

SLACK IN CONSTRUCTION – PART 1: CORE CONCEPTS

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ABOUT THIS RESEARCH

- **Outcome of a non-conventional research project**
- **Result of literature review and theoretical discussions**
 - Group of 13 academics (5 professors and 8 graduate students) from three universities
 - 10 weekly on-line meetings during a 4-month period
 - Development of a concept map



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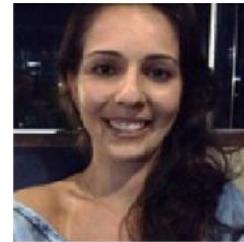
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INTRODUCTION

- Much research has been done on **how to use buffers to protect construction projects from the detrimental impact of variability**
 - There used to be a **Buffer Management track** in past IGLC conferences
- **Buffer has been defined as a cushion of resources**, e.g. time, materials, capacity, and money (Alves & Tommelein, 2003)
- Previous studies are **strongly based on the queueing theory** (Spearman and Hopp, 2020), in which production is modelled as a natural science phenomenon

INTRODUCTION

- **Limitations of buffer management techniques:**
 - They deal with variability that is **statistically described in advance**
 - However, it is **hard to anticipate and quantify uncertainty** (unpredictable variability) in complex projects (Ballard et al., 2020)
 - The concept of buffer is usually **focused on built-in and designed strategies and resources**, neglecting resilient performance that arises from **self-organisation, initiative-taking, and resourcefulness of people**

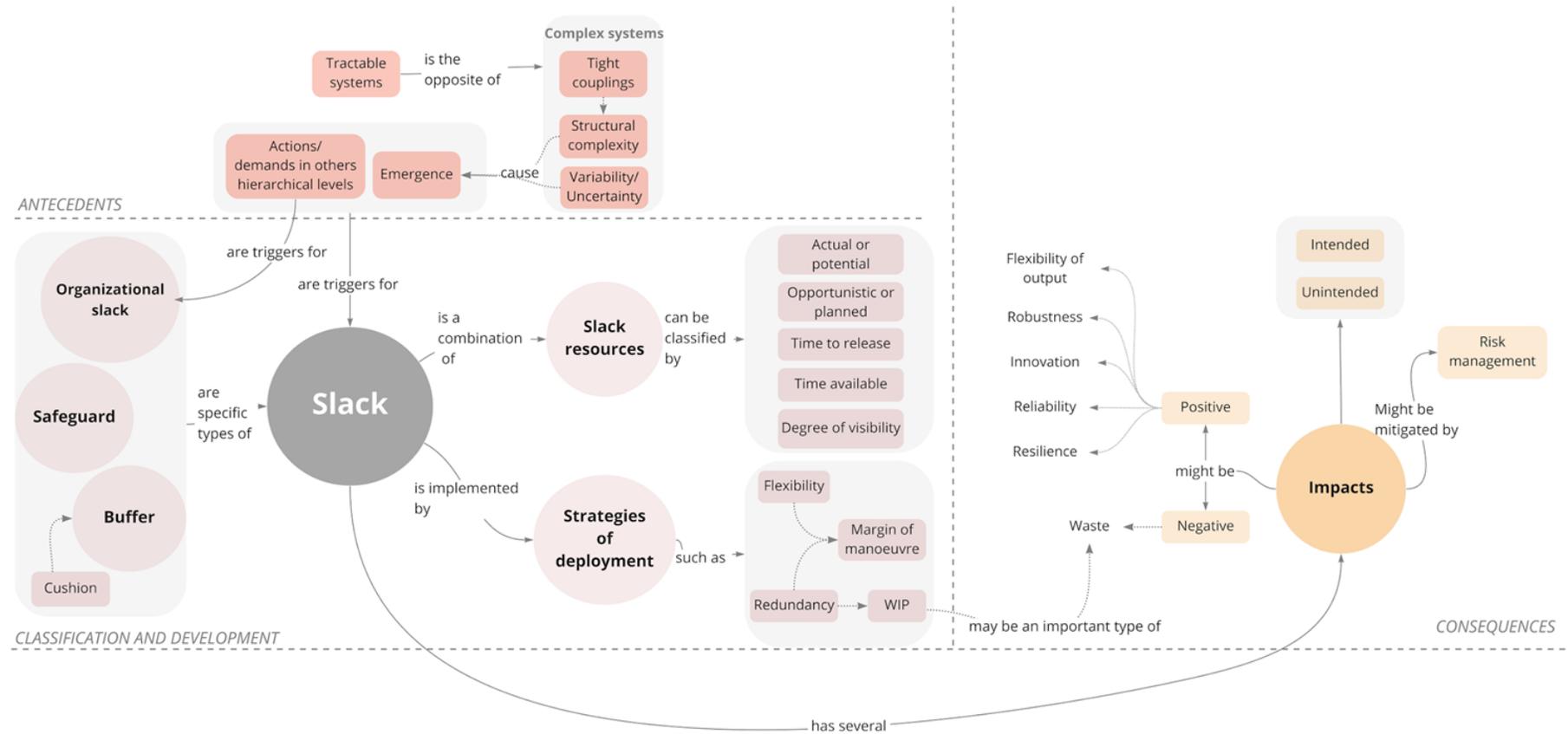
AIM OF THE STUDY

- The aim is to **develop the concept of slack and to discuss its relationships with other similar concepts**, e.g. buffer, resilience, safeguards, flexibility, and redundancy.
 - This new conceptualization assumes that construction projects must be regarded as **complex socio-technical systems**:
 - (a) Must integrate a **wide range of risk coping mechanisms** that account for **both formal and informal** approaches, across **different hierarchical levels**
 - (b) Should inspire a revision of Lean Construction practices so that they are **fit to address the growing complexity of construction projects**.

THE COMPLETE CONCEPTUAL MAP

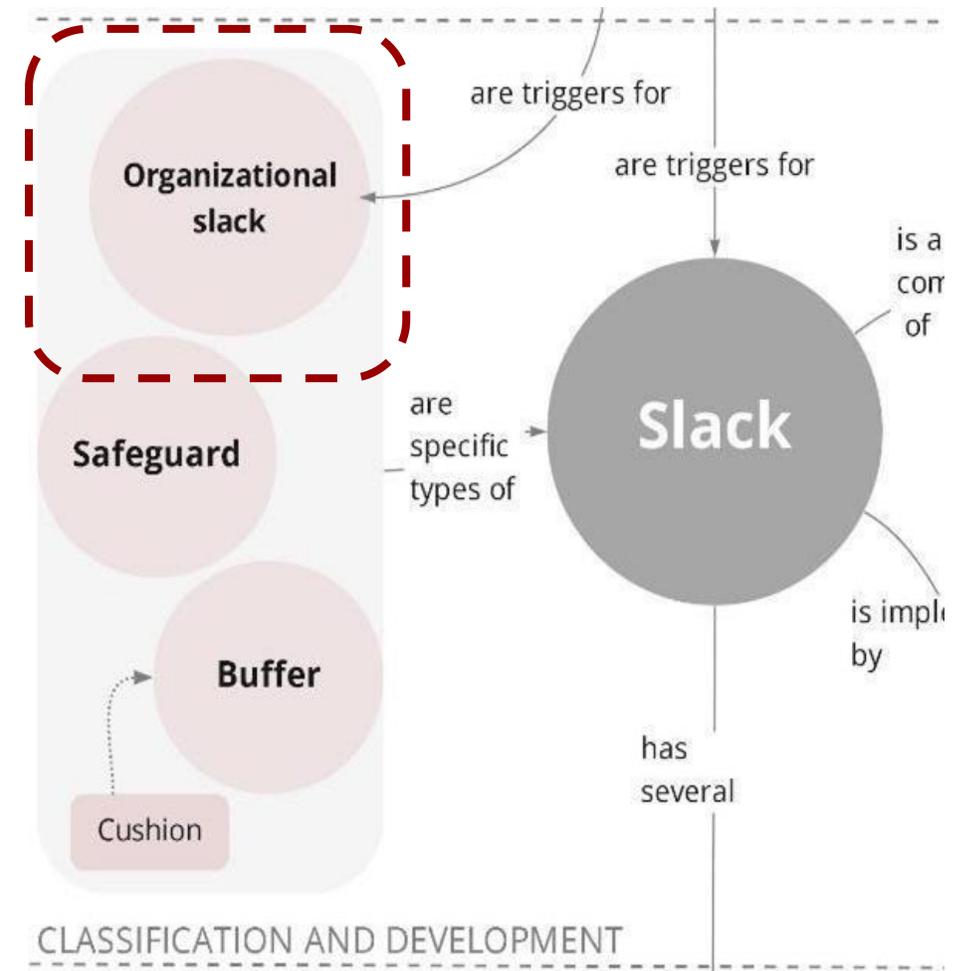
Concepts come from several disciplines:

- Engineering
- Organisational behaviour
- Innovation management
- Complexity theory
- Etc.



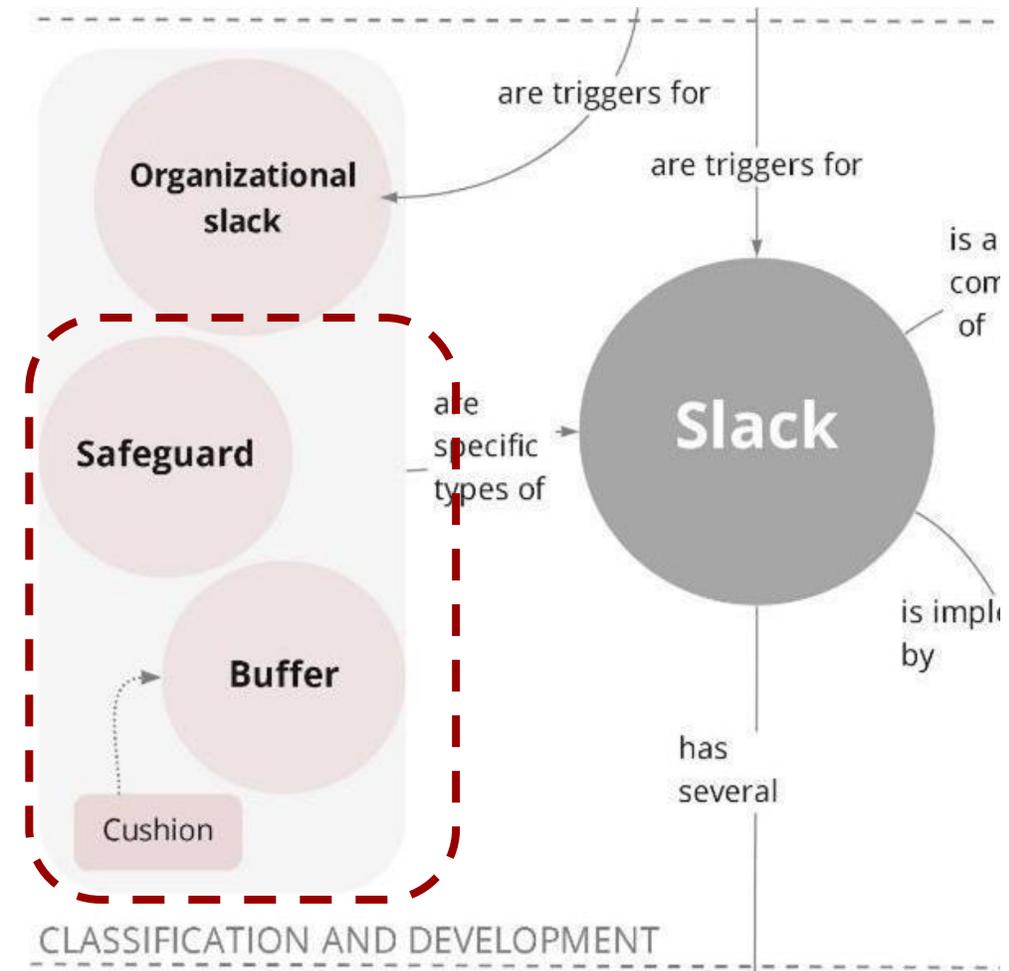
WHAT IS SLACK?

- Slack **allows an organisation to adapt successfully to internal pressures for adjustment or to external pressures for change in policy** (Bourgeois, 1981):
 - Includes protecting workflows (technical buffer), but also strategic management, conflict resolution, improvement, innovation, etc.
- Slack plays a key role by enabling people to pay attention, think, and benefit from knowledge** (Lawson, 2001):
 - Complex projects **require more, not less, time for monitoring and processing information**



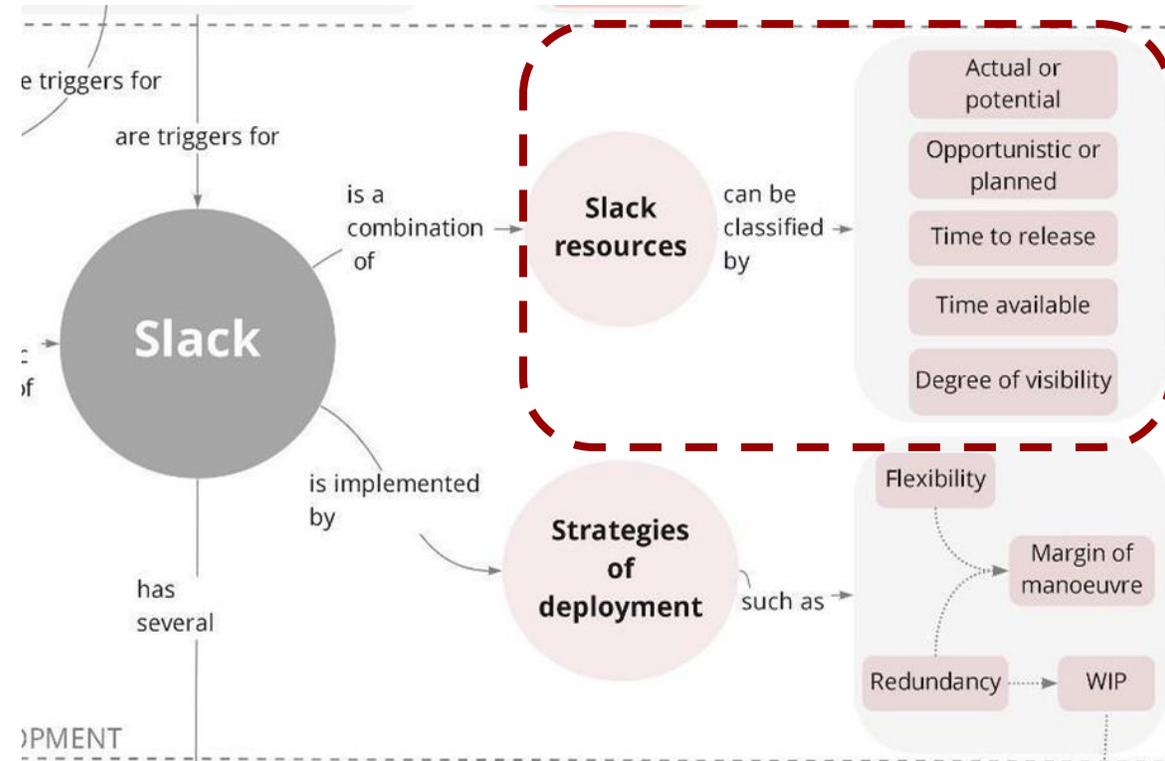
WHAT IS SLACK?

- The **narrow definition of buffer** often used in project management is similar to the concept of **technical buffer** (Bourgeois, 1981)
- **Safeguard** is a concept also used in the project management literature (especially in mega projects): **the design and physical development work for ensuring, or enhancing the embedment of an option in the project outcome** (Gil, 2007)
 - Mostly focused on work-in progress, and also on financial slack.



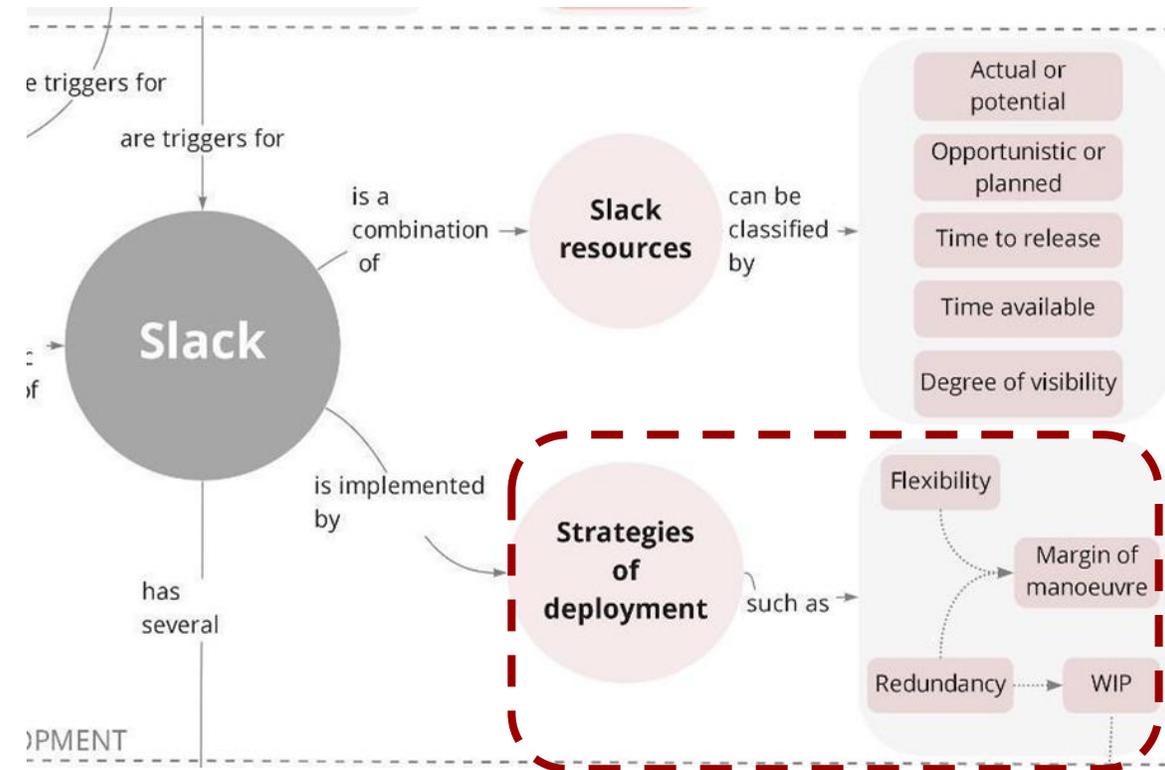
HOW TO IMPLEMENT SLACK?

- **There are different ways of categorising slack resources:**
 - Actual or Potential
 - Opportunistic or Planned
 - Time to release
 - Time available
 - Degree of visibility



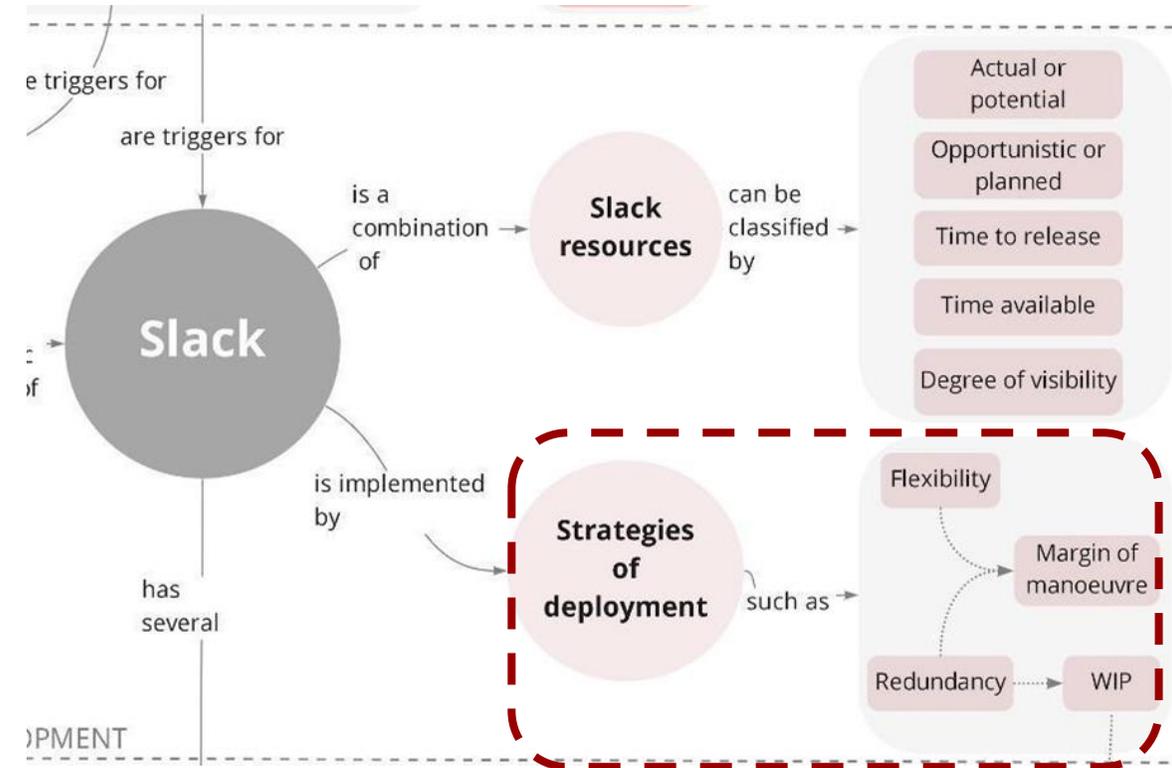
HOW TO IMPLEMENT SLACK?

- Slack strategies can be classified in two core categories:
 - Redundancy
 - Flexibility



HOW TO IMPLEMENT SLACK?

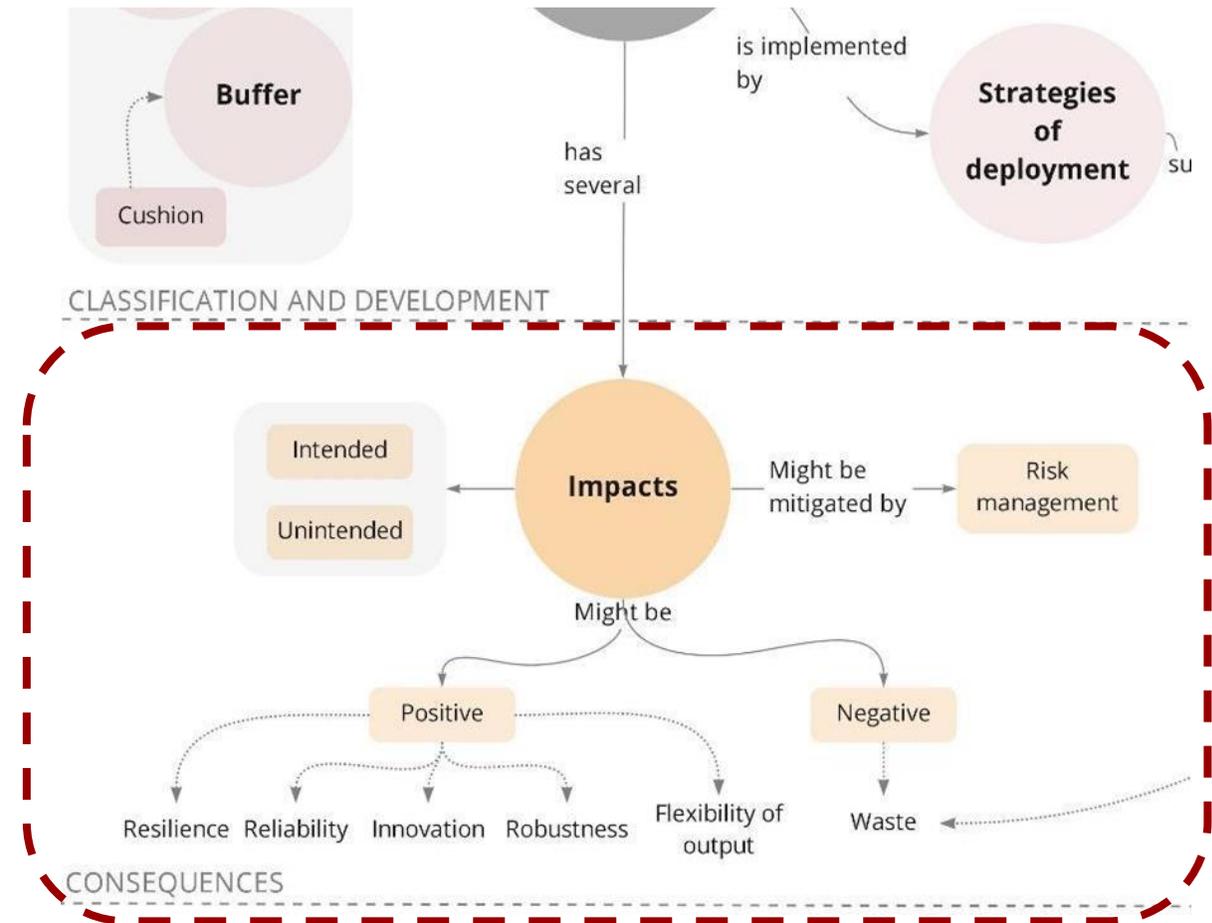
- Slack strategies can be classified in two core categories:
 - Redundancy
 - Flexibility
 - Margin of manoeuvre**



WHAT ARE THE IMPACTS OF SLACK?

• Four main categories of positive impacts of slack were identified in this investigation:

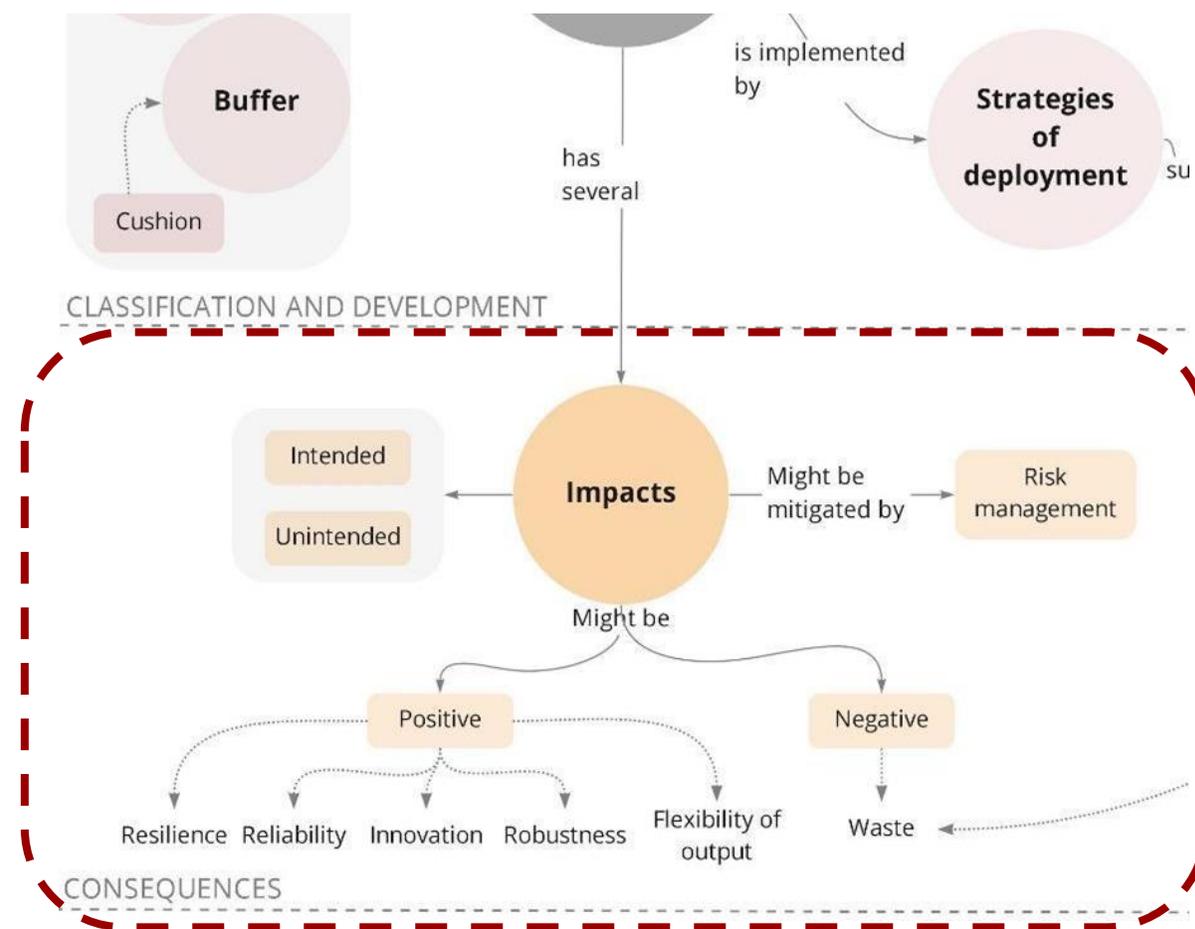
- Resilience
- Reliability
- Robustness
- Flexibility of output



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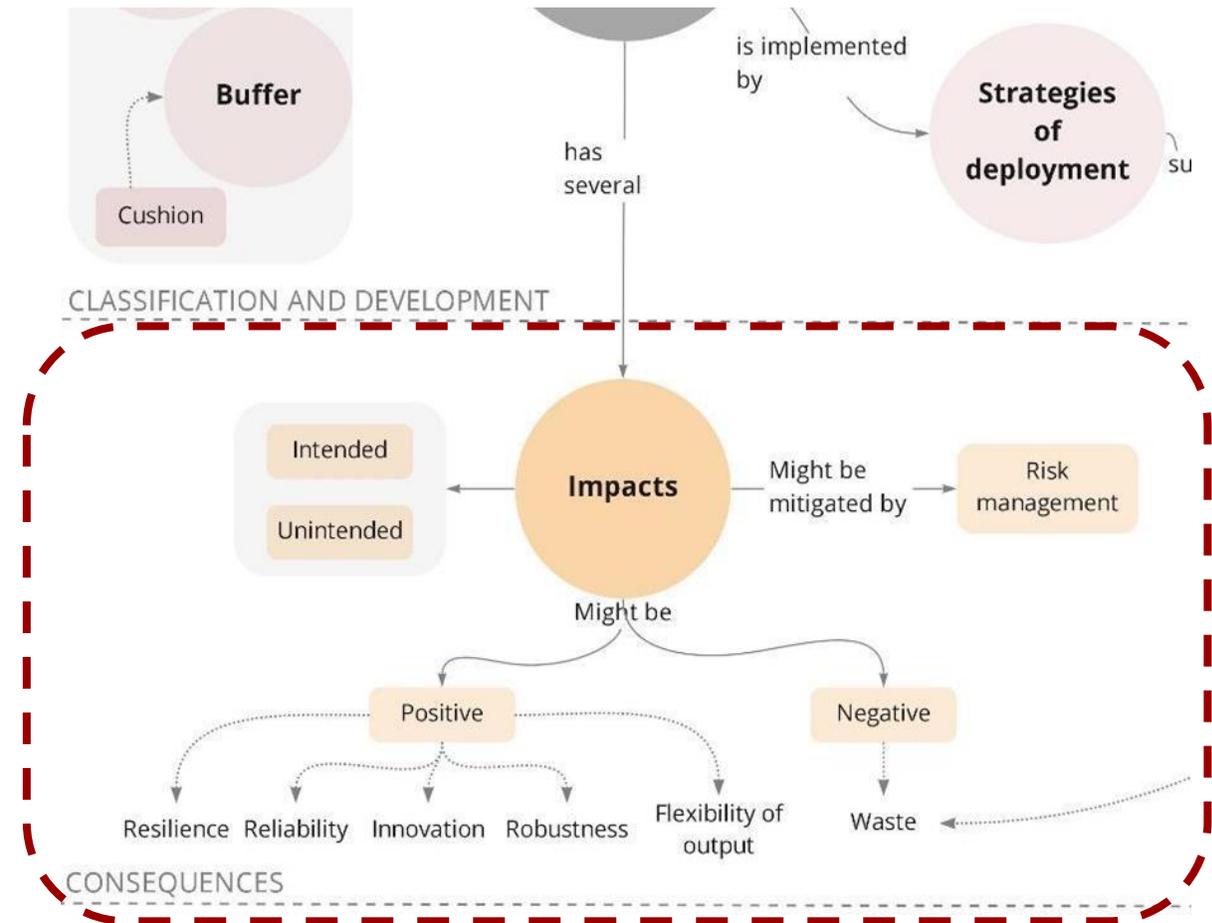
- **Resilience:** is the intrinsic ability of a system to adjust its functioning so that it can sustain required operations under both expected and unexpected conditions
- Reliability
- Robustness
- Flexibility of output



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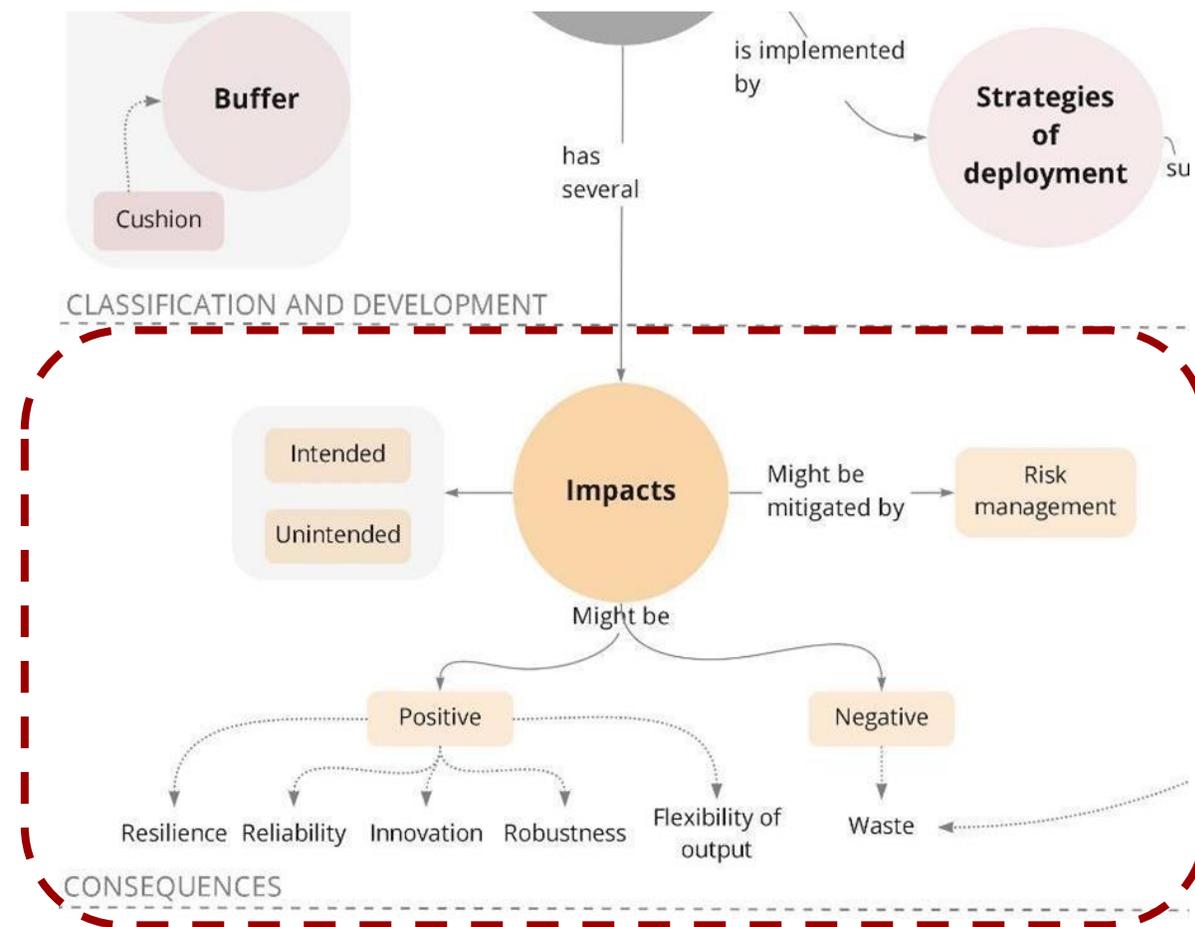
- Resilience
- **Reliability:** is the ability of a system and its components to perform required functions under stated conditions for a specified period of time
- Robustness
- Flexibility of output



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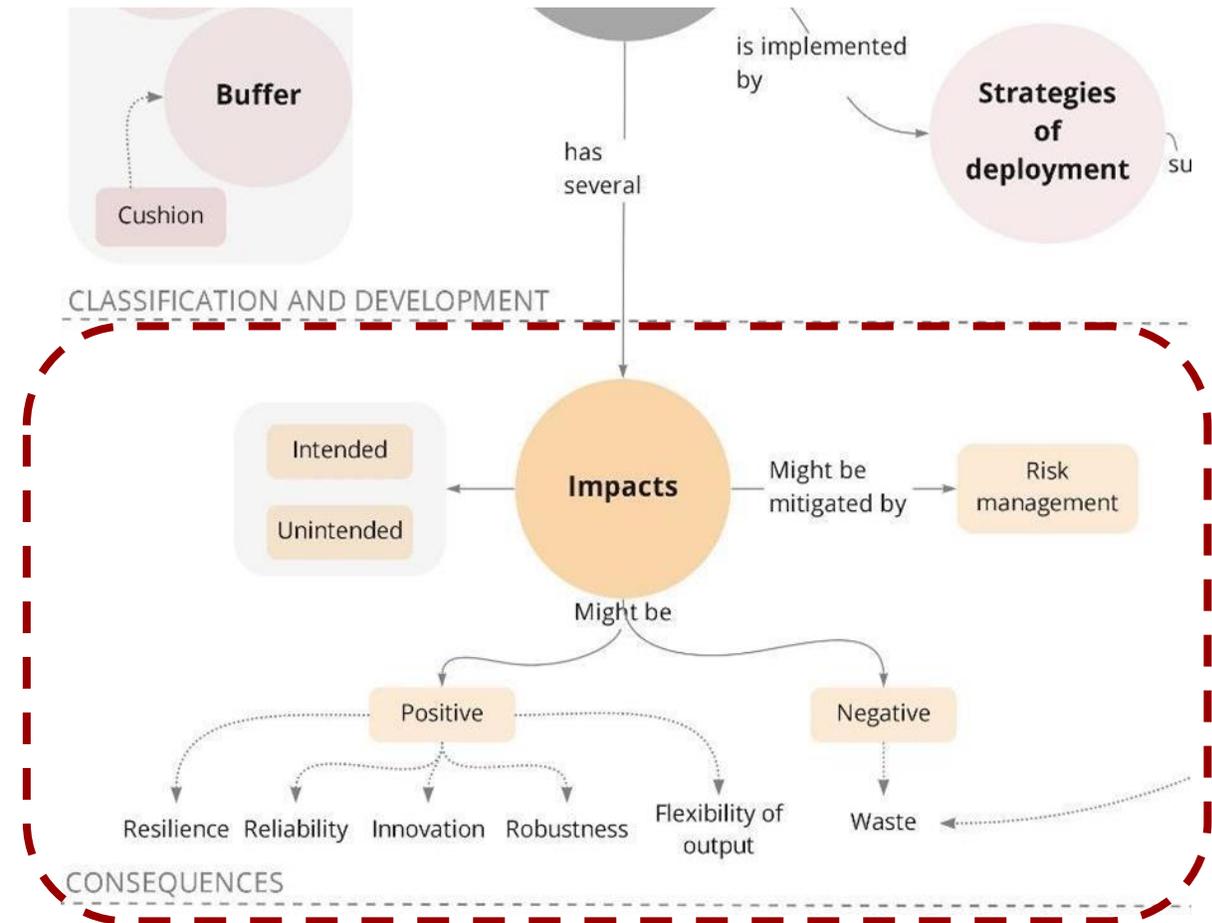
- Resilience
- Reliability
- **Robustness:** is the preservation of particular characteristics despite uncertainty in the components or in the environment. If parts of the system are removed, its behavior tends to persist
- Flexibility of output



WHAT ARE THE IMPACTS OF SLACK?

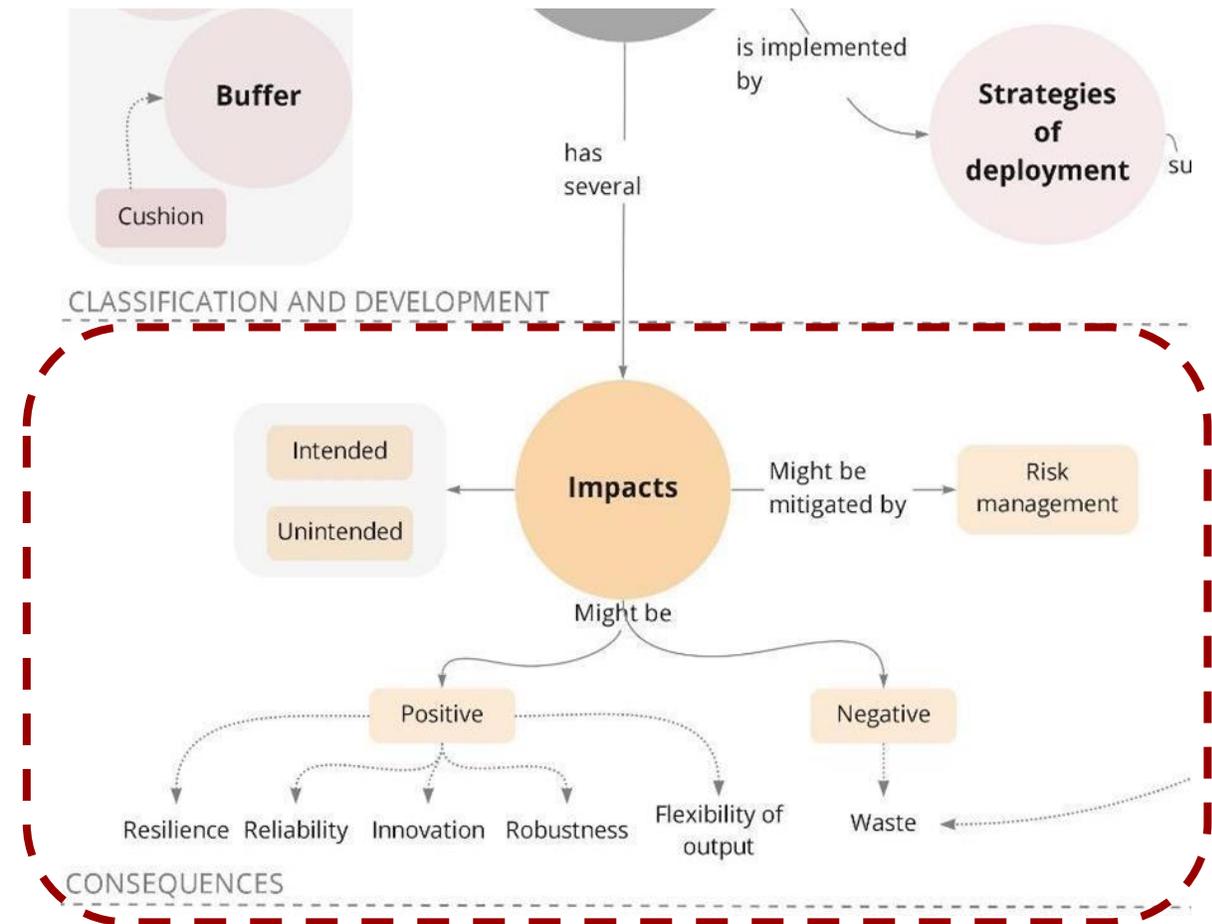
• Four main categories of positive impacts of slack were identified in this investigation:

- Resilience
- Reliability
- Robustness
- **Flexibility of output** is concerned with adapting products to fulfil specific customer requirements, without affecting system performance or cost.



WHAT ARE THE IMPACTS OF SLACK?

- From the perspective of the **Lean Production philosophy**, a negative impact of slack is the occurrence of **waste**.
- Slack** as a potential category or source of waste **should be measured and reduced**, as part of **continuous improvement** programs



DISCUSSION

- The **traditional concept of Buffer** is aligned with Factory Physics developments, i.e. a **natural science understanding of production**
- The **central problem of production is uncertainty**, which is understood mostly as flow and process variability.
- **Buffers are seen as the most important way to mitigate variability**, and mathematical models allow the optimal positioning and sizing of buffers

DISCUSSION

- The **concept of Slack** is aligned with a different conceptualization of production:
 - **Production** must be regarded **as an open, evolving system**, covering all uncertainties and risks from the environment of the system as well as the possibility of change, learning and creativity;
 - The **possibility of emergence** of new outcomes must be considered.
 - **Human beings**, with all their capabilities, must be included in the analysis; especially, uncertainty can be encountered through resourcefulness of employees or through organisational means
- This conceptualisation provides a **different perspective for the analysis and design of production systems**, by considering the impact of **different types of complexity** in construction projects.

THANK YOU!

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To be continued...

**SLACK IN CONSTRUCTION - PART 2:
PRACTICAL APPLICATIONS**

LEAN THEORY 2

15:45-16:45 (Lima Time)