AI IN CONSTRUCTION

THE JOURNEY FROM “HYPE” TO PRODUCTIVITY

INTERNATIONAL CONFERENCE FOR SUSTAINABLE CONSTRUCTION MATERIALS

Building the Future - Construction Technology of Tomorrow
Course Description

The journey that firms make from "Hype" to productivity. We remove the hype, going back to the fundamentals of AI, machine learning and identifying where the real opportunities may lie. We show where AI, in its broadest definition, is applied today by firms in Design, Construction and Operations. We consider the role that the startup ecosystem and academia are playing, alongside far-sighted owners and business owners, to bring the first productive application to life, with startling business and societal outcomes.
Alain WAHA  
*Global Lead for BIM and Digital Transformation, BuroHappold Engineering*

Reporting to the Global Design & Technology Director, Alain works to implement technology initiatives. He is also works with digital startups in #proptech and Automotive. Alain joined the construction industry in 2008 after a career in Aerospace and Automotive. Alain is a regular invited speaker at Digital Transformation and industry events such as BUILTWorlds, BILT, AutoDesk University, Ecobuild, and is an advisor to the Institute of Civil Engineers digital initiative.
Learning Objectives

1. The industry Digitalization journey that leads to AI
2. How AI is already used in Design
3. How AI is used in Construction
4. What can we expect next?

The purpose of this presentation is to convey technical knowledge to the conference participants.

The presentation also contains slides with text that summarises the content of the presentation and the main learning objectives.
BuroHappold: we make the vision viable

Olympic Stadium - London

ARTIC – Los Angeles

City of Dreams – Macau
There Is No Alternative
BIM Innovation and Computational Design

KACWC – Dhahran, KSA – 2016
Louvre - Abu Dhabi - 2017
MOTF - Dubai – 2019
We are on a journey with Technology

- Peak of Inflated Expectations: 2008
- Trough of Disillusionment
- Slope of Enlightenment
- Plateau of Productivity
- Technology Trigger: 2005

© Gartner Hype curve
© COGITAL data
Full algorythmic Geometry Generation
FULL COMPUTATIONAL DESIGN

- Complex Geometry
- Drawing Production
- Data Plotting
- Analysis Model Generation
- Design Exploration
- Hand Calculation Verification
Generalizing by using Visual Programming

- CFD – wind load generation
- Civils – automatic cutoff levels
- MEP – auto cutting holes in walls
- Fire – sprinkler design and layout
SOFTWARE IS EATING THE WORLD*
Marc Andreessen (WSJ 2011)

*including AECO
How does **Design** look like in a Digital World?
PREAMBLE ON AI

It is impossible until is is done

AI is whatever has not been done yet

Once it is done, it is just advanced curve fitting

Nelson Mandela - ANC
Changed our world

Larry Tesler - Xerox PARC
Invented Copy/Paste and more

Judea Pearl – UCLA – Turing Medal Winner
Wrote the book on Causality

AI IS AUGMENTED HUMAN INTELLIGENCE
THE TRADITIONAL DESIGN PROCESS

Early stage advice

Architects plans

Thermodynamic model

Targets met?

Iterate
WHY APPROACH DESIGN DIFFERENTLY?

- 1-2 weeks per iteration
- Early stage advice is imprecise
- Targets require balancing of conflicting factors
- Optimising design is difficult due to iteration time
C A N  W E  D E S I G N  I N T E R A C T I V E L Y ?

Interactive design workshop

Engineer  Client  Architect

This would require:

- Calculating Engineering performance in near real-time
- Interactive 3D platform to visualise design options and display Engineering performance

- Test options
- Balance trade-offs
Recent research project for a London borough (OPDC)

Parametric study:

- 36,000+ dwellings simulated

Data manipulation:

- Machine learning:
  - Support Vector Regression (SVR)
  - Cross validation used to evaluate models
  - Predicted more than half a million results
USING AI TO HARNESING PRECEDENCE DATA
BUROHAPPOLD LONDON
## Using AI to Harnessing Precedence Data

**Buro Happold London**

### Table: Block Values and Current Floor Data

<table>
<thead>
<tr>
<th>Block</th>
<th>Value</th>
<th>Current Floor: 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight</td>
<td>77.8% passing</td>
<td>77.8% passing</td>
</tr>
<tr>
<td>Overheating</td>
<td>High risk: 39%</td>
<td>High risk: 39%</td>
</tr>
<tr>
<td></td>
<td>Medium risk: 50%</td>
<td>Medium risk: 50%</td>
</tr>
<tr>
<td>Lean Reduction</td>
<td>0%</td>
<td>%</td>
</tr>
<tr>
<td>1. 1B2P</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1. 1B2P (d)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2. 3B5P</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3. 1B2P (e)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4. 2B4P</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5. 1B1P</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table: 3. 1B2P (e), Baseline Glazing

<table>
<thead>
<tr>
<th>Room</th>
<th>Bedroom</th>
<th>Kitchen</th>
<th>Living rm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daylight</td>
<td>1.55</td>
<td>2.35</td>
<td>3.64</td>
</tr>
<tr>
<td>Daylight K/L</td>
<td>3.22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overheating</td>
<td>2.84</td>
<td>2.72</td>
<td>6.47</td>
</tr>
<tr>
<td>Lean Reduction</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Juliette</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Machine learning to analyse coordination issues

Real time clash avoidance and Design Coordination Support
USING AI TO IMPROVE SPACE PLANNING AND YIELDS
WEWORK NEW YORK

WeWork App
167,000 members

NUMBER OF PEOPLE IN 4 PERSON ROOM

90% with 1-4 people

Frequency of Occurrence

Number of people in the meeting room
USING AI TO IMPROVE SPACE PLANNING AND YIELDS
WEWORK NEW YORK
USING AI TO IMPROVE SPACE PLANNING AND YIELDS
WEWORK NEW YORK

WeWork App
167,000 members

PREDICTION BY DESIGNERS

PREDICTION BY COMPUTER
# data + #machine_learning = 25% greater yield

- Buildings
  - 156 offices
- Data
  - 100,000 members
- Predictions
  - 40% better designs

**wework**

- 40% better design
- $17b valuation pre-IPO

**PREDICTION BY DESIGNERS**

**PREDICTION BY COMPUTER**

COPYRIGHT © 1976-2018 BUROHAPPOLD ENGINEERING. ALL RIGHTS RESERVED
USING AI TO OPTIMISE CONSTRUCTION PLANNING
ALICE TECHNOLOGIES – SAN FRANCISCO
USING AI TO OPTIMISE CONSTRUCTION PLANNING
ALICE TECHNOLOGIES – SAN FRANCISCO

Wedding Cake Option

Towered Option

Floor by Floor to Level 2, Open Sequence after That

Adding a third elevator crew saves 1 1/2 mo
USING AI TO IMPROVE SITE SAFETY
SMARTVID.IO
USING AI TO IMPROVE SITE SAFETY
SMARTVID.IO
BuroHappold Engineering
making the vision viable
#digitally