A BIM TOOL SUPPORTING DECISION MAKING AT EARLY STAGE DESIGN
– Towards a Transformable Architecture

ir. arch. François Denis – PhD Researcher
Buildings have a vast share in our environmental impact, including resource depletion and pollution.

Construction and maintenance initiate 50% of all material flows.

Buildings have a vast share in our environmental impact, including resource depletion, land use and pollution.

Construction and demolition result in almost 40% of all waste.

Buildings are demolished because they are not compatible with our current standards
Towards a Transformable Architecture
Concerns, mission, means
Towards a Transformable Architecture
Concerns, mission, means

We live in an age where changes increasingly lead to resource depletion and waste production.

Because most of earth’s resources are finite, we designers should use and reuse them wisely.
Our built environment is characterised as a linear process, from cradle to grave.


As an alternative we aim for closed loops, a circular process, from cradle to cradle.


Towards a Transformable Architecture

Concerns, mission, means

The structures of the built environment are never in an end state, but are rather part of a process.

Facilitating transformations is therefore vital to alleviate future impacts.
Anticipating future alterations and reducing their impact is done from the initial design, at three levels.

Design for **building** reuse
Grundbau & Siedler, Hamburg

Design for **element** reuse
Loblolly house, Maryland

Design for **material** reuse
Villa Welpelo, Rotterdam
Through various research projects a series of 23 design guidelines for transformable building have been developed and validated.

**Technical**

**Conceptual**

The table above presents an overview of the Design for Change guidelines. A breakdown by scale (element, building, neighbourhood) and by theme (interfaces, sub-components, composition) makes it possible to establish a comprehensive and clear qualitative assessment of the design and construction of a building.
Towards a Transformable Architecture

Concerns, mission, means

What if changing only a few small details would allow to design buildings facilitating change.
Decisions made early in the design phase have as significant impact on the final result.
Spatial Composition is made quite early in the design process.

Is it possible to quantify the versatility of a building?
Some buildings seem to pass the test of time

_Herenhuizen or gentry housing (Belgium)_

_Hausmann style apartments (Paris)_
Generality is an indication of the extent to which a building is independent of change.

**Generality** is an indication of the amount of potential functionality a building has without making changes to it.

Versatile building layout

Natural ventilation

IBA Grundbau und Siedler, BeL Architekten, Hamburg
Generality is an indication of the extent to which a building is independent of change.

Potential

Passive capacity

IBA Grundbau und Siedler, BeL Architekten, Hamburg
Some buildings can adapt to changing needs.

Solids IJburg - Amsterdam, NL
Adaptability is an indication of the extent to which a building can adapt to changing requirements or needs.

**Adaptability** is an indication of the ease of changing sub-assemblies in order to increase functionality

Remove partitioning walls

Update building skin

Solids Ijburg - Amsterdam, NL
Adaptability is an indication of the extent to which a building can adapt to changing requirements or needs.

Ease if changing

Active capacity

Solids IJburg - Amsterdam, NL
Towards a Transformable Architecture
Concerns, mission, means

Develop a tool helping designers to make *better informed decisions* directly from the first phases of the project.
Towards a Transformable Architecture

Concerns, mission, means

The tool

The parameters
There is an opportunity to develop tools supporting designer at the conceptual stage


THE FEEDBACK LOOP

BUILD

MEASURE

LEARN

ANALYZE

HYPOTHESES

BASELINE

EXPERIMENTS

METRICS

Pivot / Persevere
Towards a Transformable Architecture
Concerns, mission, means

BIM and its integrated management of information and geometry allow us to optimize and compare the passive functional capacity of a building or a concept.
There is an opportunity to develop a tool providing feedback from the “available” information.

Key strategies for Transformable Buildings
Towards a Transformable Architecture

Concerns, mission, means

The tool

The parameters
Towards a Transformable Architecture

Concerns, mission, means

What makes a space polyvalent?

What makes a space comfortable?
Towards a Transformable Architecture

Concerns, mission, means

Its spatial layout

Spatial connectivity influences the adaptability and the generality of a plan

Case 1

Case 2

Figure 1.1: The relations between individual spaces (a, b, and c) affect the spatial configuration, as shown by the Justified Plan Graphs below each case. The Total Depth, listed next to each node, has higher values in the second case. (image adapted from Hillier, 2007, p. 24)

Accessibility Connectivity

Geometric tools allow to quantify and analyse the adaptability and generality of building plans

SAGA - Spatial Assessment of Generality and Adaptability

*Figure A.1:* SAGA-SA analysis of Paduart’s apartment type A. There are no general spaces ($G_{sa}=0$). Adaptable spaces (the living room and kitchen) cover 70% of the surface area ($A_{sa}=0.70$). These could be extended to include the bathroom ($PA_{sa}=0.06$).

The transposition of this kind of tool in BIM allowed to automate the process and provide a feedback to the user.
Towards a Transformable Architecture
Concerns, mission, means

Its dimensions, its proportions
The proportion and the shape of spaces influence the building’s versatility

Le Modulor - Corbusier

The proportion and the shape of spaces influence the building’s versatility

Andrea Palladio - Seven Ideal Plan Shapes for Rooms

The proportion and the shape of spaces influence the building’s versatility

A stretched space is more dynamic

A compact space is more static

The proportion and the shape of spaces influence the building’s versatility

Andrea Palladio - *Determining the Heights of Rooms*

The proportion and the shape of spaces influence the building’s adaptability and generality.

Dimensions
Proportions

Length/ width ?

Perimeter / Area

$P^2/A = \text{ratio}$
Towards a Transformable Architecture
Concerns, mission, means

Qualitative potential
Quality and comfort of a space influence the versatility of a building

A **qualitative** space is more likely to be preserved or reused
Quality and comfort of a space influence the versatility of a building

Towards a Transformable Architecture

The tool will allow to assess and compare a project (its spatial layout, dimensions and qualitative potential) and to determine its versatility.
Towards a Transformable Architecture

Once, the passive qualities of the building developed, the designer can decide to go further and increase the potential of adaptability or transformability of the building.
Towards a Transformable Architecture

Using information that is already implemented in the BIM to provide feedback to the user and allow him to make « Better Informed Decisions »
Therefore, buildings are designed to **allow change** and reduce their future impact.


Towards a Transformable Architecture

« Your task is not to foresee the future, but to enable it. »

Antoine de Saint-Exupéry