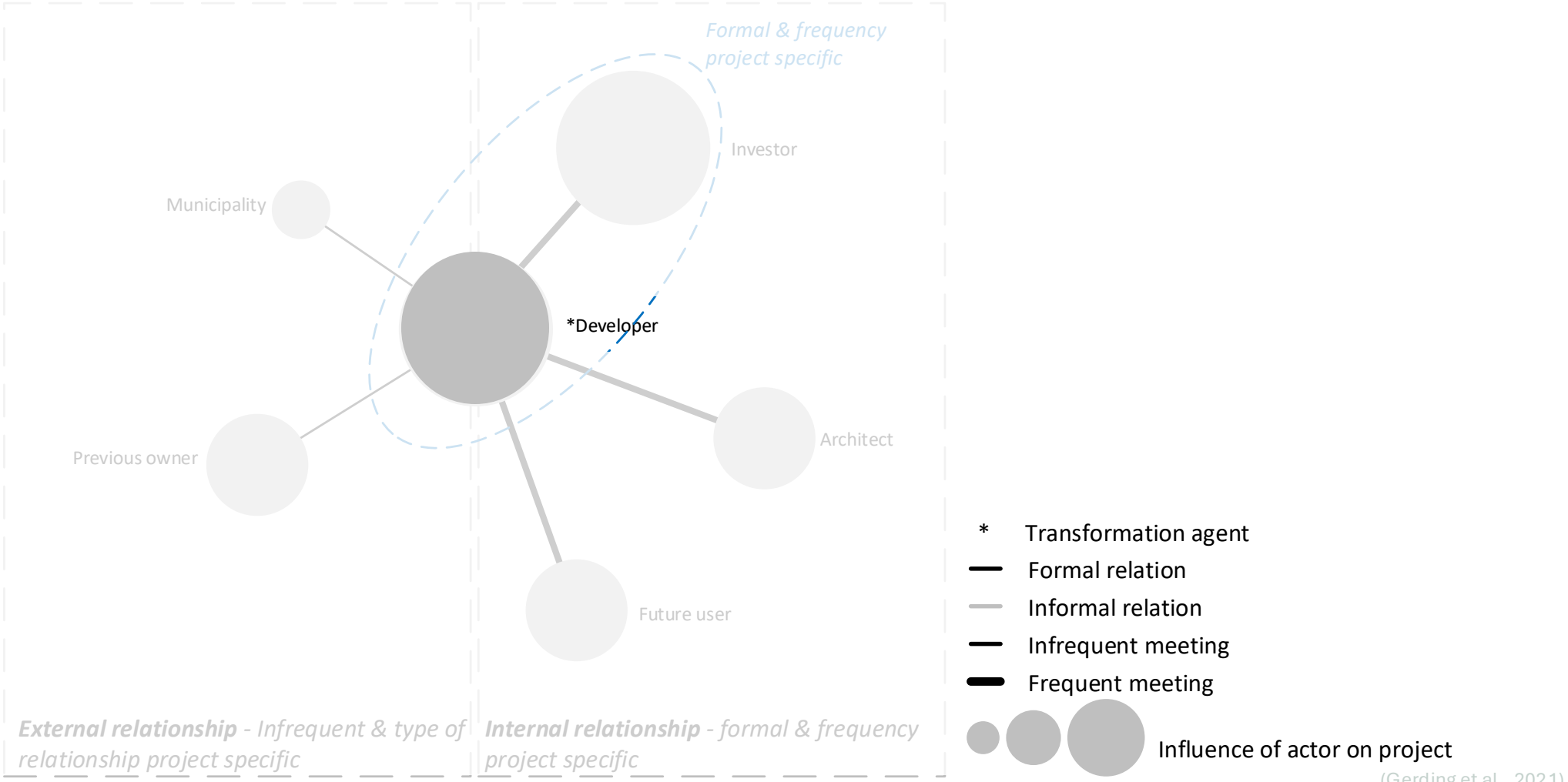
(Brand, 1994)
(Circle Economy & Metabolic, 2022)
(Transitieteam Circulaire Bouweconomie, 2020)

When & who - Inception



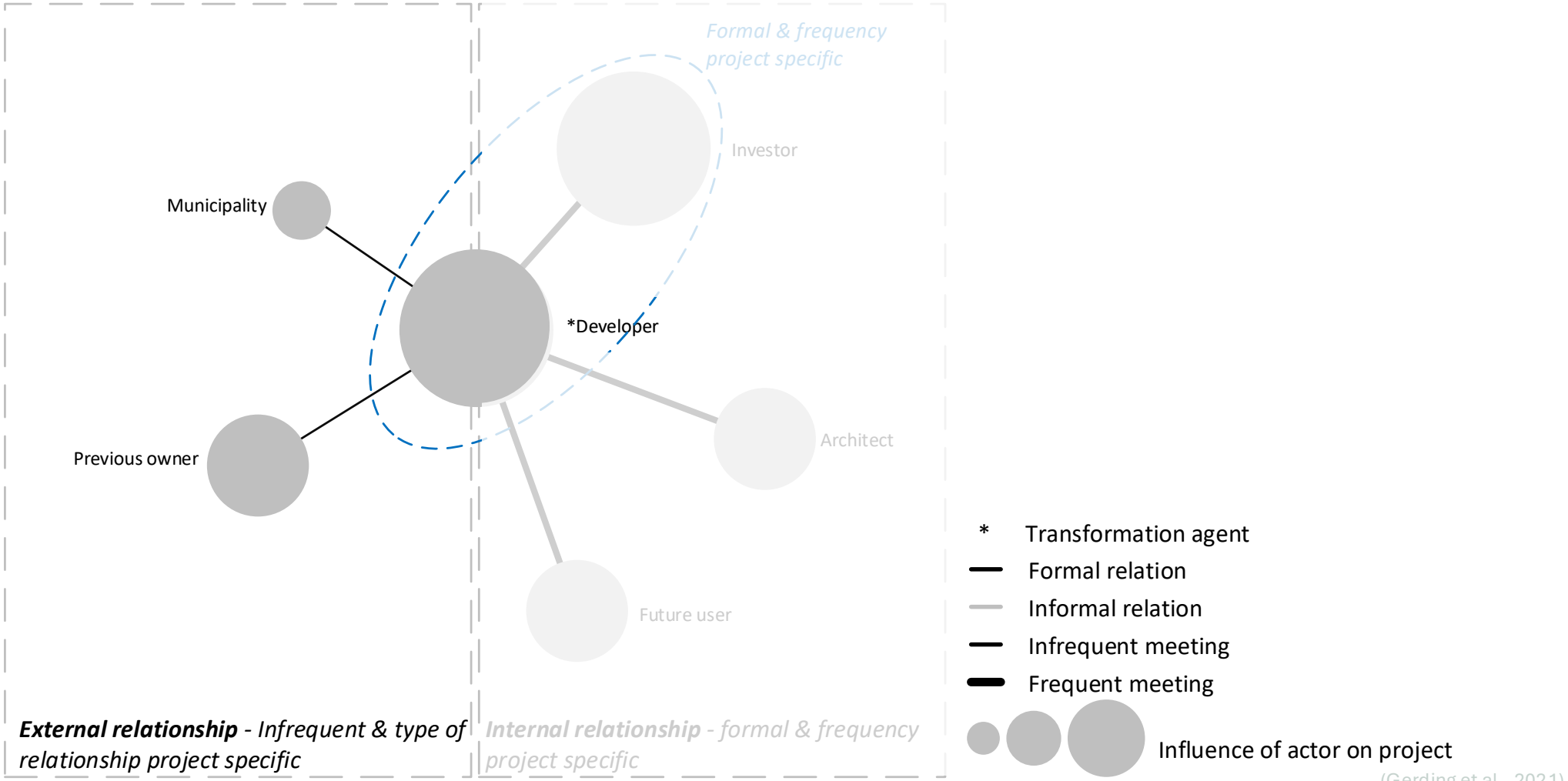
(Gerding et al., 2021)

When & who - Inception



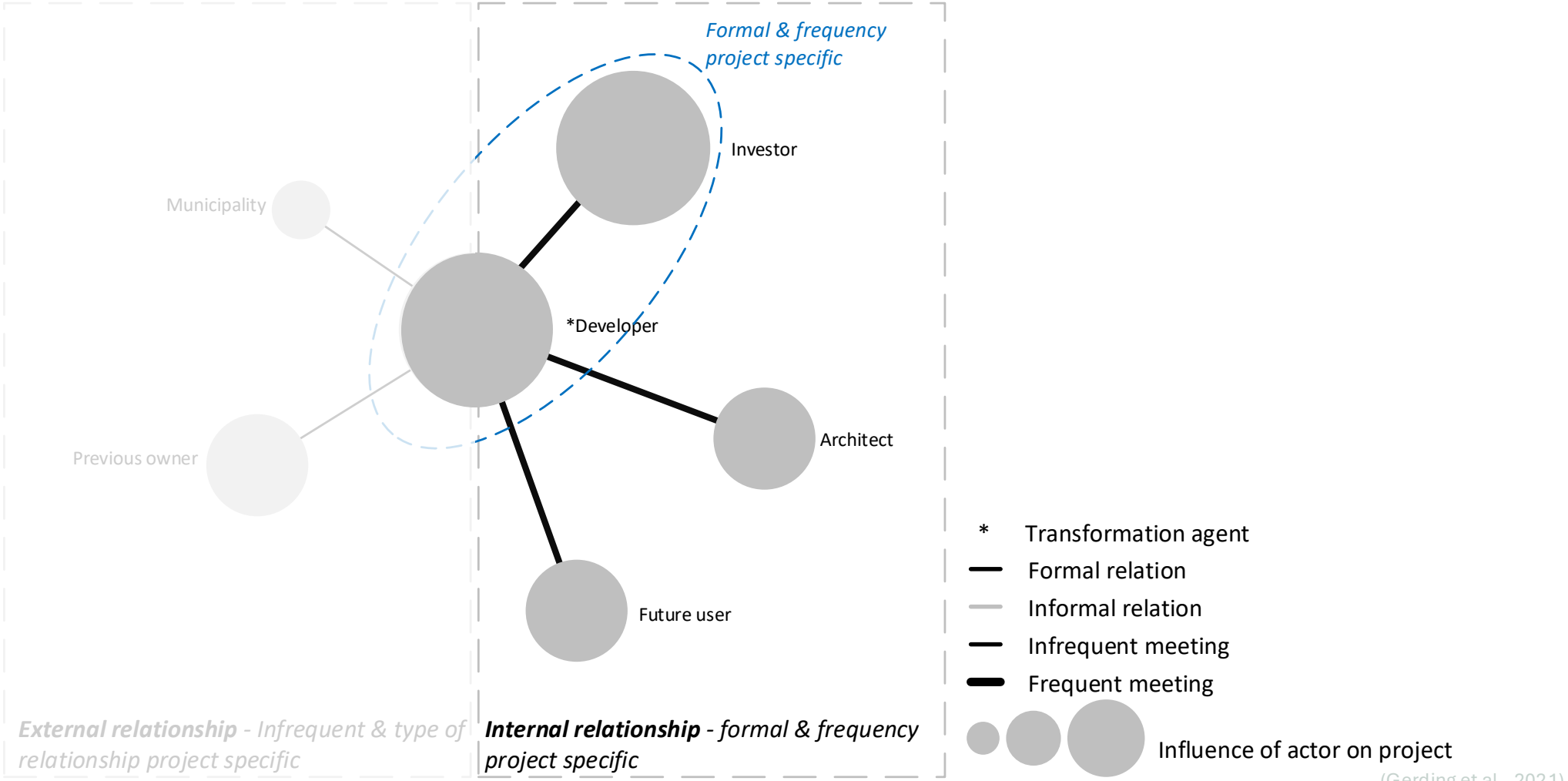
(Gerding et al., 2021)

When & who - Inception



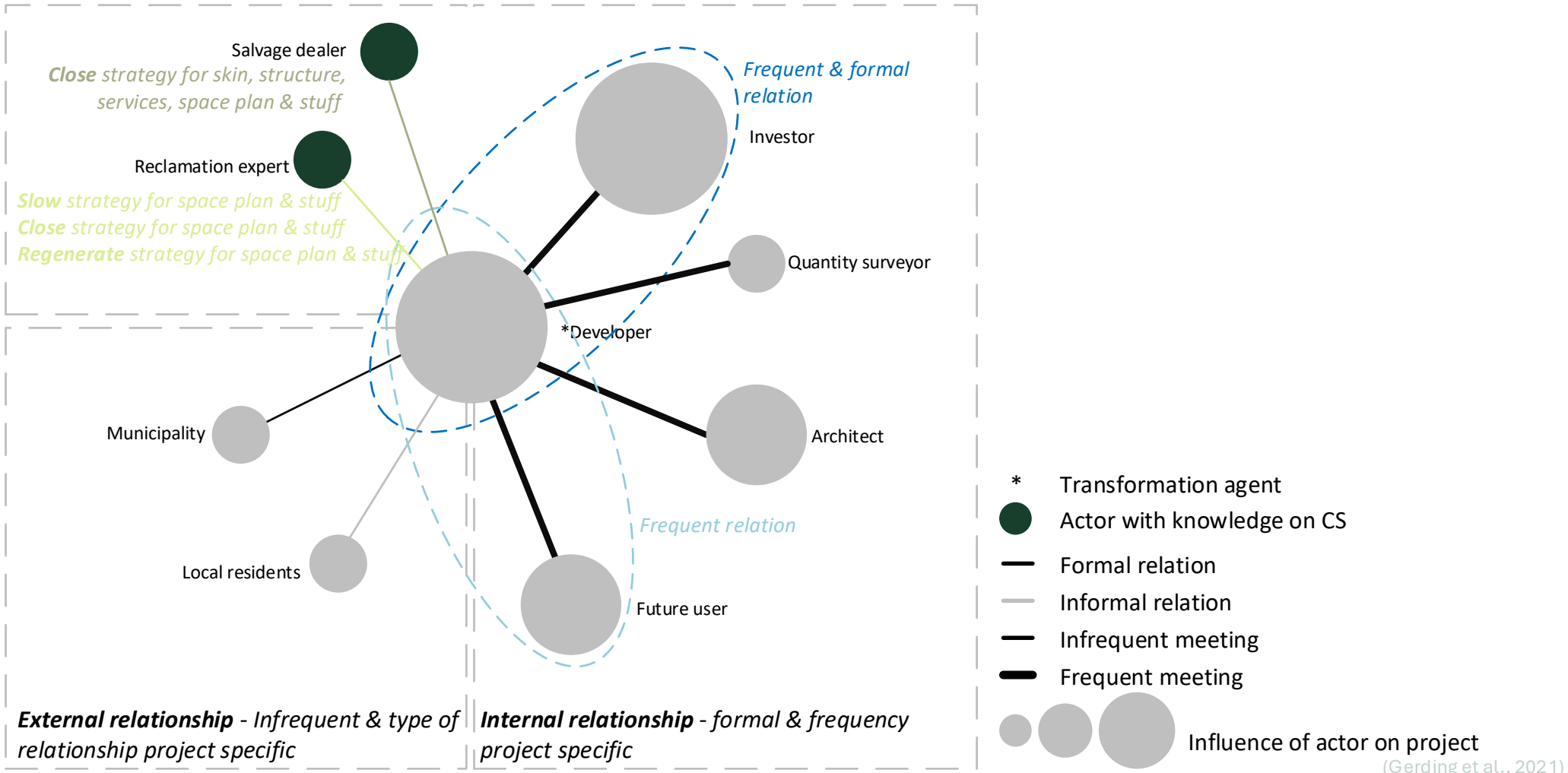
(Gerding et al., 2021)

When & who - Inception



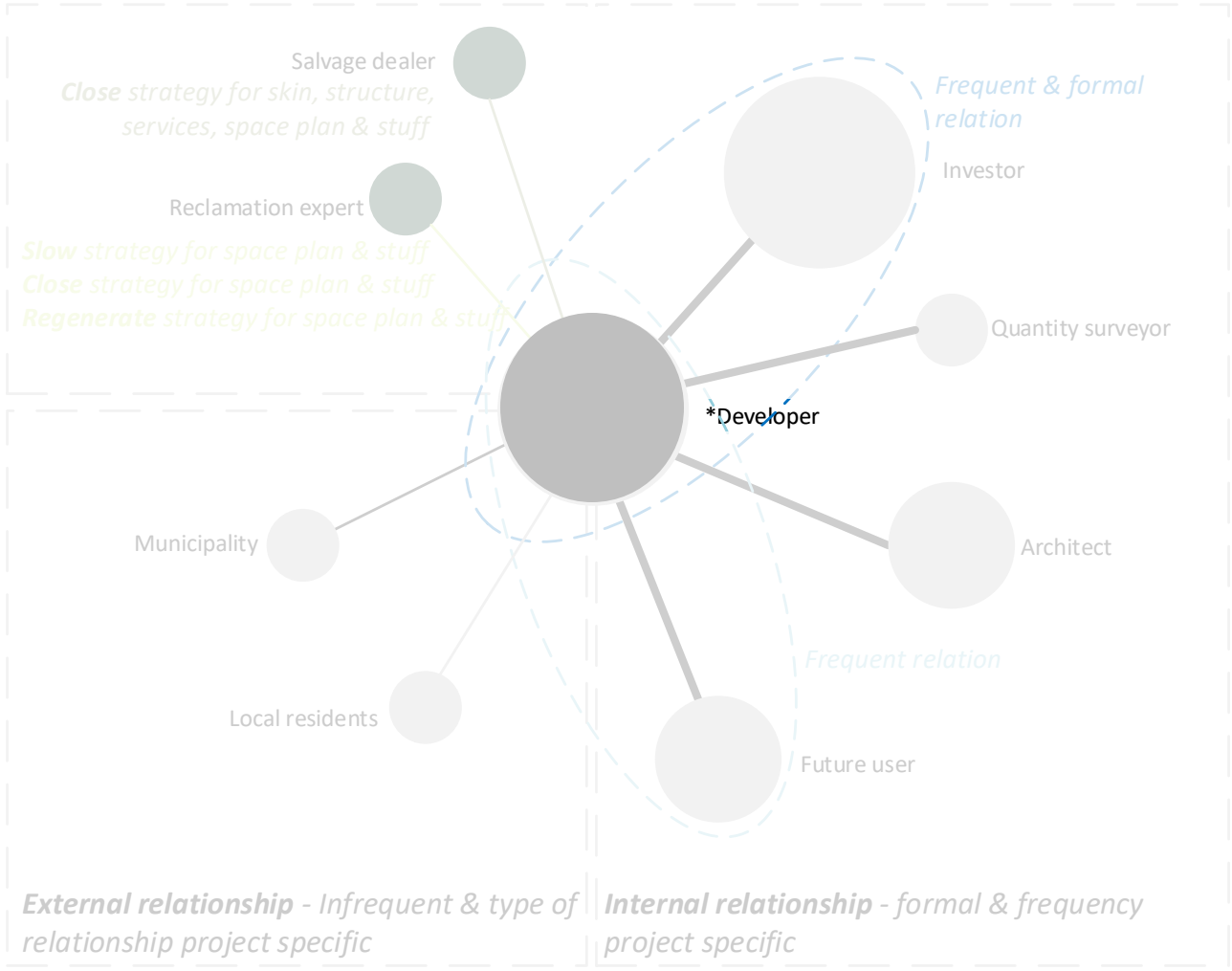
(Gerding et al., 2021)

When & who - Feasibility



(Gerding et al., 2021)

When & who - Feasibility



* Transformation agent

Actor with knowledge on CS

Formal relation

Informal relation

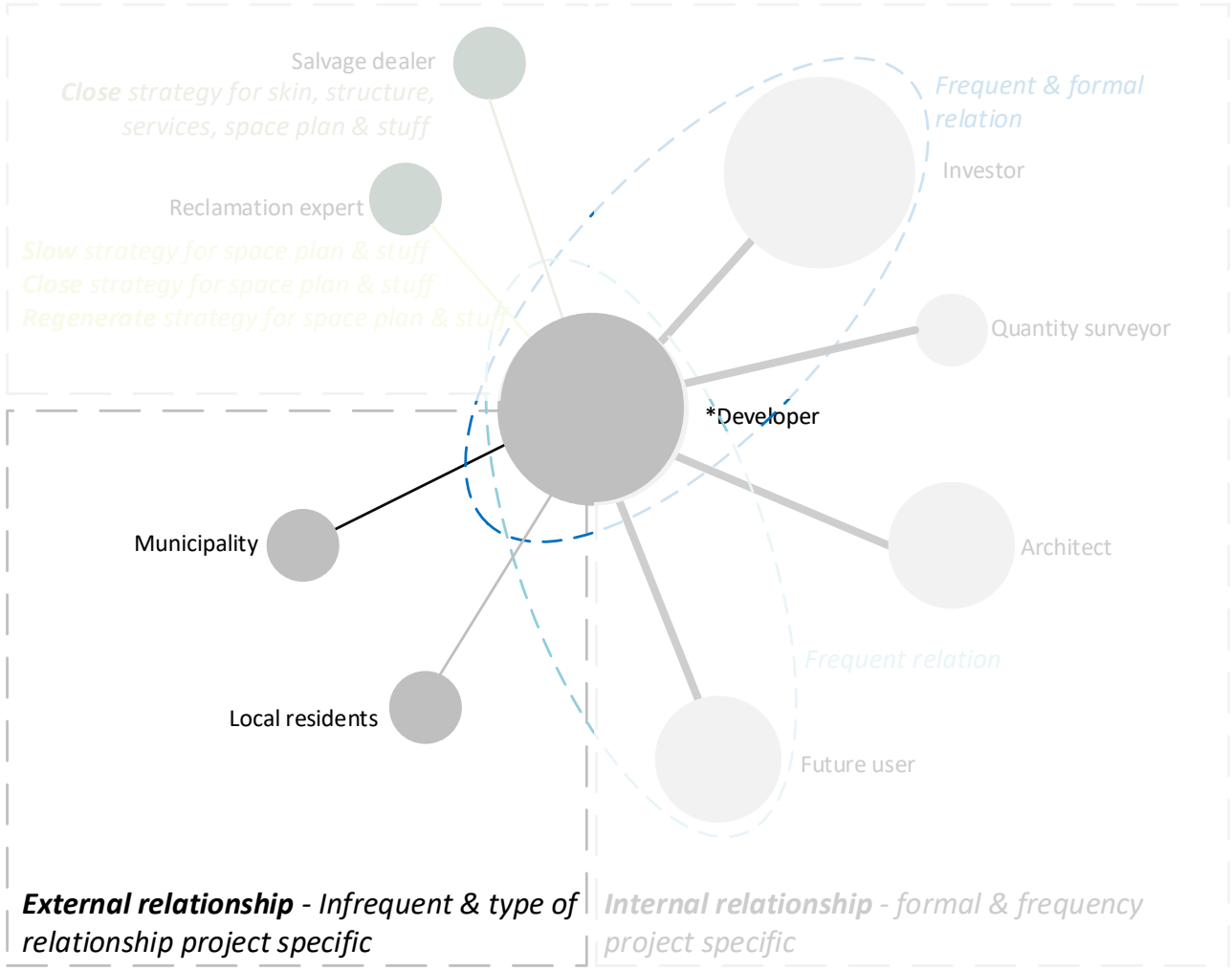
Infrequent meeting

Frequent meeting

Influence of actor on project

(Gerding et al., 2021)

When & who - Feasibility



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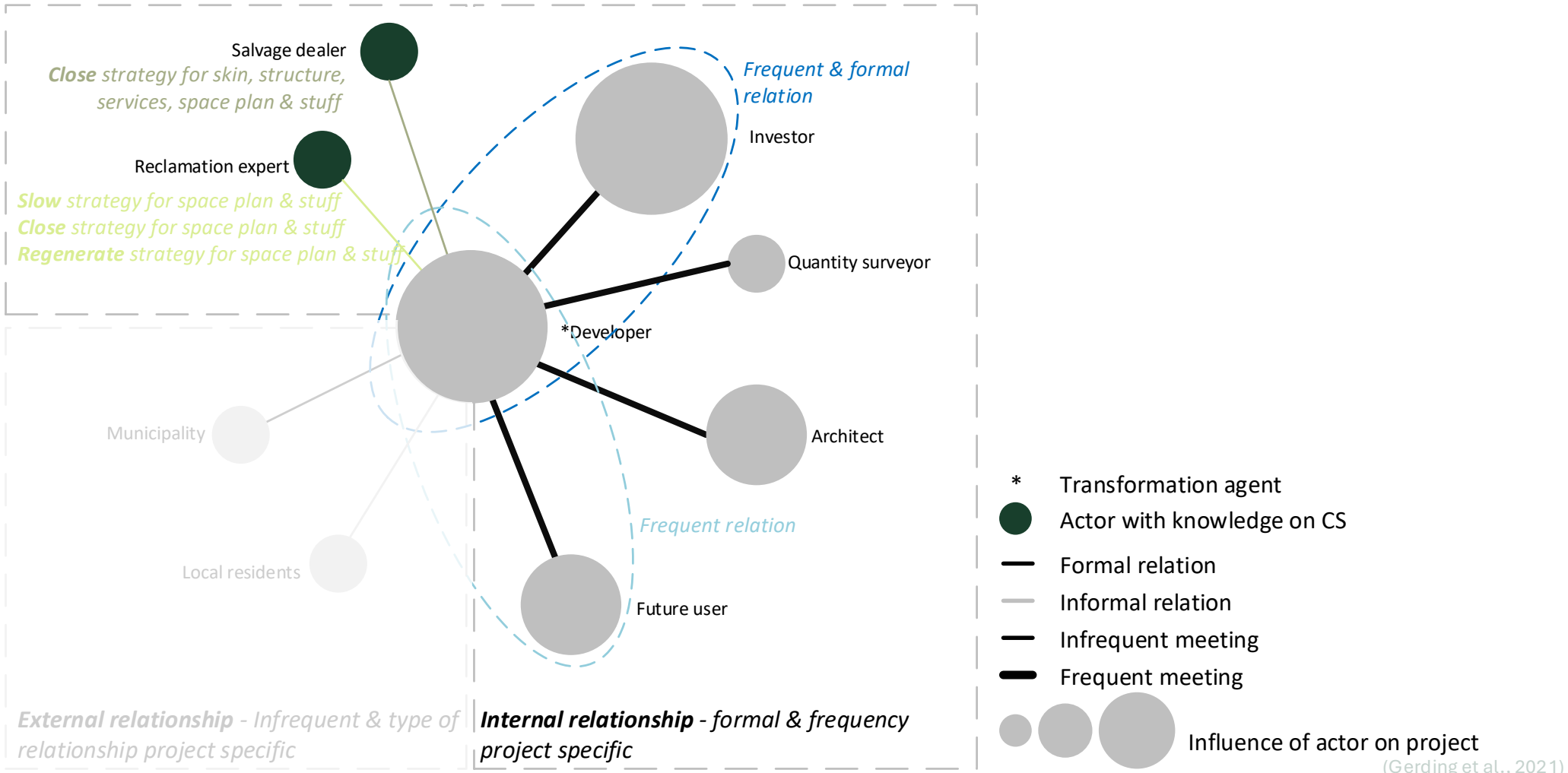
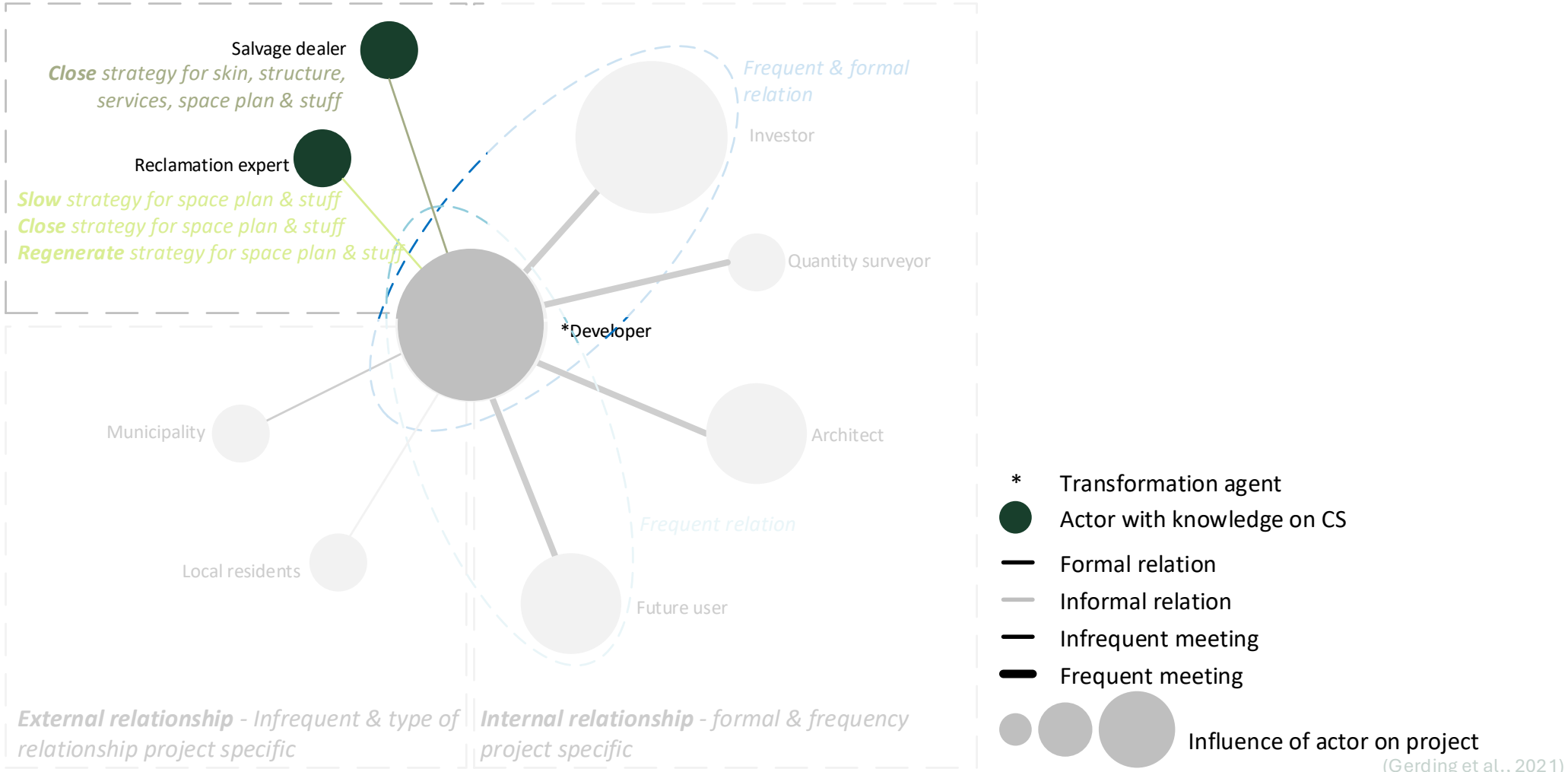


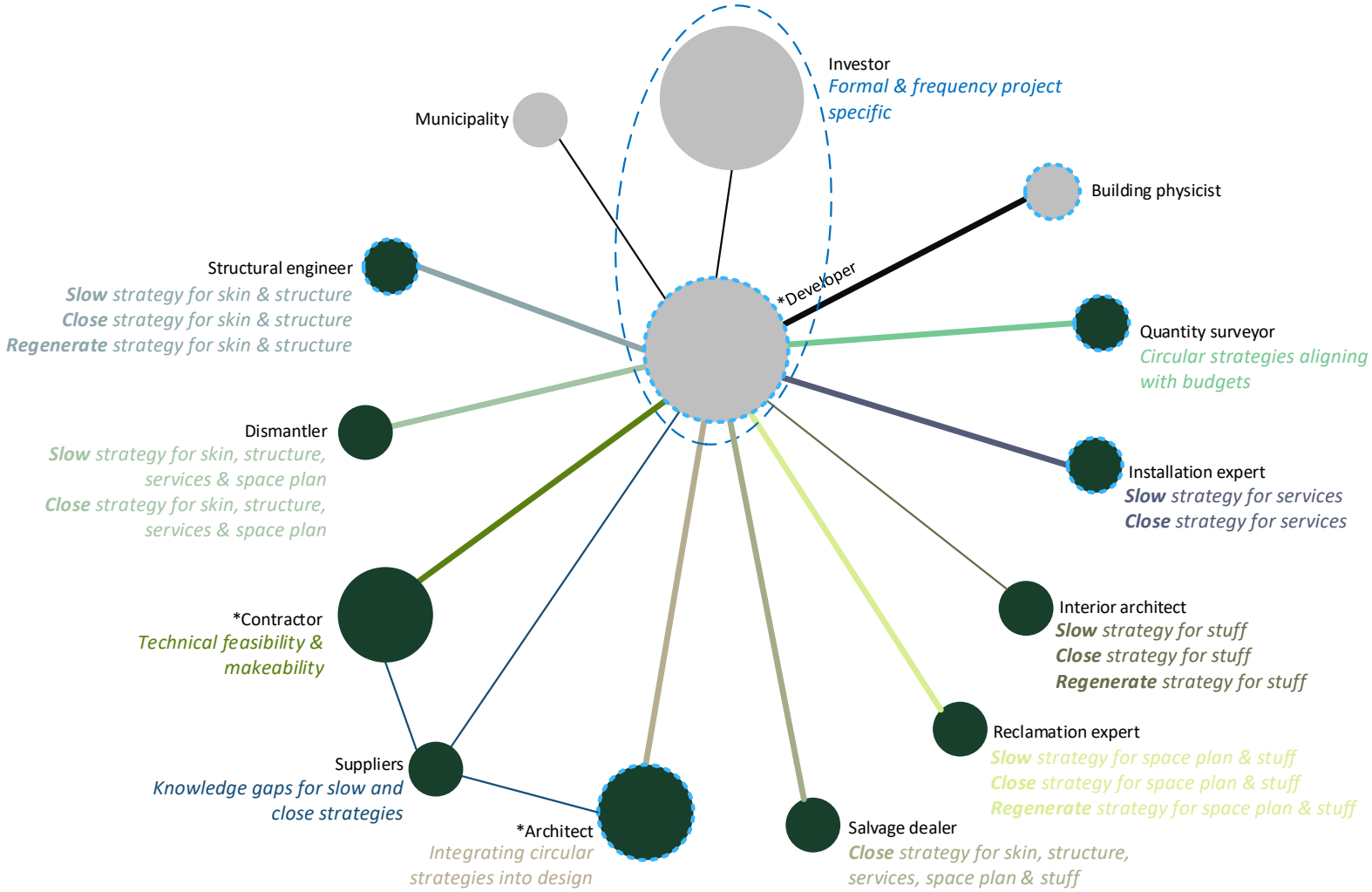
(Gerding et al., 2021)

When & who - Feasibility



(Gerding et al., 2021)

When & who - Design



* Transformation agent

Project team

Actor with knowledge on CS

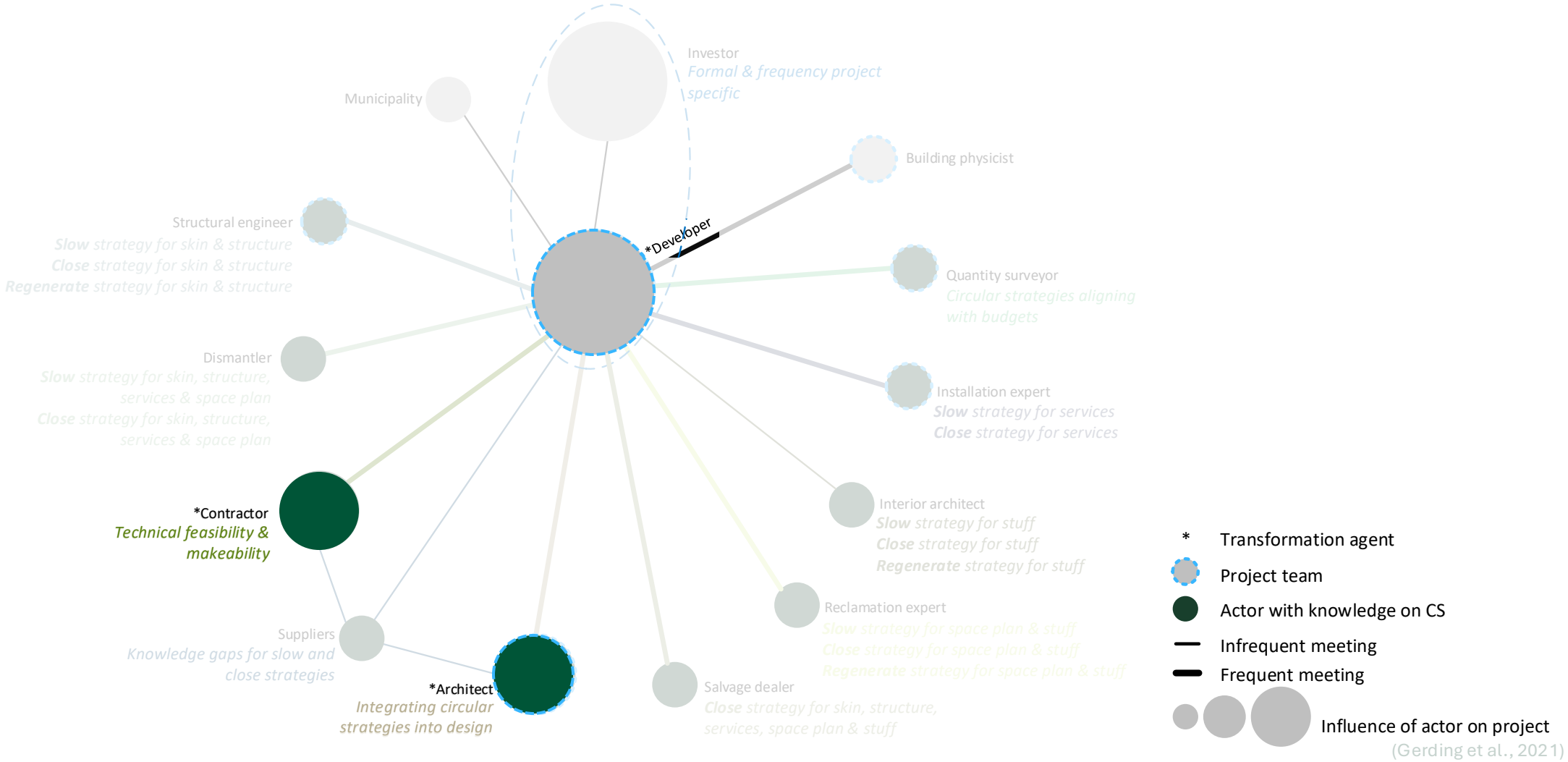
Infrequent meeting

Frequent meeting

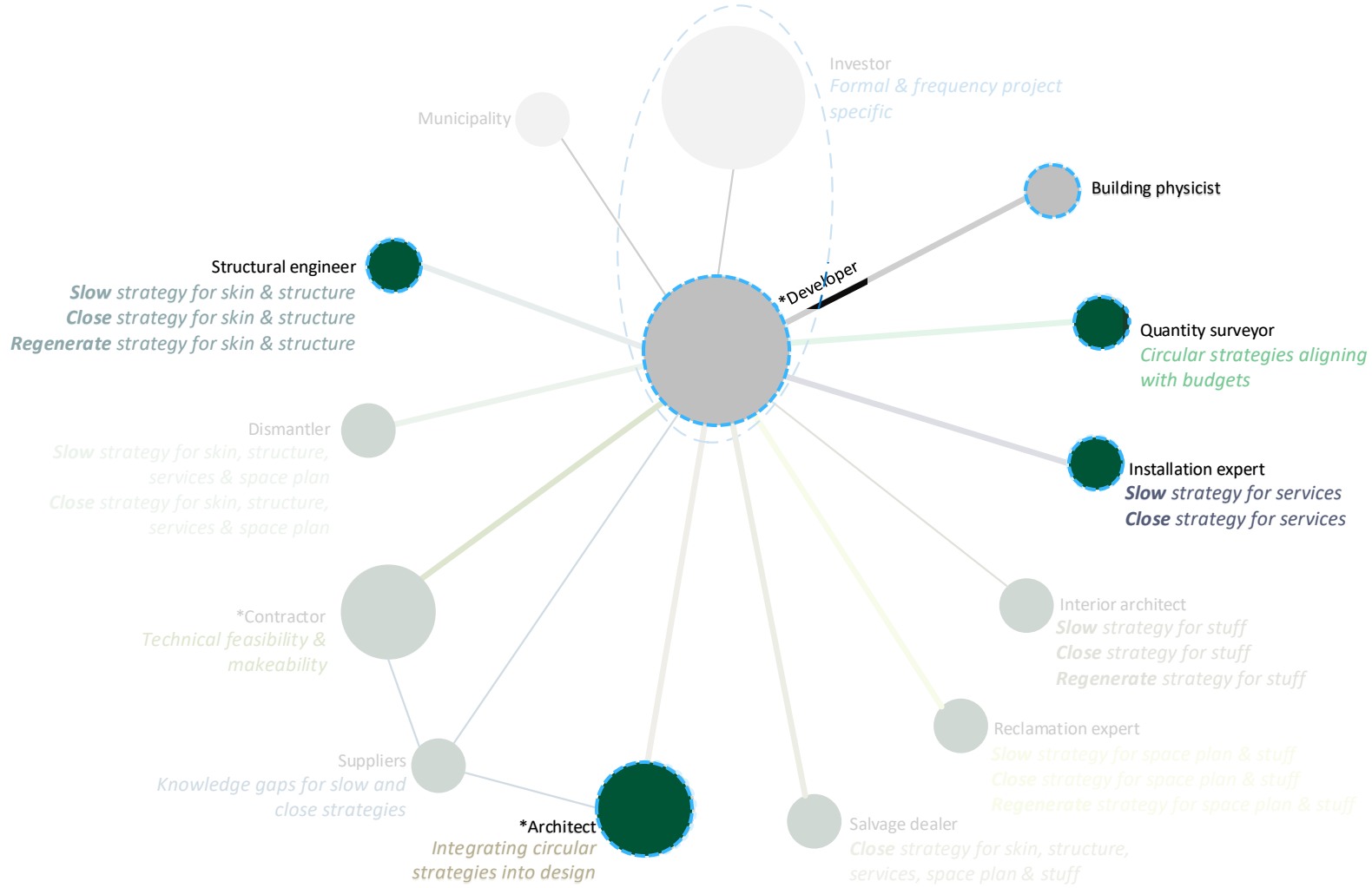
Influence of actor on project

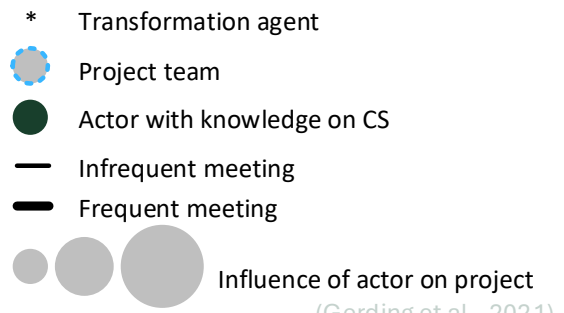
(Gerding et al., 2021)

When & who - Design



When & who - Design





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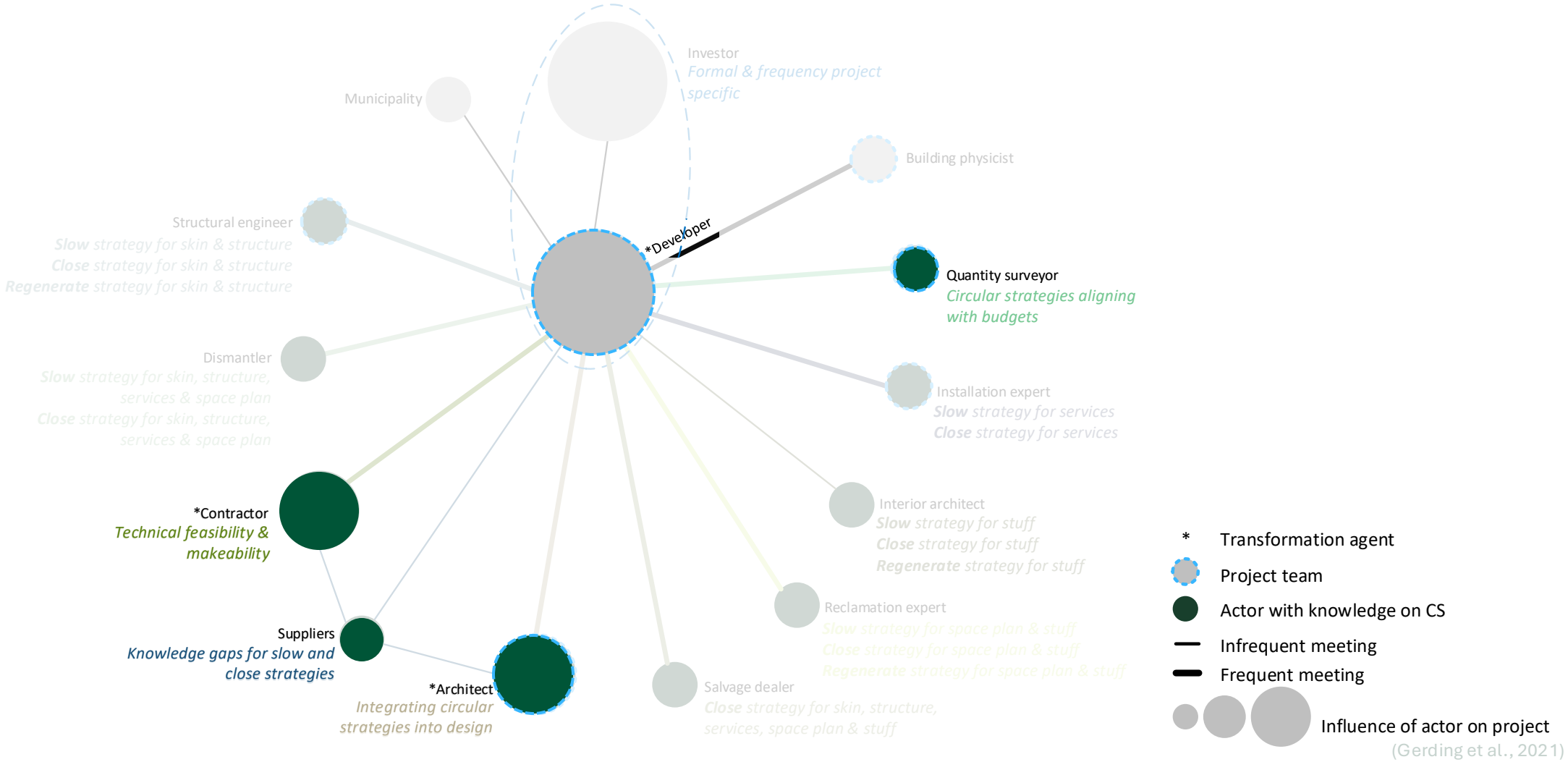
When & who - Design



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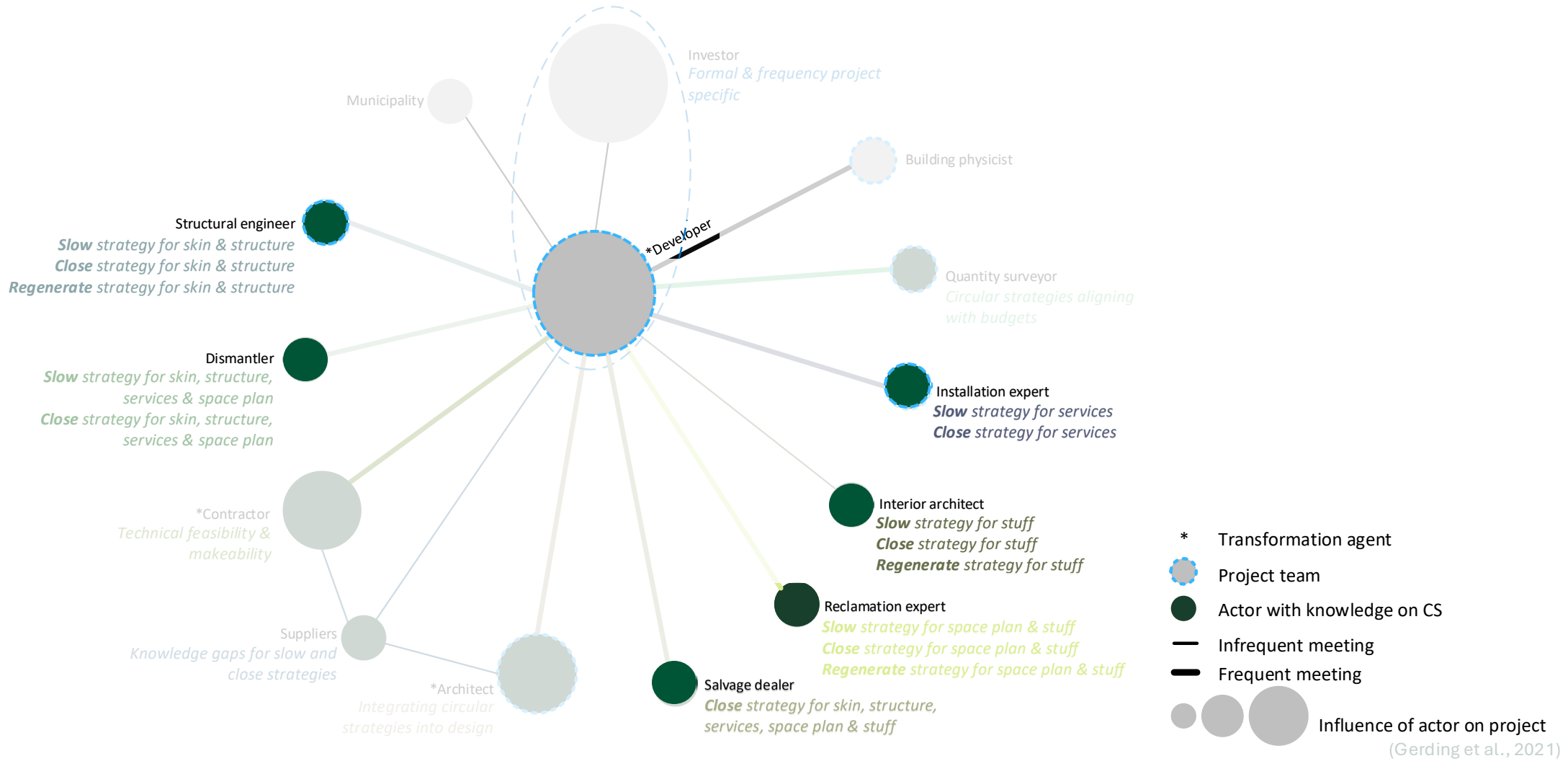
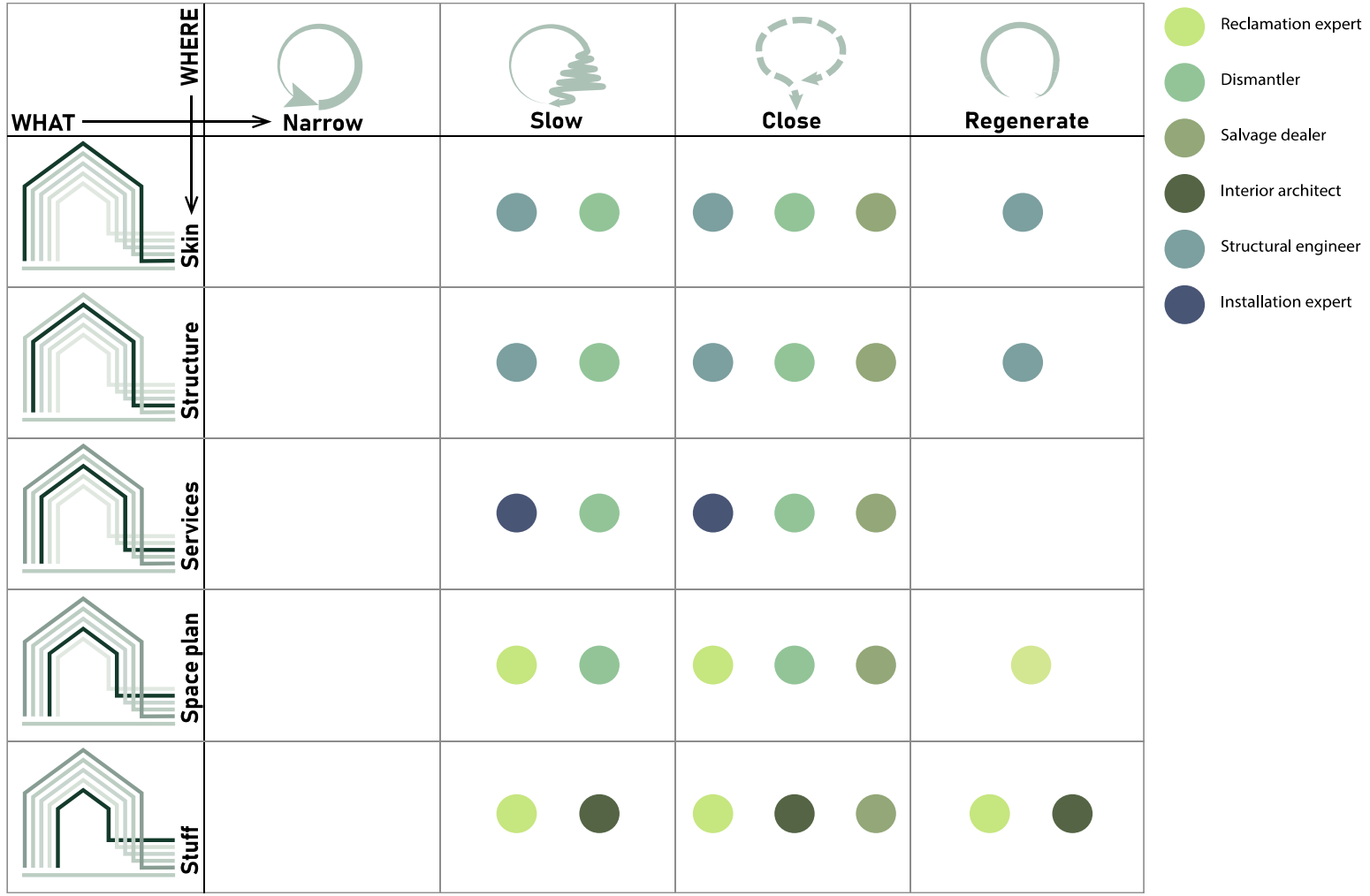


When & who - Design



When & how - inception

Define

ACTIVITIES

- Define and document a circular ambition
- Assess the spatial and functional feasibility for adaptive reuse
- Assess the technical condition
- Assess the reuse potential of materials and components
  - For visible elements: assess potential and define a reuse objective
  - For concealed elements: define a reuse objective as input for later assessment
- Investigate the legal requirements for adaptive reuse
- Assess the economic feasibility of the project
- Acquire the building

When & how - Feasibility

Refine ***Iterative***

ACTIVITIES

- (Engage potental future users)
- Align future user(s) and/or investor(s) with circular goals and conduct expectation management
- Establish clear boudaries, prioritization list, and qualitative requirements for circularity in the program of requirements
- Establish quantitative and measurable targets in the program of requirements
- Establish a flexible program of requirements for functions
- Assess the reuse potential of materials and components in detail
- Conduct destructive research
- Verify and correct existing building drawings
- Explore available reclaimed materials in the market
- Allocate financial and planning reserves & risks

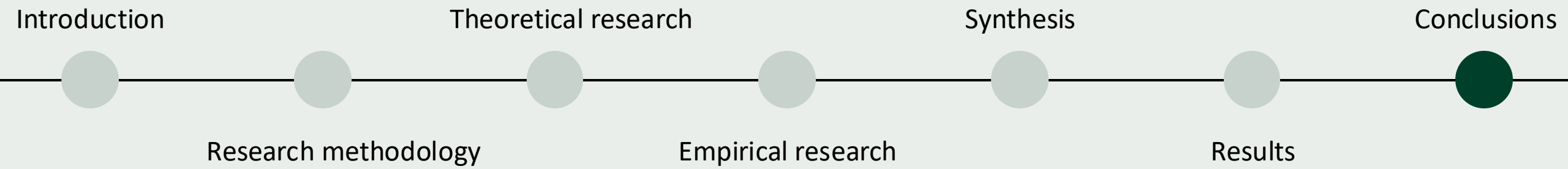
When & how - Design

Align

ACTIVITIES

- Establish a circular procurement strategy
  - With circular selection & award criteria
- Establish a project team
- Propose design alternatives
- Consult suppliers in assessing reuse opportunities
- Develop technical program of requirements
- Include experienced contractor for technical feasibility
- Develop detailed design
- Experiment with materials
- Offer circular material alternatives
- Develop technical specifications
- Include salvage dealer and / or dismantler
- Evaluate identified reuse potential
- Develop circular demolition specification
- Obtain municipal permits

7 Conclusions

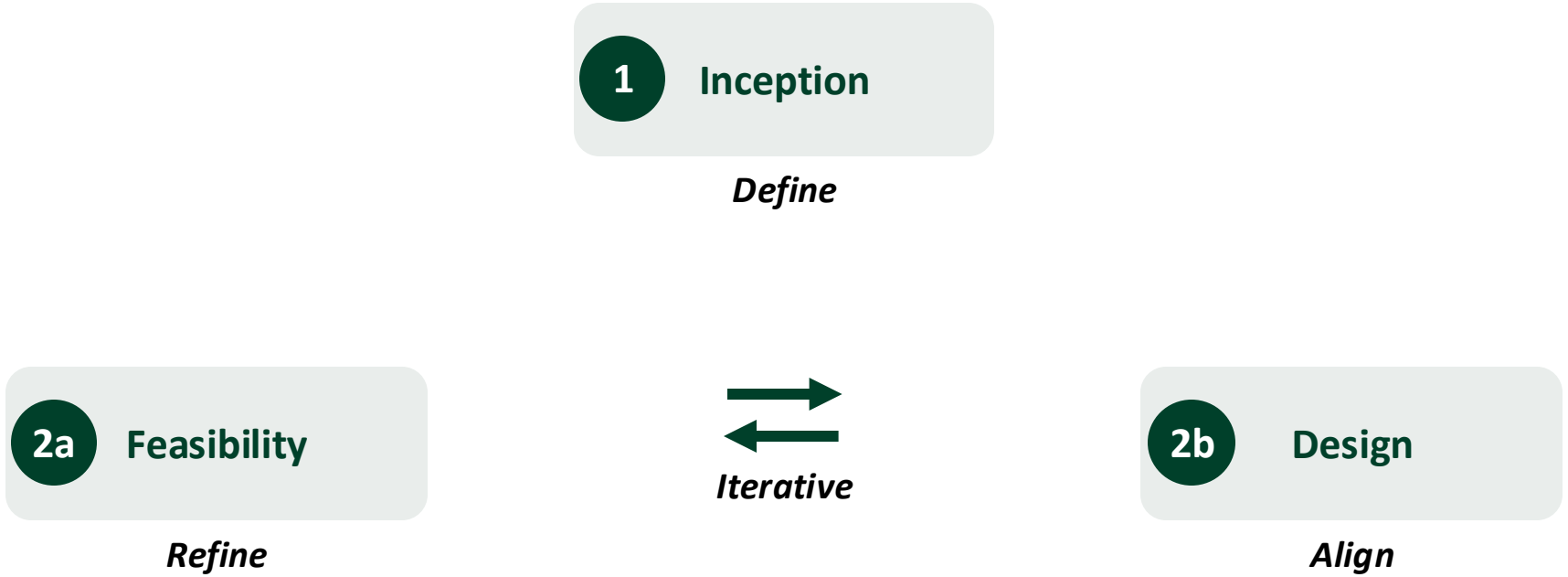


SRQ1: What circular strategies are applicable in adaptive reuse projects?

WHAT → / WHERE ↓	Narrow	Slow	Close	Regenerate
Skin		✓		
Structure		✓		
Services				
Space plan				
Stuff				

(Brand, 1994)
(Circle Economy & Metabolic, 2022)
(Transitieteam Circulaire Bouweconomie, 2020)

SRQ2: What is the influence of each early phase in the development process on the level of integration of circular strategies?



SRQ3: What type of actors are involved in circular adaptive reuse projects and how do these actors collaborate in the phases?

Traditional project team

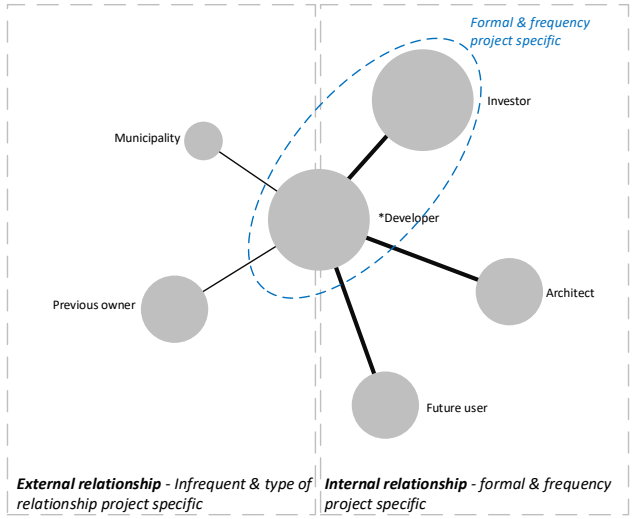
- Developer
- Architect
- Consultants
- Contractor

!!!
Include knowledge in the project team

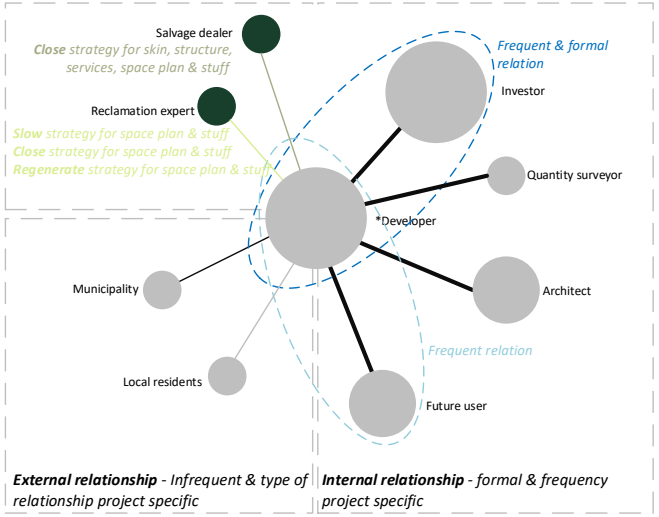
Circular specialists

- Transformation agents
- Salvage dealers
- Reclamation experts
- Dismantlers
- Circularity experts

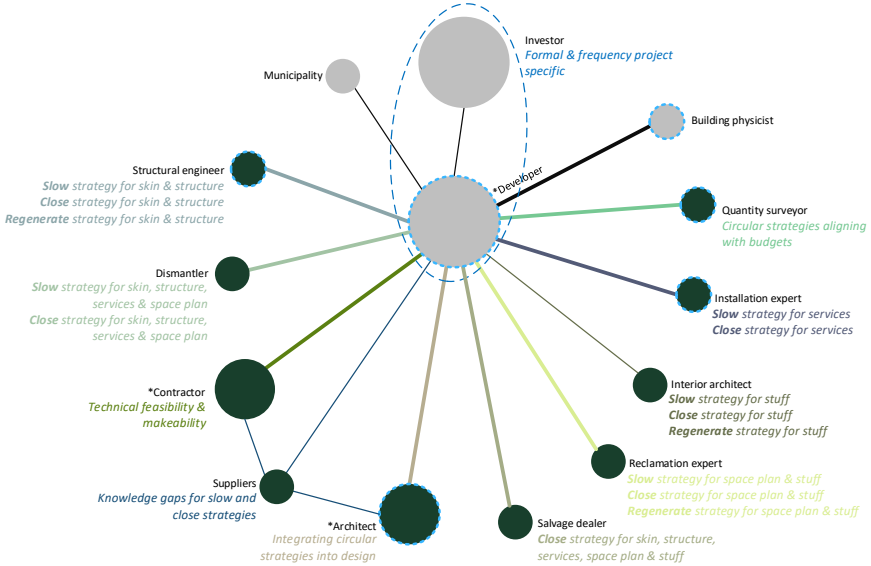
SRQ3: What type of actors are involved in circular adaptive reuse projects and how do these actors collaborate in the phases?



Inception



Feasibility



Design

(Gerding et al., 2021)

SRQ3: What type of actors are involved in circular adaptive reuse projects and how do these actors collaborate in the phases?

Exploratory

Set direction

Co—define requirements

Expert knowledge exchange

Intensifies

Close coordination

Inception

Feasibility

Design

SRQ4: What key activities in each early phase contribute to the integration of circular strategies?

Inception

Feasibility

Design

SRQ4: What key activities in each early phase contribute to the integration of circular strategies?

Inception

ACTIVITIES

- Define and document a circular ambition
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  - For concealed elements: define a reuse objective as input for later assessment
- Investigate the legal requirements for adaptive reuse
- Assess the economic feasibility of the project
- Acquire the building

Feasibility

ACTIVITIES

- (Engage potental future users)
- Align future user(s) and/or investor(s) with circular goals and conduct expectation management
- Establish clear boudaries, prioritization list, and qualitative requirements for circularity in the program of requirements
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- Allocate financial and planning reserves & risks

Design

ACTIVITIES

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  - With circular selection & award criteria
- Establish a project team
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- Include experienced contractor for technical feasibility
- Develop detailed design
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- Develop technical specifications
- Include salvage dealer and / or dismantler
- Evaluate identified reuse potential
- Develop circular demolition specification
- Obtain municipal permits

How can Dutch real estate developers organise the early phases of the development process to support the integration of circular strategies in adaptive reuse projects?

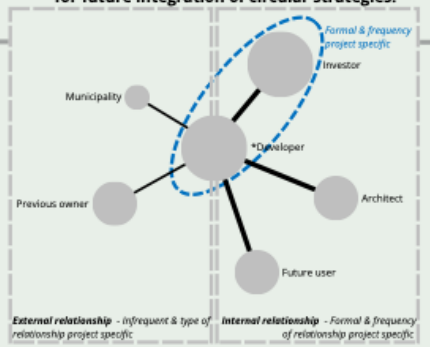
ORGANISATION OF THE EARLY DEVELOPMENT PHASES

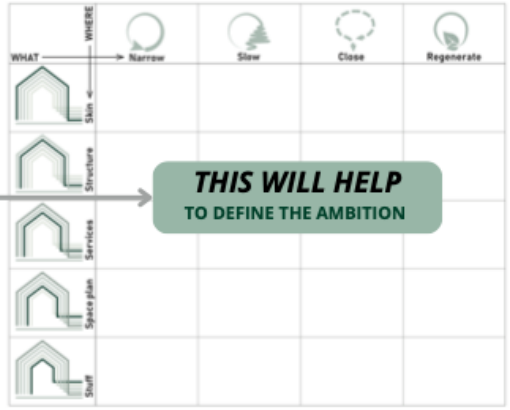
1 INCEPTION — DEFINE

ACTIVITIES
That support early identification of circular potential and AR feasibility:

- Define and document a circular ambition
- Assess the spatial and functional feasibility for adaptive reuse
- Assess the technical condition
- Assess the reuse potential of materials and components
  - For visible elements: assess potential and define a reuse objective
  - For concealed elements: define a reuse objective as input for later assessment
- Investigate the legal requirements for adaptive reuse
- Assess the economic feasibility of the project
- Acquire the building

COLLABORATION**
Is exploratory, aiming to understand project potential and create conditions for future integration of circular strategies:





THIS WILL HELP
TO DEFINE THE AMBITION

2a FEASIBILITY — REFINE

ACTIVITIES
That translate ambitions into concrete circular requirements and guide in-depth circular research on building and market conditions:

- (Engage potental future users)
- Align future user(s) and/or investor(s) with circular goals and conduct expectation management
- Establish clear boudaries, prioritization list, and qualitative requirements for circularity in the program of requirements
- Establish quantitative and measurable targets in the program of requirements
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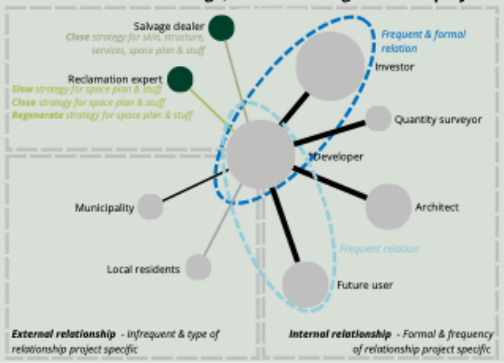
- Assess the reuse potential of materials and components in detail
- Conduct destructive research
- Verify and correct existing building drawings
- Explore available reclaimed materials in the market
- Allocate financial and planning reserves & risks

COLLABORATION**
Serves to clarify priorities, with actors co-defining requirements, exchanging technical & market knowledge, and commiting to shared project outcomes:



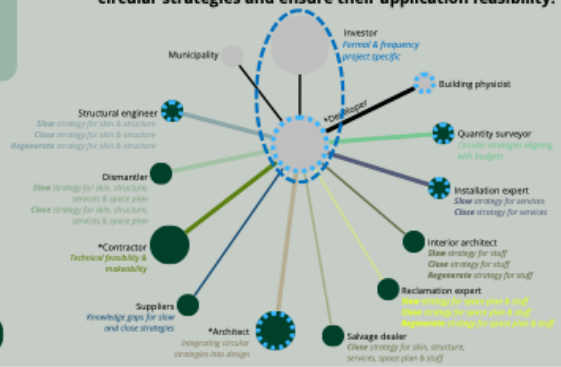
ITERATIVE

2b DESIGN — ALIGN

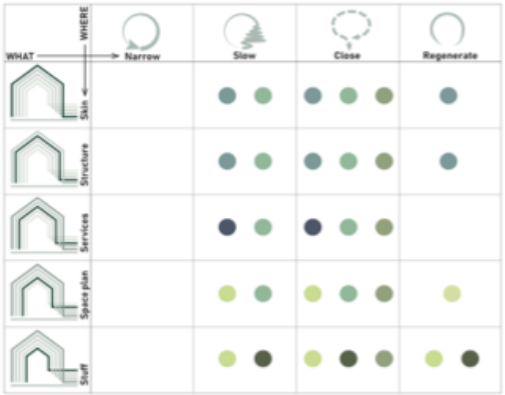
ACTIVITIES
That operationalise circular ambition through integrated design documents and ensure technical and practical feasibility:

- Establish a circular procurement strategy
  - With circular selection & award criteria
- Establish a project team
- Propose design alternatives
- Consult suppliers in assessing reuse opportunities
- Develop technical program of requirements
- Include experienced contractor for technical feasibility
- Develop detailed design
- Experiment with materials
- Offer circular material alternatives
- Develop technical specifications
- Include salvage dealer and / or dismantler
- Evaluate identified reuse potential
- Develop circular demolition specification
- Obtain municipal permits

COLLABORATION**
Intensifies, requiring close coordination among actors to operationalize circular strategies and ensure their application feasibility:



FIND YOUR PARTNER
TO REALISE CIRCULAR STRATEGY



LEGEND

- * Transformation agent
- Project team
- Actor with knowledge on CS
- Formal relationship
- Informal relationship
- Infrequent relationship
- Frequent relationship
- Influence of actor on project
- ** Collaboration model illustrates how actor relationships can be organised to support circular ambitions

- Reclamation expert
- Dismantler
- Salvage dealer
- Interior architect
- Structural engineer
- Installation expert

Recommendations for practitioners

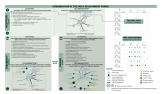
- **Acknowledge contextual factors** that influence the feasibility of circular strategies
- **Align the project team** around a shared definition and ambition of circularity
- **Invest in circular expertise** to tackle knowledge gaps & include them in the project team
- **Communicate the long-term value** of circular strategies to investors
- **Develop recognized certifications** to strengthen credibility

THANK YOU

Questions?

‘Organise’

‘To make arrangements for something to happen’



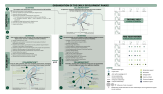
Setting up the collaboration and engaging actors with required expertise (collaboration models, find you partner model)

7S

Structure

Skills

‘To do or arrange something according to a particular system’



Translating circular strategies into structured project activities (strategy-layer matrix & framework activities)

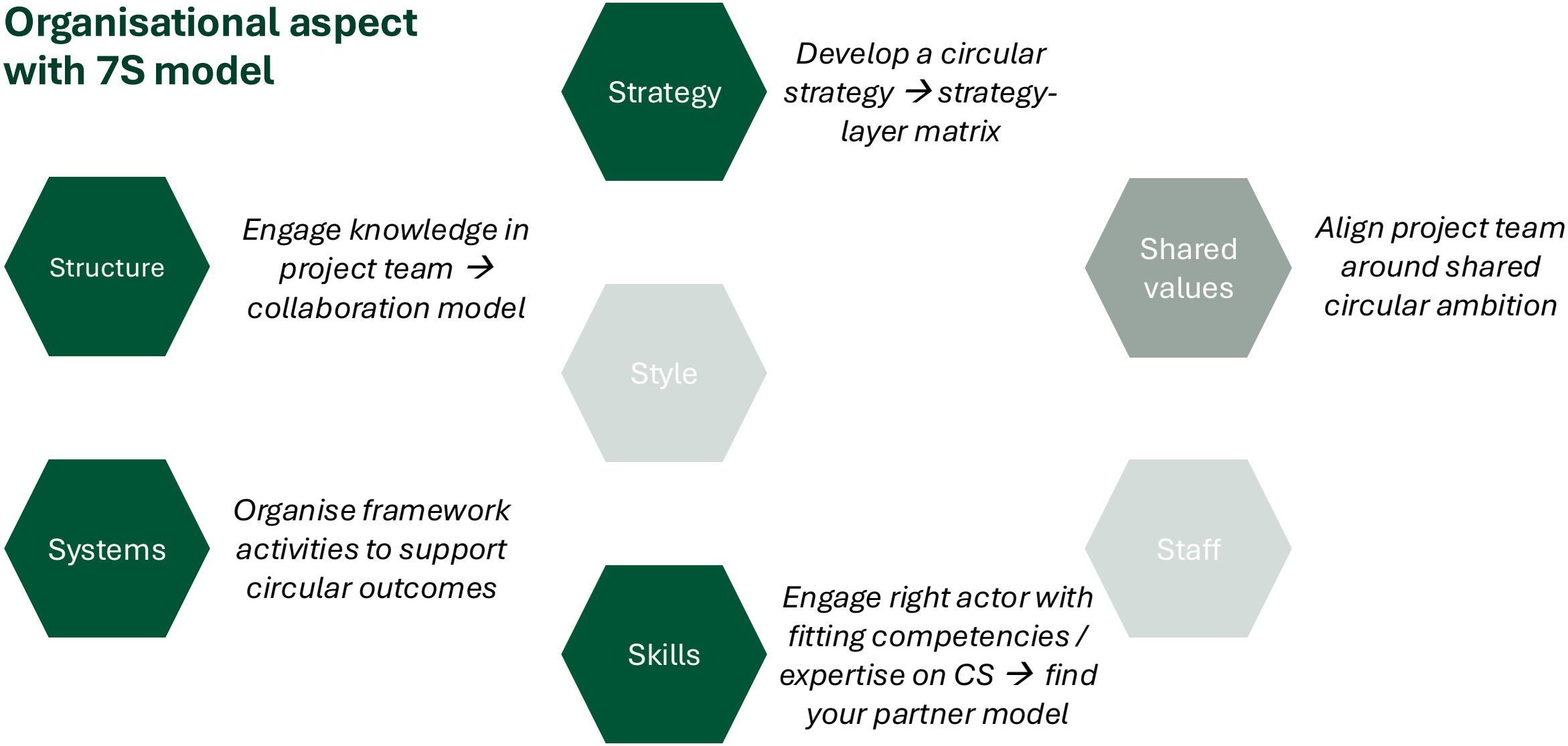
7S

Strategy

System

(Cambridge Dictionairy, n.d.)

Organisational aspect with 7S model



Recommendations for academics

- **Conduct more case studies** to strengthen validity
- **Broaden the scope to international** cases to reveal broader insights
- **Research all phases** of the development process to address interconnected nature of the phases
- **Investigate financial barriers** to explore strategies to overcome them

Literature gap

- Detailing how developers can actively support circularity through **targeted collaboration** per phase
- Identifies **specific activities** that support circular integration per phase
- Shows that **phases interact iterative**, rather than a linear manner