Modularization in Construction

Anders Kudsk
NCC Danmark A/S
M.Sc., Ph.D.
Head of Sektion, Innovation and Koncepts
Anders Kudsk

Ph.D. Modularization in the construction industry - from a system deliveries and Mass Customization approach
M.Sc. Civil Engineering
Skilled joiner

NCC - Development
Automated Production, 3D Concret print
3D/ BIM/ VDC
Projektweb
Data Onsite
Calculation
Strategies
Platforms/ Koncepter
Agenda

- NCC in brief
- Characteristics of larger construction projek
- Modules in historical buildings
- Platforms in NCC Danmark A/S
- The Modularity Assessment Matrix
- Configuration with Parametric Design - Example
NCC in brief
NCC’s markets
NCC 2017

Sales
SEK 54.6 Billion
€5.3 Billion

Employees 17,800
Five specialized business areas

NCC Industry
NCC Infrastructure
NCC Building Nordics
NCC Building Sweden
NCC Property Development
We...

...are one of the largest residential construction companies in the Nordics

...have a strong and profitable local business
Storage and Logistics
Swimming facilities
Office buildings
Hospitals
Sustainable refurbishment
Shopping centers
Indoor sporting facilities
Residential
Characteristics of larger construction projek

- National Markets - Customers and Suppliers
- National (municipality) regulation
- Large products + 10mio. €
- Price ~ 1.5€ / kg
- Unique products
- Strong individual customers
- Systemic not modular
- 100 years lifetime
Modules in historical buildings

[Bertelsen, 1997]
Modules in historical buildings

[Engelmark]
Platforms in NCC
”Danske Kontorhuse” – History

Basic Model

NNIT

2009

2010
NCC "Danske Kontorhuse"
Fourteen projects on the same platform – different architecture
NCC ”Danske Kontorhuse”
Different projects based on the same platform

Flintholm Company House
Teglholmen
Cph Port Company House
ATEA
NNIT

+225,000 m2 office space ⇒
cost savings of 15%
The Modularity Assessment Matrix
The Modularity Assessment Matrix
The Modularity Assessment Matrix

- Slightly modularized product with detailed module descriptions
- Highly modularized product with detailed module descriptions
- Customized product
- Highly modularized product with loosely described modules

Top-down Approach

Low modularity  High modularity

Proportion of modules
In projects where you can use the already prepared architectural examples, the knowledge from the start is even greater, and the design time even shorter.

A project that can only exploit selected concept solutions, will give valuable experience from the incorporated individual solutions.

Starting point in the Building examples
Project with selected solutions for the concept:
Configuration with NCC’s concept solution:
Traditional Design
The Modularity Assessment Matrix

- **Bottom-up Approach**

- **Module description detail**
  - High detail module description
  - Low detail module description

- **Proportion of modules**
  - Low modularity
  - High modularity

- **Slightly modularized product with detailed module descriptions**
  - Customized product
  - Highly modularized product with loosely described modules
The Modularity Assessment Matrix

Module description detail

High detail module description

Slightly modularized product with detailed module descriptions

Highly modularized product with detailed module descriptions

Low detail module description

Customized product

Highly modularized product with loosely described modules

Low modularity

High modularity

Proportion of modules
Design proces based on platform in the car industry

Platform

Car Model based on platform

Concept

Individual building based on concept

Individual flat in a individual building

Individuel car based on model
Design process based on fixed design in the car industry

Fixed car design

Car Model* based on fixed car design

- Citroën C1
- Toyota Aygo
- Peugeot 108

Individuel car based on model

Design process in NCC based on Product

Fixed building design

Standard building based on Product

Individual flat in a standard building

* C1, Aygo and 108 is practically the same car made in corporation between the 3 companies

09-11-2018 NCC AB
The Customer Order Specification Decoupling Point

Specifications created in development processes

Specifications created in variant specification processes

- Norms and Standards
- Generic product structures
- Standard parts and modules
- Standard products

Engineer to order
Modify to order
Configure to order
Select variant

Degree of completed specifications
0% - 100%
The Customer Order Specification Decoupling Point

Specifications created in development processes

Specifications created in variant specification processes

Norms and Standards

Generic product structures

Standard parts and modules

Standard products

Engineer to order

Modify to order

Configure to order

Select variant

Traditional Construction project

Degree of completed specifications

0% 100%
The Customer Order Specification Decoupling Point

- Norms and Standards
- Generic product structures
- Standard parts and modules
- Standard products

- Modify
- Configure
- Select variant
- Engineer to order

Degree of completed specifications
0% - 100%