IGLC 28

BERKELEY, CA 6-12 JULY 2020

28th ANNUAL CONFERENCE OF THE INTERNATIONAL GROUP FOR LEAN CONSTRUCTION

EXPLORING MISTAKEPROOFING IN HEALTHCARE DESIGN

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University of HUDDERSFIELD
Inspiring global professionals

ART DESIGN ARCHITECTURE HUDDERSFIELD

INTRODUCTION

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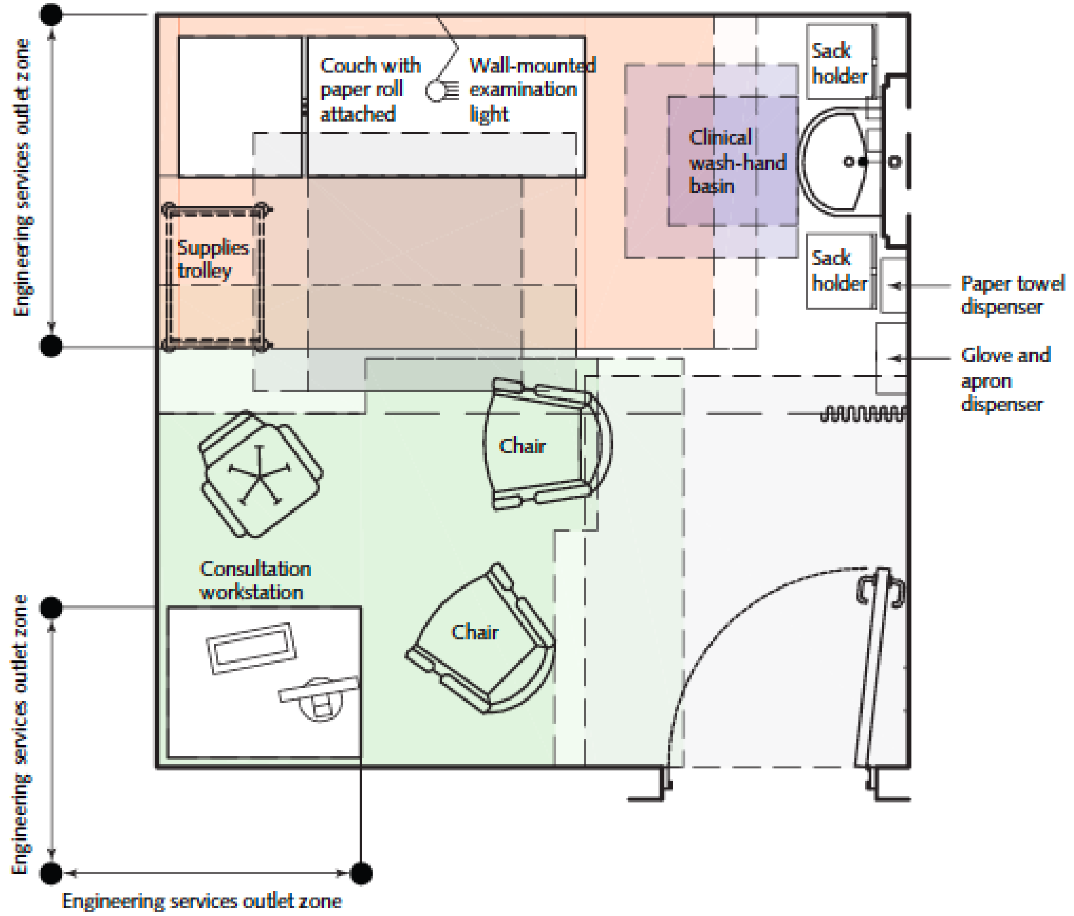

Source: HBN 00-03

Brent Emergency Care and Diagnostic Centre, North West London Hospitals NHS Trust (Photographer: Lisa Payne)

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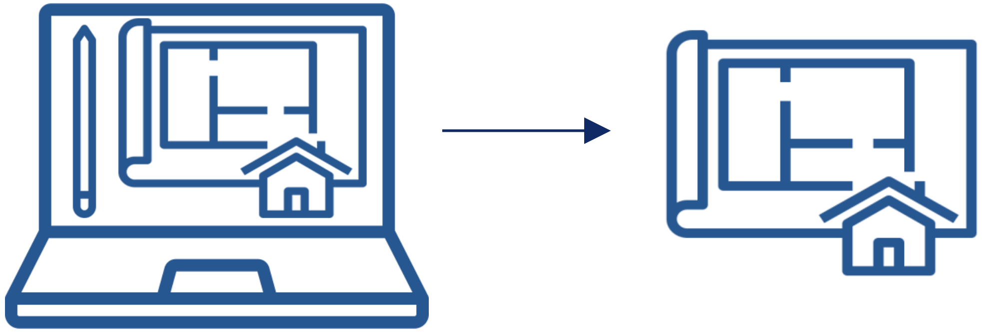
INTRODUCTION

BUILDING
DESIGN

INTRODUCTION

BUILDING DESIGN

DESIGN OUTPUT



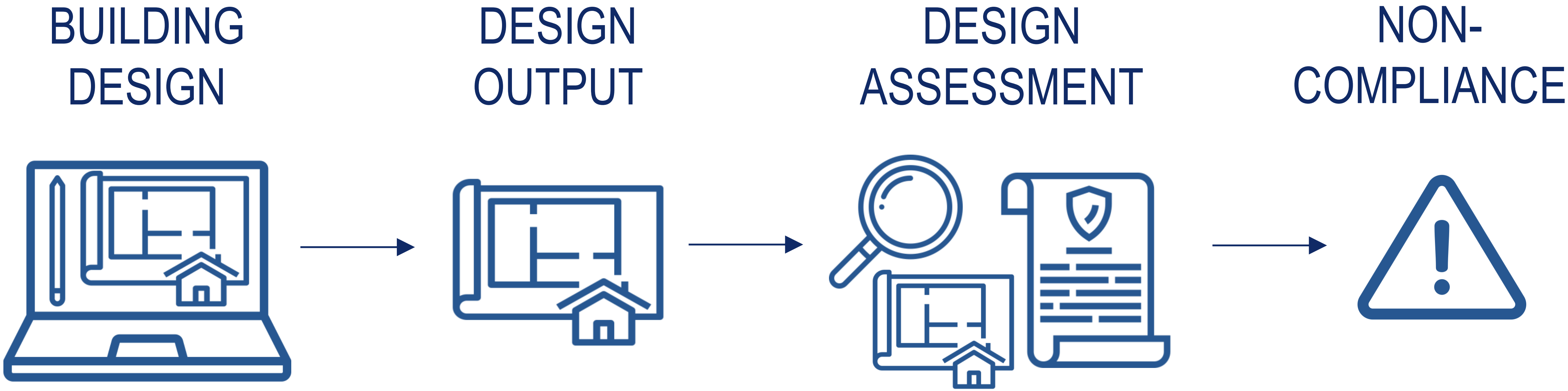
INTRODUCTION

BUILDING DESIGN

DESIGN OUTPUT

DESIGN ASSESSMENT

INTRODUCTION



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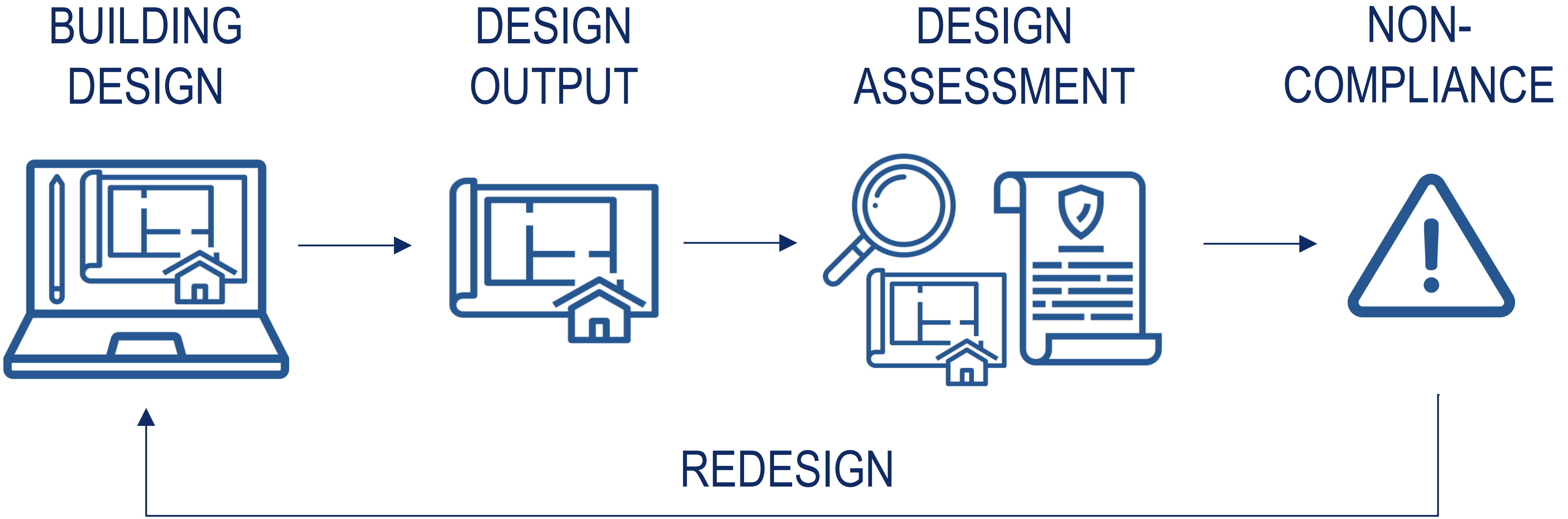

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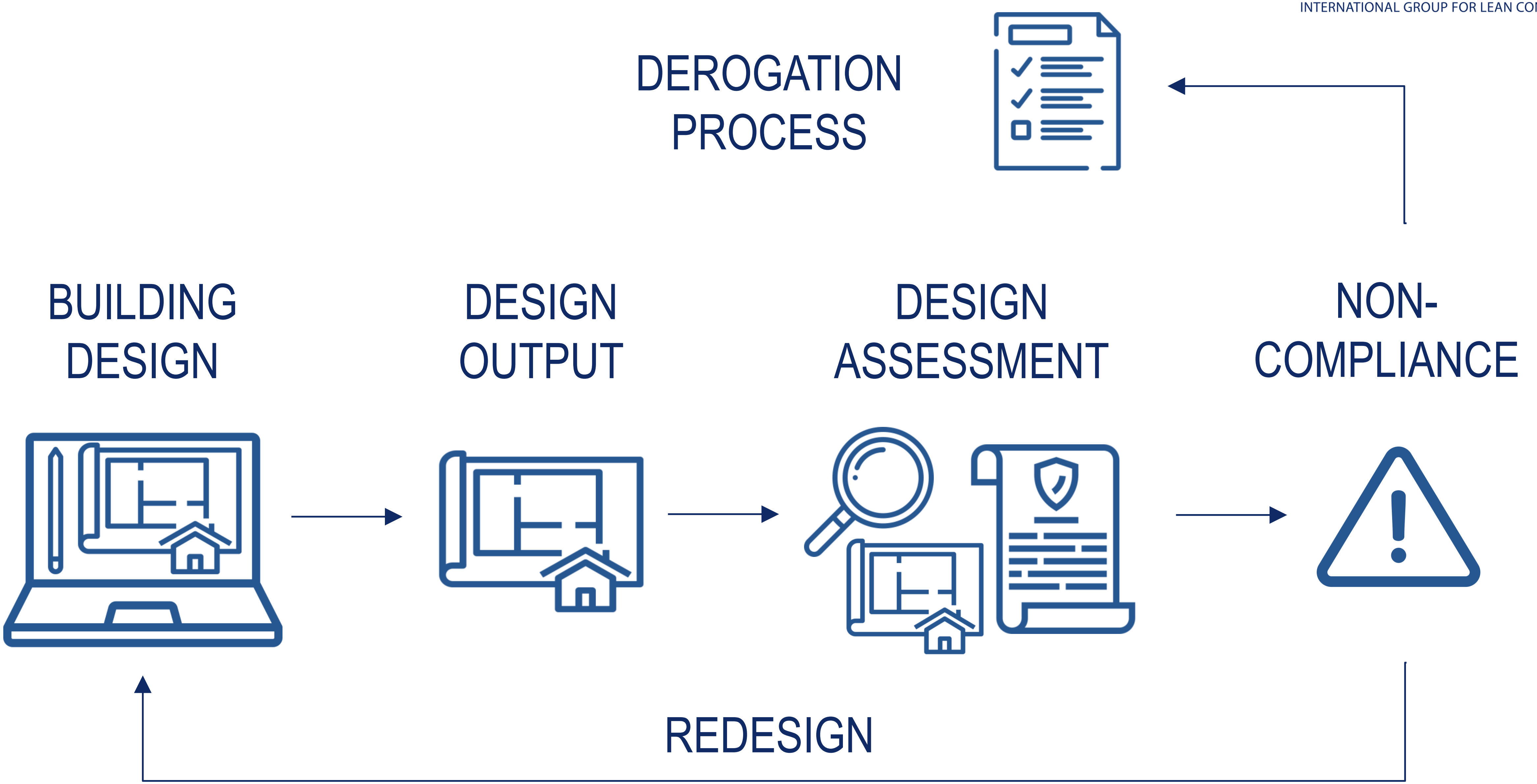

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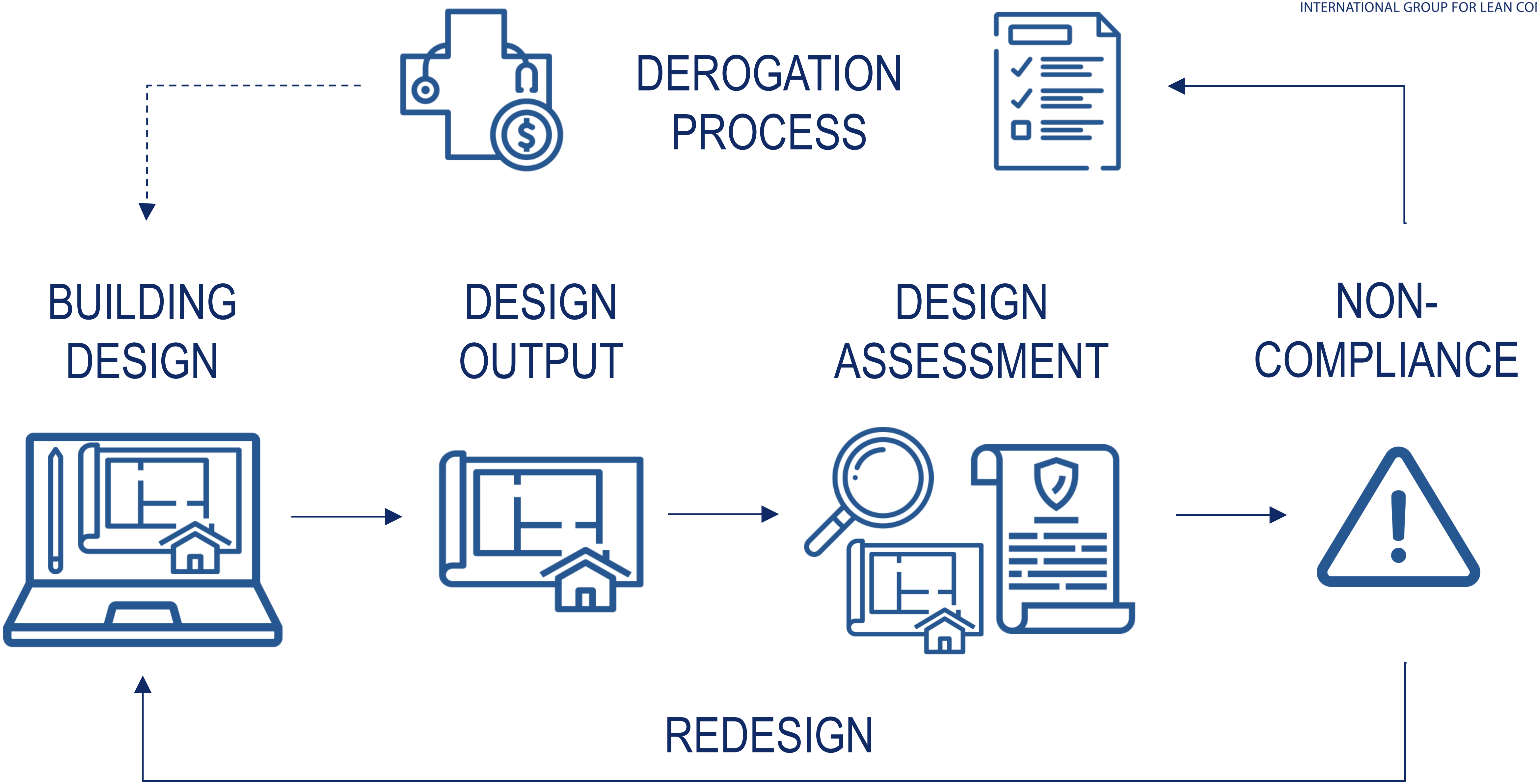

INTRODUCTION

DESIGN
OUTPUT

at the end of design

INTRODUCTION

DESIGN
OUTPUT

at the end of design

DESIGN
ASSESSMENT

independent and
isolated process

INTRODUCTION

DESIGN OUTPUT

at the end of design

DESIGN ASSESSMENT

independent and isolated process

NON-COMPLIANCE

late detection

INTRODUCTION

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at the end of design

DESIGN ASSESSMENT

independent and isolated process

NON-COMPLIANCE

late detection

rework

REDESIGN

INTRODUCTION

potential source of delay and overspending

DEROGATION PROCESS

DESIGN OUTPUT

at the end of design

DESIGN ASSESSMENT

independent and isolated process

NON-COMPLIANCE

late detection

rework

REDESIGN

INTRODUCTION

potential source of delay and overspending

DEROGATION PROCESS

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at the end of design

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independent and isolated process

NON-COMPLIANCE

late detection

can be understood as a design mistake

rework

REDESIGN

INTRODUCTION

AUTOMATION streamlines design assessment

INTRODUCTION

AUTOMATION streamlines design assessment

problematic with subjective requirements

↓

human involvement

↓

implicit and abstract requirements

(Nawari 2012; Dimyadi and Amor 2013; Lee et al. 2019)

INTRODUCTION

AUTOMATION — streamlines design assessment

HYBRID APPROACHES — degrees of automation
human involvement

problematic with subjective requirements

↓

human involvement

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implicit and abstract requirements

(Nawari 2012; Dimyadi and Amor 2013; Lee et al. 2019)

INTRODUCTION

AUTOMATION — streamlines design assessment

design support systems → mistakeproofing

HYBRID APPROACHES — degrees of automation
human involvement

problematic with subjective requirements
↓
human involvement
↓
implicit and abstract requirements

(Nawari 2012; Dimyadi and Amor 2013; Lee et al. 2019)

AIM

How existing technologies can support mistakeproofing in healthcare design (theoretical analysis).

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METHOD

DSR

ongoing PhD research

preliminary findings

Evidence from theoretical data from literature review

Results partially informed by empirical data

AIM

How existing technologies can support mistakeproofing in healthcare design (theoretical analysis).

METHOD

1. Identification of technologies to support design

2. Classification according to the principles of mistakeproofing, based on their use in design

3. Analysis of technologies and their application

DSR

ongoing PhD research

preliminary findings

Evidence from theoretical data from literature review

Results partially informed by empirical data

TECHNOLOGIES AND MISTAKEPROOFING

Prevent Occurrence of Human Mistake

MISTAKE

Minimise Effects after Occurence of Human Mistake

(Shingo 1986; McMahon 2016; Tommelein 2019)

TECHNOLOGIES AND MISTAKEPROOFING

ELIMINATE | PREVENT | REPLACE | FACILITATE

Prevent Occurrence of Human Mistake

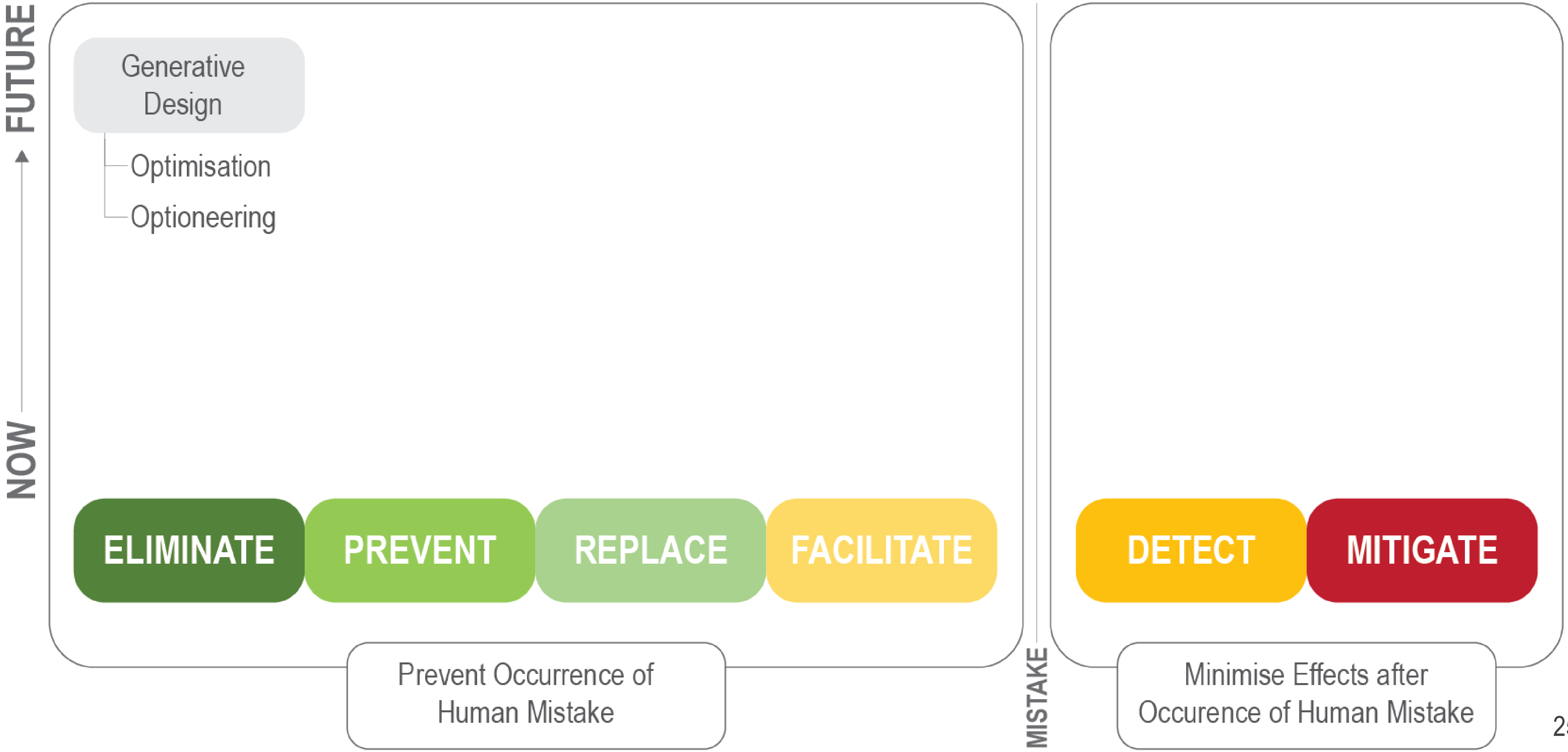
MISTAKE

DETECT | MITIGATE

Minimise Effects after Occurence of Human Mistake

(Shingo 1986; McMahon 2016; Tommelein 2019)

TECHNOLOGIES AND MISTAKEPROOFING



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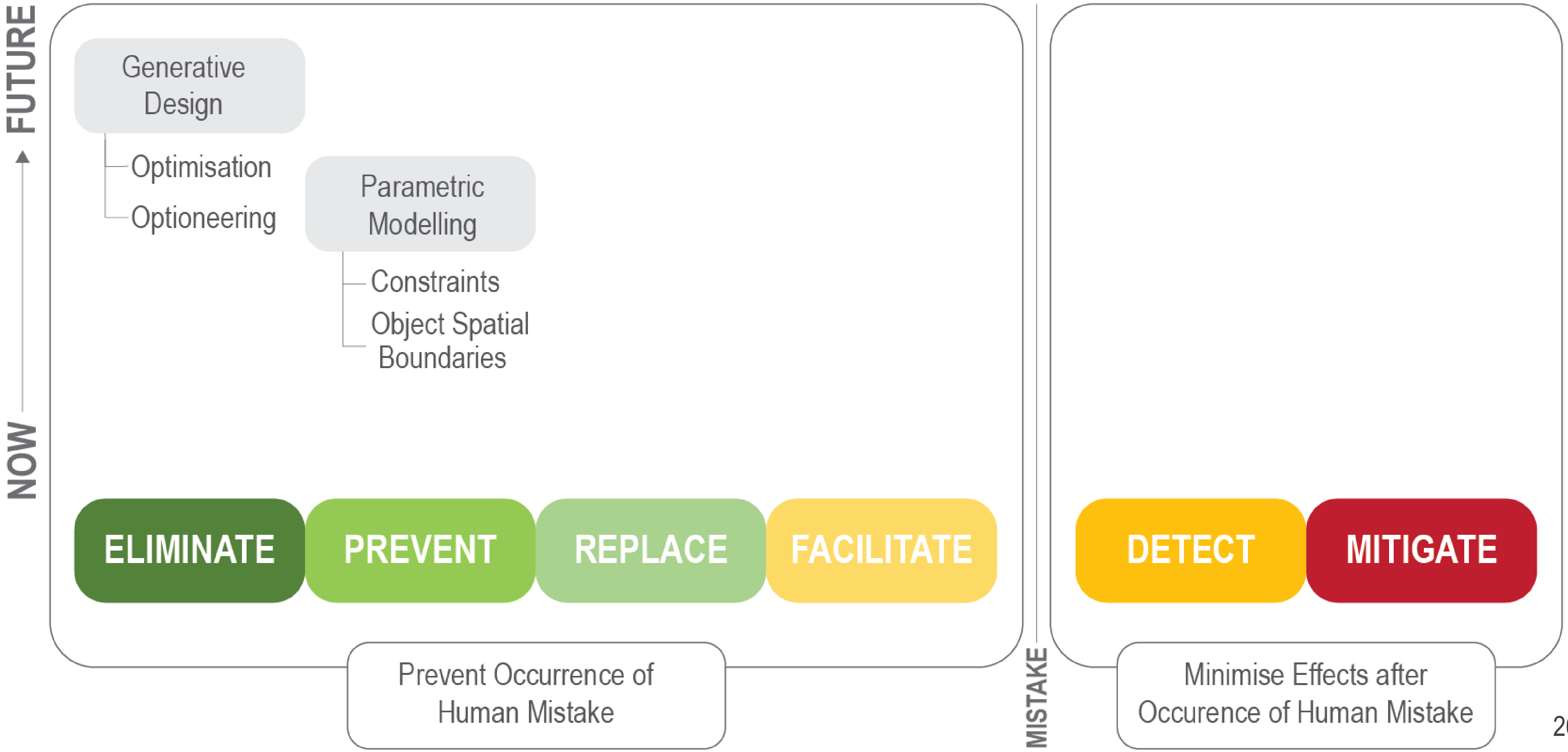

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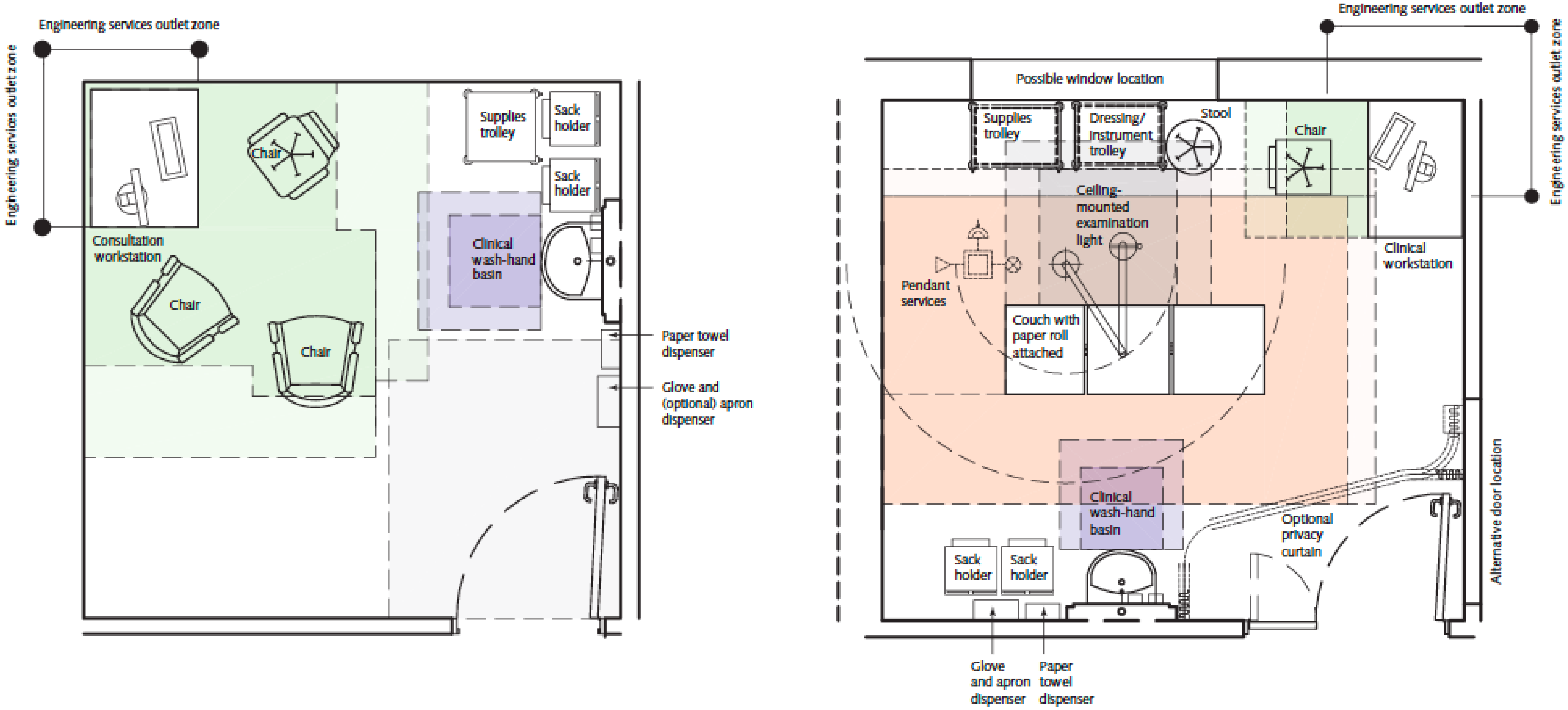

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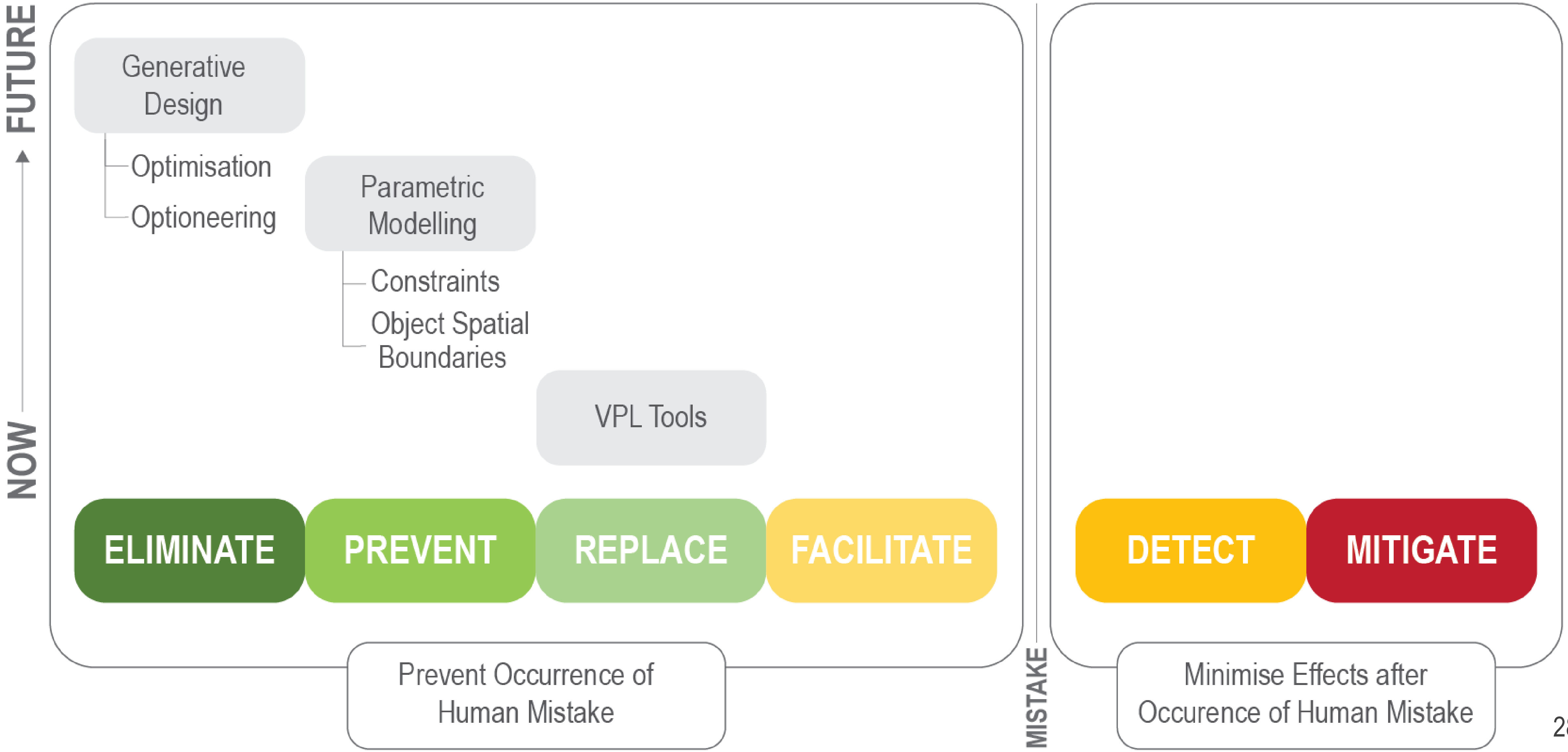

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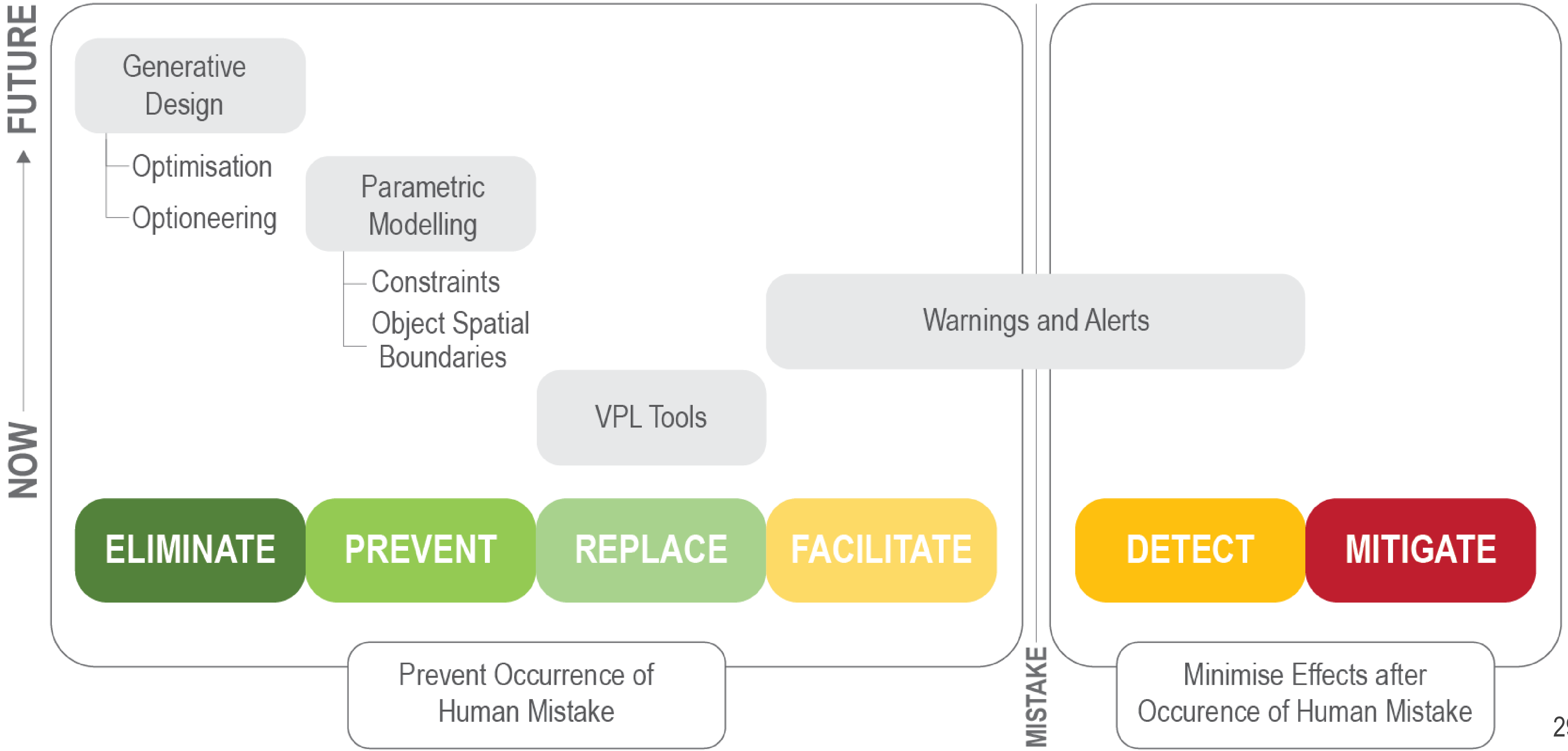

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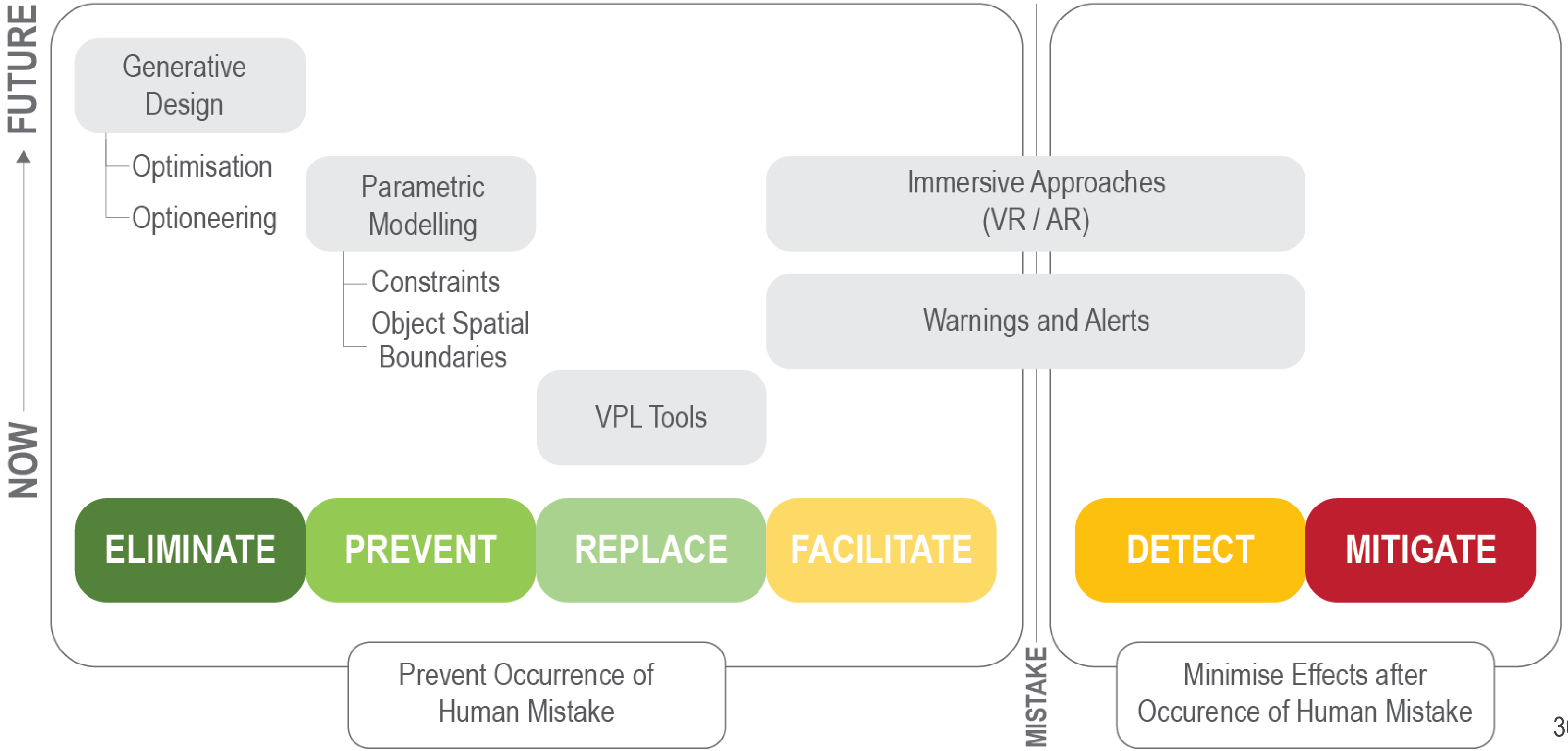

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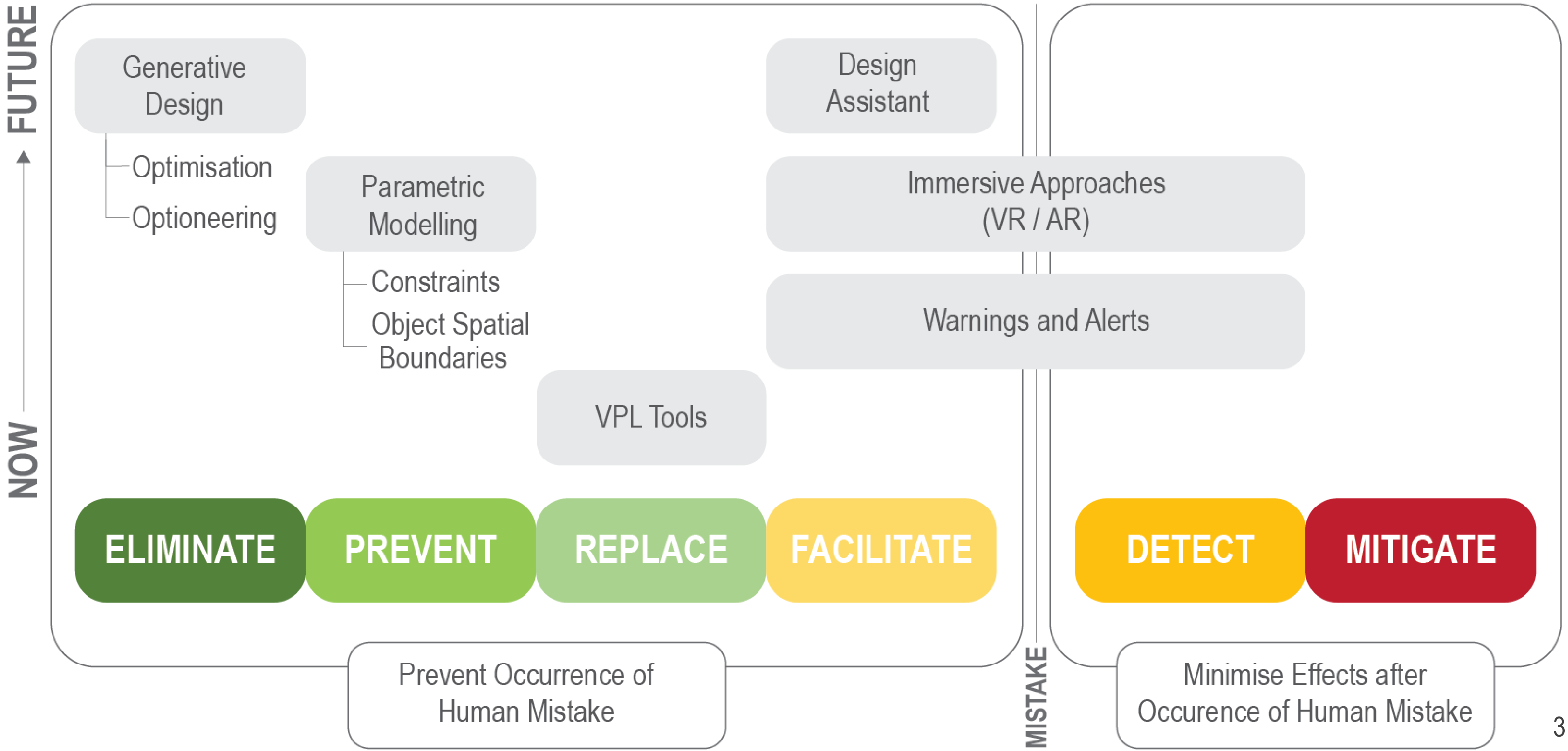

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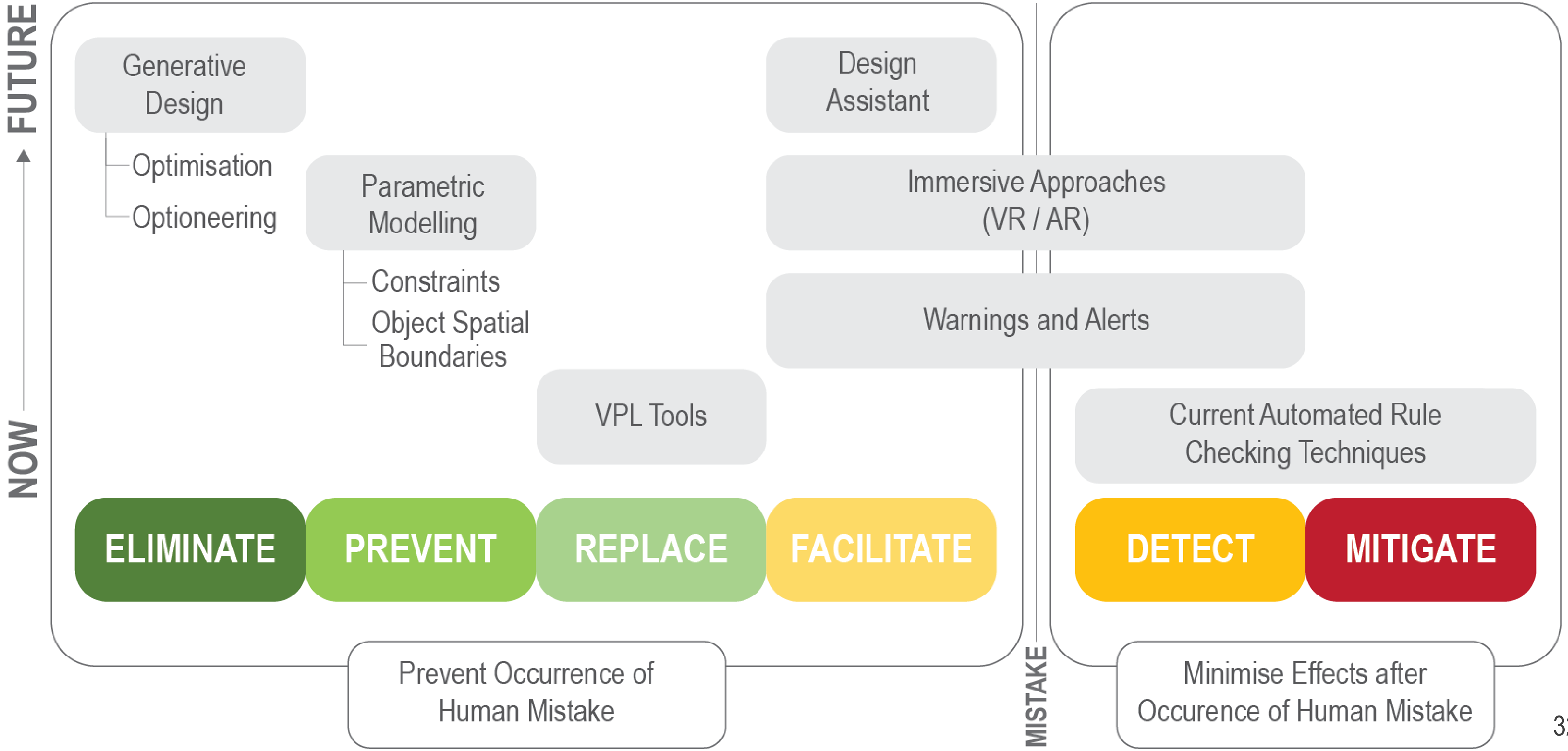


DISCUSSION

TECHNOLOGY		APPLICATION	LIMITATION
E	Generative Design	Sorting layout of floorplans based on constraint requirements of area and spatial adjacencies.	Needs pre-definition of rules and constraints to feed AI algorithms; need to be integrated with designers' workflow.
P	Parametric Modelling	A window must have a wall as a host; minimum free distances in front and on both sides of beds.	Needs pre-definition of rules and parameters to be incorporated into object families.
R	VPL Tools	Repetitive operations - including, adapting and modifying objects with repetitive parameters.	Might need further inspection depending on the accuracy of the VPL algorithm.
F	Design Assistant	Suggest where, how and why elements should be inserted; track decision-making process.	Need to excel interfaces between humans and technologies; integrate with designers' workflow and cognitive process.
F, D	Warnings and Alerts	Visually flag potential mistakes; promptly inform designers after any mistake is detected.	The amount and frequency of warnings can be overwhelming; warnings might be ignored by the user.
F, D	Immersive VR / AR	Use of VR headsets and software to walk-through the design.	Humans can feel uncomfortable while using this type of technology; depends on the quality of hardware/software.
D, M	Automated Rule Checking	Checking building models against set of encoded rules; can be isolated or continuous.	Depend on the way existing software has been developed; low adaptability and flexibility to sets of requirements.

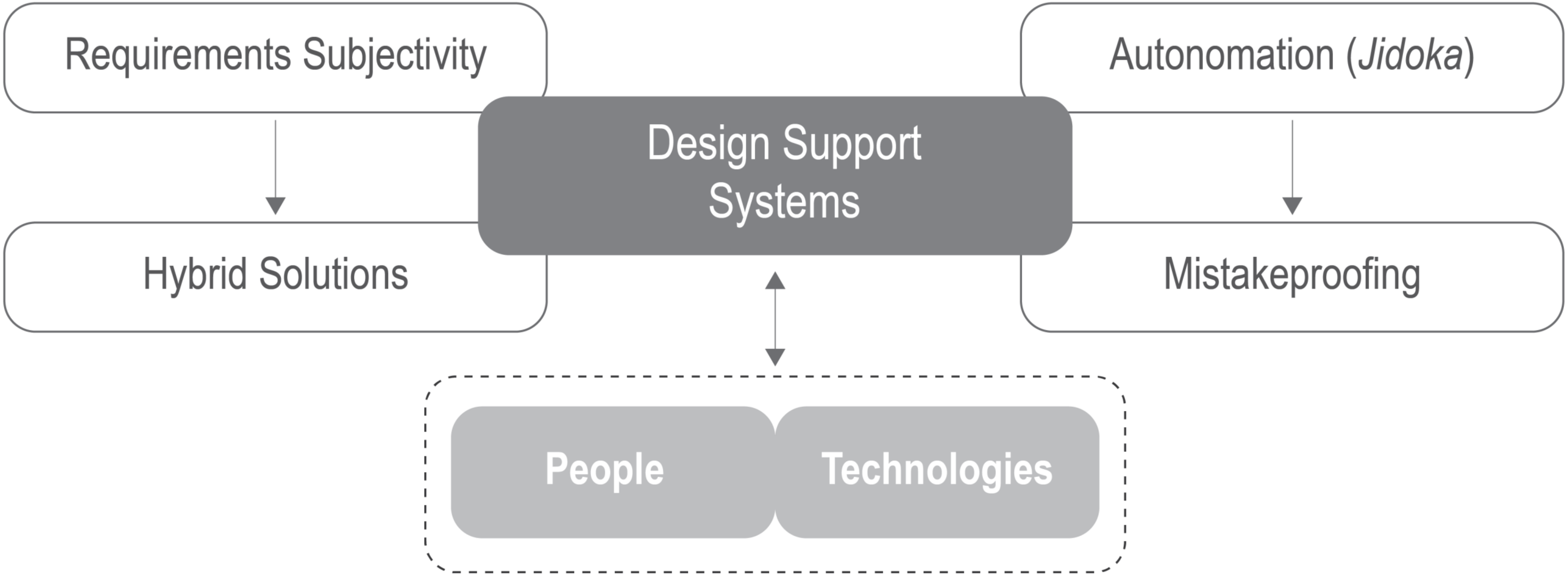
DISCUSSION

MISTAKES IN DESIGN

DISCUSSION

MISTAKES IN DESIGN

THEORETICAL IMPLICATIONS



FINAL REMARKS

It is feasible to adopt mistakeproofing concepts in design

LIMITATION
technologies were theoretically assessed
validation in design practice is needed

FUTURE WORK
further investigate and test contributions from each technology in practice

Need to understand the relationship between
human designers and **technologies**
to further explore mistakeproofing possibilities in design

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THANK YOU!

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