Creating Total Value

Disruptive technologies changing asset design + delivery

Bryden Wood

14th May 2019
Problem statement: What’s wrong with *construction*?
2.5 billion more people will live in cities by 2050

Source: United Nations Department of Economic and Social Affairs
Structural + Civil Engineering
Design for Asset Optimisation
Chip Thinking®
Architecture + Integrated Design
DfMA, Systemisation + Platforms
BIM
Mechanical + Electrical Engineering
Process Facility Design
Creative Technologies
1. Start by understanding the value drivers
Financial value
- Capital cost
- Net present value
- Return on investment
- Margin
- Exposure to / managing risk
- Speed of delivery
- Operational integrity + resilience
- Residual value
- Core business value chain

Quality of design
- Brand
- Impression
- Aesthetics
- Working environment
- Flexibility / adaptability
- Flow
- Efficiency

Social value
- Environmental impact
- Impact on local communities + infrastructure
- Democratisation - spreading the economic benefit
- Providing for a social need
- Accessibility / inclusivity

Value from doing
- Education skills + training
- Collaboration
- Stretching horizons
- Systemisation
- Building capability
- Improving approaches + processes
- Moving the status quo
- Creating an information base to build on
CHIP:
A set of interacting or interdependent components making up a ‘chunk’ of the supply chain.

MODULE:
A set of interacting or interdependent components providing a supporting function to the chips.
<table>
<thead>
<tr>
<th>CHIP</th>
<th>Plant Loads (kW)</th>
<th>Diversification</th>
<th>Lighting Load (kW)</th>
<th>Diversification</th>
<th>Ventilation Plant Loads (kW)</th>
<th>Diversification</th>
<th>Cooling Plant Loads (kW)</th>
<th>Diversification</th>
<th>Misc Allowance at 50 kN/m² (kN)</th>
<th>Diversification</th>
<th>Total (MWh)</th>
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<tbody>
<tr>
<td>Storage Silo (Bulk Liquid Sorbitol)</td>
<td>0.0</td>
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<td>20%</td>
<td>0.0</td>
<td>100%</td>
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<td>Storage (RM, FG, PM)</td>
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<td>98.9</td>
<td>100%</td>
<td>127.1</td>
<td>60%</td>
<td>126.0</td>
<td>50%</td>
<td>299.6</td>
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<td>1.6</td>
<td>100%</td>
<td>2.5</td>
<td>100%</td>
<td>3.0</td>
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<td>100%</td>
<td>9.0</td>
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<td>Sil Tank</td>
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<td>Storage (Tote Storage)</td>
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<td>0.6</td>
<td>100%</td>
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<td>50%</td>
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<td>0.2</td>
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<tr>
<td>Make (Bulk Dispense)</td>
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<td>15.9</td>
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<td>2.2</td>
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<td>60%</td>
<td>0.9</td>
<td>100%</td>
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<td>Make (Pack and Fill Toothpaste)</td>
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<td>14.6</td>
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<td>75.6</td>
<td>100%</td>
<td>190.8</td>
<td>60%</td>
<td>9.7</td>
<td>75%</td>
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<td>Pack and Fill (Palletiser &amp; Shrink Wrapper)</td>
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<td>50%</td>
<td>0.6</td>
<td>50%</td>
<td>2.3</td>
<td>100%</td>
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<td>0.3</td>
<td>100%</td>
<td>1.3</td>
<td>60%</td>
<td>0.2</td>
<td>20%</td>
<td>5.8</td>
</tr>
</tbody>
</table>

### Annual Water Consumption (m³/annum)
![Graph of Annual Water Consumption](image)

### Annual Electricity Consumption (kWh/annum)
![Graph of Annual Electricity Consumption](image)

### Annual Gas Consumption (kWh/annum)
![Graph of Annual Gas Consumption](image)
Faster option appraisal

Joint decision making + accountability

Leaner contingencies through better understanding of risks

Optimised procurement

Flexible + agile solutions

Better decision making, better use of capital
2. **Never** compromise the quality of design - **achieve standardisation without relinquishing individuality.**
DfMA strategy benefit areas

- Shorter Overall Construction Programme
  - Independent of adverse weather during construction
  - Services included in trusses off-site, meaning faster installation
  - Allows equipment installation to start sooner than traditional build
  - Continued erection in winter time until -20°C
  - Building is weather-tight sooner allowing fit-out to start sooner
  - Equipment in sooner allows for validation activity to start earlier

- Certainty of Programme + Quality
  - Independent of adverse weather during construction
  - Off-site assembled, pre-commissioned MEP
  - Less material stored at site
  - Fewer operatives on site
  - Lower risk of falling materials

- Safety in Construction
  - Off-site fabrication means less congestion at site
  - Reduced working height required
  - Quality surveillance system
  - Off-site pre-testing
  - Standardised process

- Quality
  - Standardised components and processes increase quality + competitiveness
  - Reduced energy consumption during construction process
  - Reduction in concrete used
  - Reduction of construction waste
  - Optimised use of materials, recycling of waste, less noise + dust etc.

- Sustainability
  - Allows better contracting
  - Early Contractor Involvement / Relationships with experts
  - Allows competitive tendering of packages for discrete services
  - Design, Build, Maintain, Operate, Own

- Procurement
  - Allows option to service (applied to B+Q Clean Utilities, Labs etc.)
  - Parallel activity, unconstrained by other work
  - Independent of overall schedule

- Smarter Buying
  - Independent of adverse weather during construction
  - Off-site assembled, pre-commissioned MEP
  - Less material stored at site
  - Fewer operatives on site
  - Lower risk of falling materials

- Faster Sourcing
  - Independent of adverse weather during construction
  - Off-site assembled, pre-commissioned MEP
  - Less material stored at site
  - Fewer operatives on site
  - Lower risk of falling materials

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Design for Manufacture + Assembly
10% of the time
90% of the value

90% of the time
10% of the value

With thanks to
David Miller
Agree where standardisation adds most value
Components
- Trusses
- Columns
- Building Fabric
- Walls
- Ceilings
- Flooring
- Fixed furniture & equipment
- Furniture
- Architectural metalwork
- Security modules
- Waste modules
- Change modules
- Accessories

Interfaces
- Interface library – connections between standard components
- Structural connections
- Envelope to structure
- Internal fit out to envelope / structure
- Walls to ceilings

Design tools
- Sub-assemblies comprising standard components in common configurations

Packaging
- All components with packaging for shipping

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Supply chain mapping
Small, upskilled, highly productive teams
Small, upskilled, highly productive teams

- 60% reduction in programme
- 75% reduction in labour
- Cost neutral (achieves world class standards for the cost of traditional construction in emerging markets)

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- 60% reduction in programme
- 75% reduction in labour
- 2x increase in productivity
- Upskilled operatives (lower cost)
- Cost neutral (achieves world class standards for the cost of traditional construction in emerging markets)
3. **Continual improvement**, not constant reinvention
DfMA can be introduced over time

Increasing improvements in site productivity

Increasing efficiency of BIM workflows

Reduced reliance on skilled labour

- Traditional build
- Traditional build with standard interface
- Traditional build with off site manufactured (OSM) elements
- Project specific OSM
- Product
- System build
- Component build

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Evolution of an idea

GSK ‘NewWays’ 2007 → Herts BSF 2009 → Circle Reading 2009
Evolution of an idea

Gutenborg 2013

Platforms 2017
Automated construction 2018…
2004 – Pier product, Heathrow + Gatwick Airports

- 50% reduction in overall programme
- 36% reduction in cost vs. traditional
- 80% of work taken offsite
2015 – Temporary Flight Connection Centre, Heathrow Airport

- 38% reduction in overall programme
- 28% reduction in cost vs. traditional
- 75% reduction in hours on site
- Sketch design to operational facility in 12 months
- Stand closures reduced by 6 months - £1.2 million saving in prelims alone
4. Evolution of Platforms
BILLY

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14.
Platforms combine design, manufacture, and procurement principles holistically to ensure a greater degree of rationalisation and integration
A Platform-based approach to construction
Platforms manifest themselves as a ‘kit of parts’ of pre-engineered components, assemblies and products that go together in pre-defined ways.
Benefits of Platforms
Current state
Platform enabled

Integrated system comprises total construction intellectual property

Platforms + supply chain

Digital library + workflows

Supplier

Design team

Project

Assembler

Client

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“Platforms could achieve a 33% reduction in capital cost”
£785
£235.59 / m²

- Slab edge bracket: £75
- Windpost: £16
- Pointing: £8
- Slinging onto facade: £26
- Transport to site: £12
- Labour to assemble Megablocks: £18
- Cost of 10 x Superblocks using KPMG rates: £30

47.5% saving

Megablocks: £236 / m²
Precast concrete: £450 / m²

Benchmark costs for brick-faced twin wall pre-cast concrete: £400 - £500 / m²

Cost vs. precast
Requirements for single programme - often currently served by one factory

Aggregating the requirements for multiple programmes (through the use of shared components) starts to create a consistent pipeline

Eventually a level workload is created, which can be split across multiple facilities working at a known and predefined level of output
Each Industrial Revolution results in an increase in jobs.
Automated design
Platforms = RULES

RULES = Automated Design
What do we mean by automated design?
Automated Design

- different, but just as slow
- where are now
- the same, but faster
- faster + smarter
Automated design
Towards a platforms approach
Accelerated design for **Platform-based Buildings**
Select solutions rather than develop options
Optimise site layouts using a genetic algorithm
Digital assembly from a known library of components
Automated construction
Platform adopters
“The designer grants the Client an irrevocable, royalty-free, worldwide and non-exclusive licence in perpetuity to use, copy and reproduce the Materials for any purpose whatsoever.”
A platform approach means we will use digitally designed components across multiple types of asset and apply those components wherever possible, minimising the need to design bespoke components.

For example, a single component could be used as part of a school, hospital, prison building or station.

The three principles are:
1. Design for manufacture;
2. Use a Platform approach;
3. Open for manufacture, use and procurement.
Further reading

www.brydenwood.co.uk/resources/174/
Thank you.

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