

BIM in CM- Course Overview + Overview of CM

Vishal Singh

Aalto University, 28th February 2019

Learning outcomes

LO1: Understand the basic aspects and topics in construction management

LO2: Understand the systemic processes and management practices in construction projects

LO3: Recognize the role of information and knowledge management in construction projects

LO4: Familiarize with the fundamental concepts of BIM and other information systems in construction

LO5: Recognize the complexity and systemic dependencies in a construction project, in terms of products, processes and people.

Teachers

Vishal Singh



PhD (Sydney)

- Engineering Design
- BIM and digitalization
- Design thinking
- Teams and collaboration

Olli Seppanen



PhD (TKK)

- Operations Management
- Construction Economics
- Lean Construction
- Location-Based Management
- Production management

Antti Peltokorpi



PhD (TKK)

- Operations Management
- Construction Economics
- Value co-creation in business networks
- Production theories in construction

BIM Instructor



PhD researcher: Aalto University

BIM education – revisiting and reframing engineering education

BIM instructor @Aalto University

Lecturer: Kymenlaakson AMK and Metropolia AMK

Sunil Suwal

Email: Sunil.Suwal@aalto.fi

Lectures

28.2. Overview of the Course + What makes CM different? [Vishal]

7.3. IM and KM in construction [Vishal]

14.3. Design and lifecycle management [Vishal]

21.3. Planning the building project- scheduling [Olli]

28.3. Construction phase of a building project [Antti]

4.4. Design management- and digital construction workflows [Olli]

11.4. (13:15- 15:30) Exam

Exercise sessions

4.3. Overview of exercise sessions. Intro. to ArchiCAD and Trimble Connect [[Sunil](#)]

11.3. Fundamentals of BIM- **Lecture** [[Vishal](#)] + Intro. to algorithmic design [[Kane](#)]

18.3. ArchiCAD contd. [[Sunil](#)]

25.3. Solibri- classifications, checking, Information take off [[Sunil](#)]

1.4. Classifications, checking, information take off, etc (ArchiCAD/ Tekla) [[Sunil](#)]

8.4. Construction Site visit [[Antti](#)]

*All project work related to exercise sessions need to be submitted in time

Main Assignments

Assignment 1: Submit case report (teams of 2-3) on one of the listed case topics (to be provided). Report template (3000-4000 words) will be provided. Teams will supplement the report with references to technical reports and articles.

Submission deadline 22.4.2019

Assignment 2: BIM exercise as a teamwork (teams of 2-3). Submit model, drawings and a brief report (1000 words)

Submission deadline 18.05.2019

Grading

Exam- 45% (25-30/45 from material on slides, rest from mandatory reading materials)

Completion of all exercise sessions- 25% (5/25 on timely completion and attendance)

Assignment 1: 10%

Assignment 2: 20%

Grading: 5 (>85), 4 (75-84), 3 (65-74), 2 (55-64), 1 (45-54), **Fail (<45)**

Questions?

This Lecture...

What are the different types of construction projects? And, how is the construction industry changing?

What makes construction projects different to other engineering disciplines such as mechanical? What makes it challenging?

Who are the main stakeholders in a construction project? And, what is their role in different phases of a construction project?

Scope of Construction management

Planning and managing the construction project from beginning to completion

- Traditionally until handover

But also useful to know the use phase, because

- there could be follow up requirements
- there are renovation projects
- lifecycle planning is becoming part of project proposals

The question is...

- Can we approach all the projects the same way?
- If not, can there be a generic construction management practice? What are the key aspects of this generic approach?
- What phases are most critical? Where and on what should we put more time and resources?

Typical phases



Types of construction projects

- Residential
- Commercial
- Institutional
- Heavy civil
- Industrial, and
- Environmental

- Housing
- Commercial_office
- Commercial_shopping
- Hospitals and healthcare
- Schools and educational facilities
- Public services _ transport stations
- Industrial buildings
- Infrastructure projects
- Bridges, roads, etc
- Stadiums, etc
- Dams, power stations, etc
- ...

Routine Vs Non-routine projects



| | Routine | Non-routine |
|---------------------|-----------------------------|---------------------------------------|
| Scenario | Mostly known | Often new challenges |
| Techniques | Use established methods | Potentially new techniques |
| Focus/ objective | Efficiency Repeatability | Landmark, exemplar Repeatability?? |

New construction Vs Renovation projects



What are the potential differences?

- Merge modern solutions with old techniques
- Accuracy and documentation of existing parts
- **Assessing** quality of existing structures and spaces
- Cost-benefit analysis (is it worth renovating?)

...

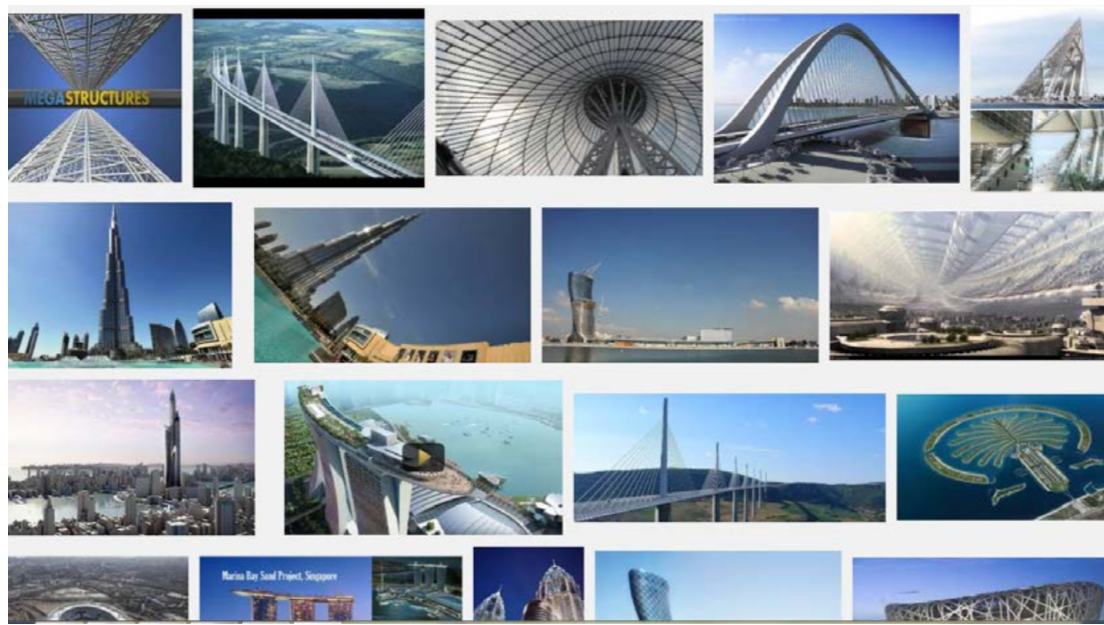
Catalog design Vs Custom Design Projects



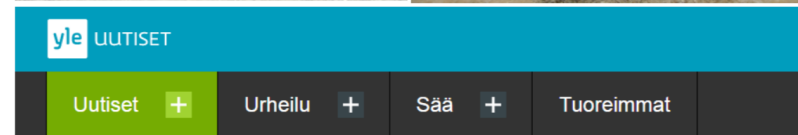
How does the CM role change with the type of project?

Which of these types are likely going to be more dominant in the future?

Megastructures!



- New technological boundaries
- Longer time period
- Extremely large teams
- International/ multi-cultural teams
- High cost/ schedule implications



UUTISET > NEWS

News 13.6.2016 19:25 | updated 13.6.2016 19:27

Helsinki Deputy Mayor: Metro expansion delay "unbelievable"

What other ways can you classify construction projects?

Does that help identifying unique requirements?

改写历史

History Rewritten

31. 12. 2011

<https://www.youtube.com/watch?v=rwvmru5JmXk>

Warm-up assignment

Type of project



| | Pre-design | Design | Pre-construction planning | Construction | Finishing | O&M | Renovation | Decommissioning |
|--|------------|--------|---------------------------|--------------|-----------|-----|------------|-----------------|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

Consider at least 5 types of projects. For each project category list the key factors to consider across each of the lifecycle phases. Present the results in a Table.

Which phases have greater variance in factors?

Grading= Complete/ Incomplete. If Incomplete then penalty of -2 marks

What makes construction sector different to other engineering disciplines such as manufacturing or automotive sector?

Basic differences

- One of the oldest sectors...
 - Everyone understands something of it! DIY is common!
- Widely varied practices globally... high dependence on local factors
- Differences across products, processes and people(?)

The focus is **project** based!

Projects: measuring success & performance

Time

Cost

Quality (?)



Constructability/ Buildability?

Customer satisfaction, value delivery (?)

Learning and application (in and from the projects)

Building as a **Product**

How is it different to other manufactured products?

OIKOTIE FLAT CARS HUUTO.NET JOBS CLEANING

FOR SALE FOR RENT LEAVE

For Sale Flat
Vacation Rentals
Garages & Warehouses
Plots
Agriculture & Forest Facilities

Flat previous

Apartments for sale

Add location or zip code ? +

Free Search ? +

Type of house ?

- Apartment houses
- Terraced
- Semi-Detached
- Detached houses
- Wooden house

Rooms

- 1h
- 2h3h4h5h
- 6h7h +

Price (€)

min max

Habitable area (in m²)

min max

autofie Used vehicles New cars Buyer's guide on the side of the road
Brand Service


Tykkää <4,2 L We like you!
Do you like us you already?

LAAKKOSELLA JAOSSA VAIHTOAUTON OST
2 000 000,00

Home > New cars

Choose your character

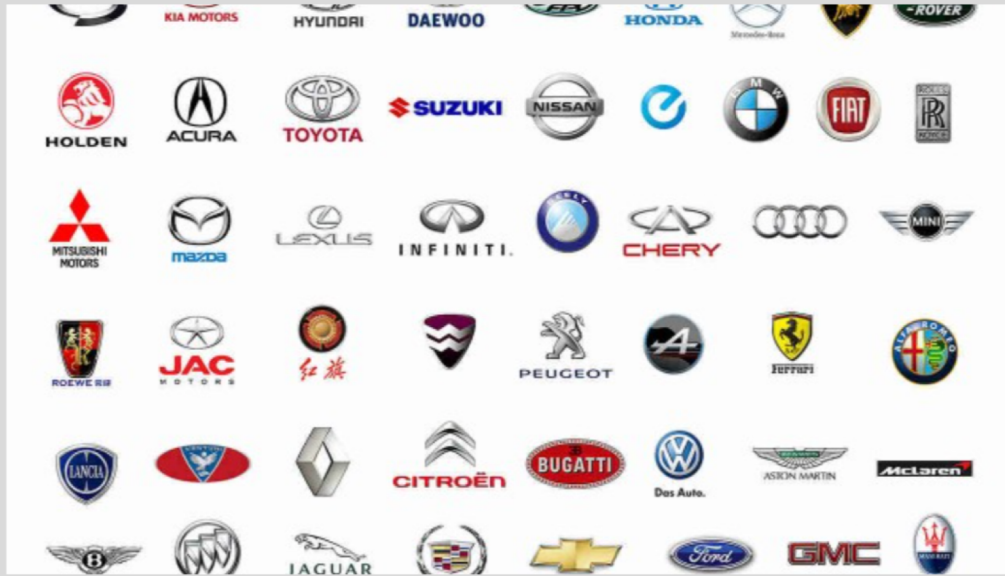
- Alfa Romeo
- Audi
- BMW
- BMWi
- Citroën
- Dacia
- DS
- Ferrari



A?

Product brand is rarely a dominant factor!

Are there any truly global construction companies? If not, why?

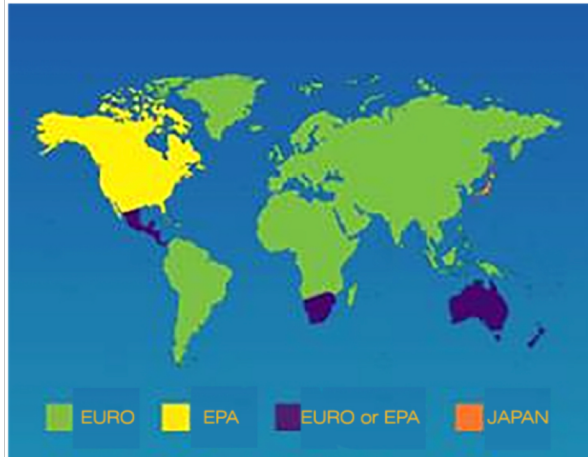


**Top car
manufacturers
in the world**

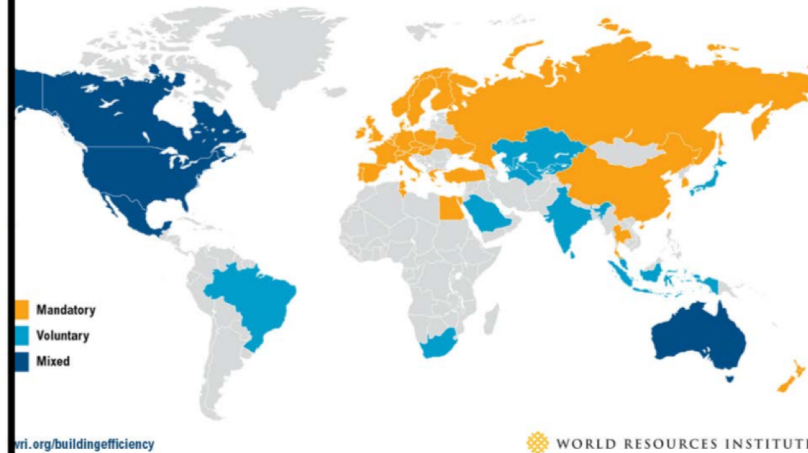
What does it mean for construction management?

Regulations and standards- example

World-over **emission regulations** for commercial vehicles is currently governed by three major legislative standards.



Global Status of Building Energy **Codes and Standards** for the Non-Residential Sector



Building as a Product

- Typically little reuse of design
- Value of Location vs building
- Unique site-location
 - Region, access, orientation, **regulations**, terrain, etc
 - Culture and legacy
- Material and local resources
- Product repurpose... function may change overtime

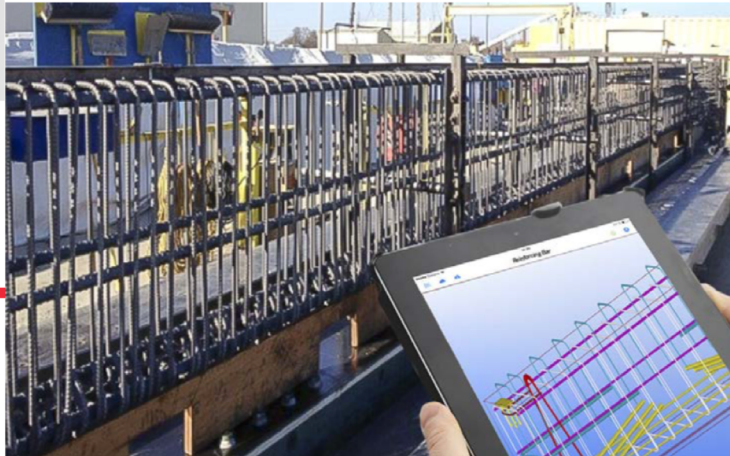
Requirements analysis: Scope?

- Often very focused on unique customers/ clients
- Who is the customer, who is the owner, who is the user?
- But we still make quite a lot of it from standard components?
- Project and resources committed by customer before delivery
 - Customer lock-in
 - Does this implicitly impact the delivered quality?

Building/ construction as **Process**

How is it different?

As-designed to As-built! **How?**



A?

Traditional Product Development Process



| Concept | Research | Analysis | Develop | Launch |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Idea Generation</p> <ul style="list-style-type: none"> ▪ Requests ▪ Customer Pain ▪ Market Studies ▪ Legislation ▪ Competitors | <p>Assess Market</p> <ul style="list-style-type: none"> ▪ Segment & size ▪ Growth potential ▪ Customer needs ▪ Legal issues ▪ Competition | <p>Business Analysis</p> <ul style="list-style-type: none"> ▪ Cost/Benefit ▪ Resources Required ▪ Capital Expenses ▪ Profitability/Margin ▪ Anticipated Sales | <p>Product Development</p> <ul style="list-style-type: none"> ▪ Technical Specs ▪ Prototyping ▪ Trial Production ▪ Testing & QA ▪ Test Market Selling | <p>Go to Market</p> <ul style="list-style-type: none"> ▪ Marketing Plan ▪ Sales Training ▪ Distribution Plan ▪ Collateral Design ▪ Set Launch Date |
| <p>Key deliverables</p> <p>Products concept docs</p> | <p>Key deliverables</p> <p>Market Research Report Market Req. Document Product Definition Statement</p> | <p>Key deliverables</p> <p>Business Case Profitability Analysis Product Req. Document</p> | <p>Key deliverables</p> <p>Product Dev. Schedule Product Testing Report Product Req. Document</p> | <p>Key deliverables</p> <p>Product Launch Plan Product Launch Budget Product ROI Forecast Target Launch Date Set</p> |

How is construction sector different?

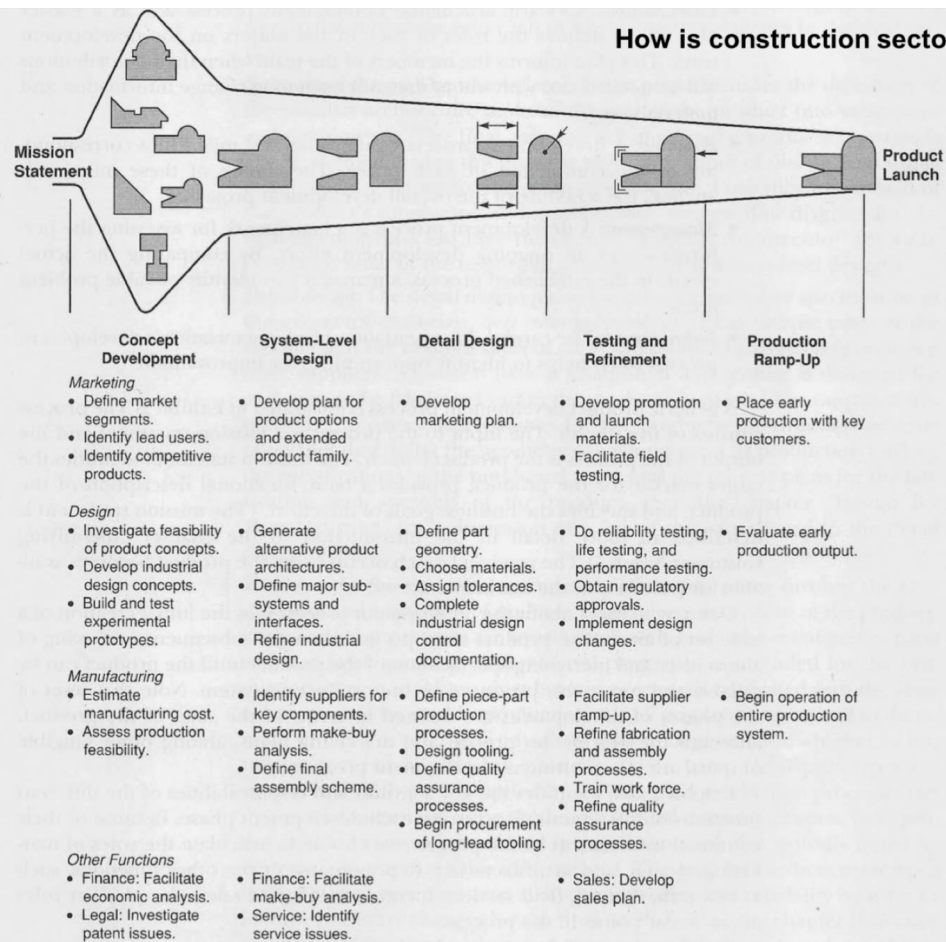
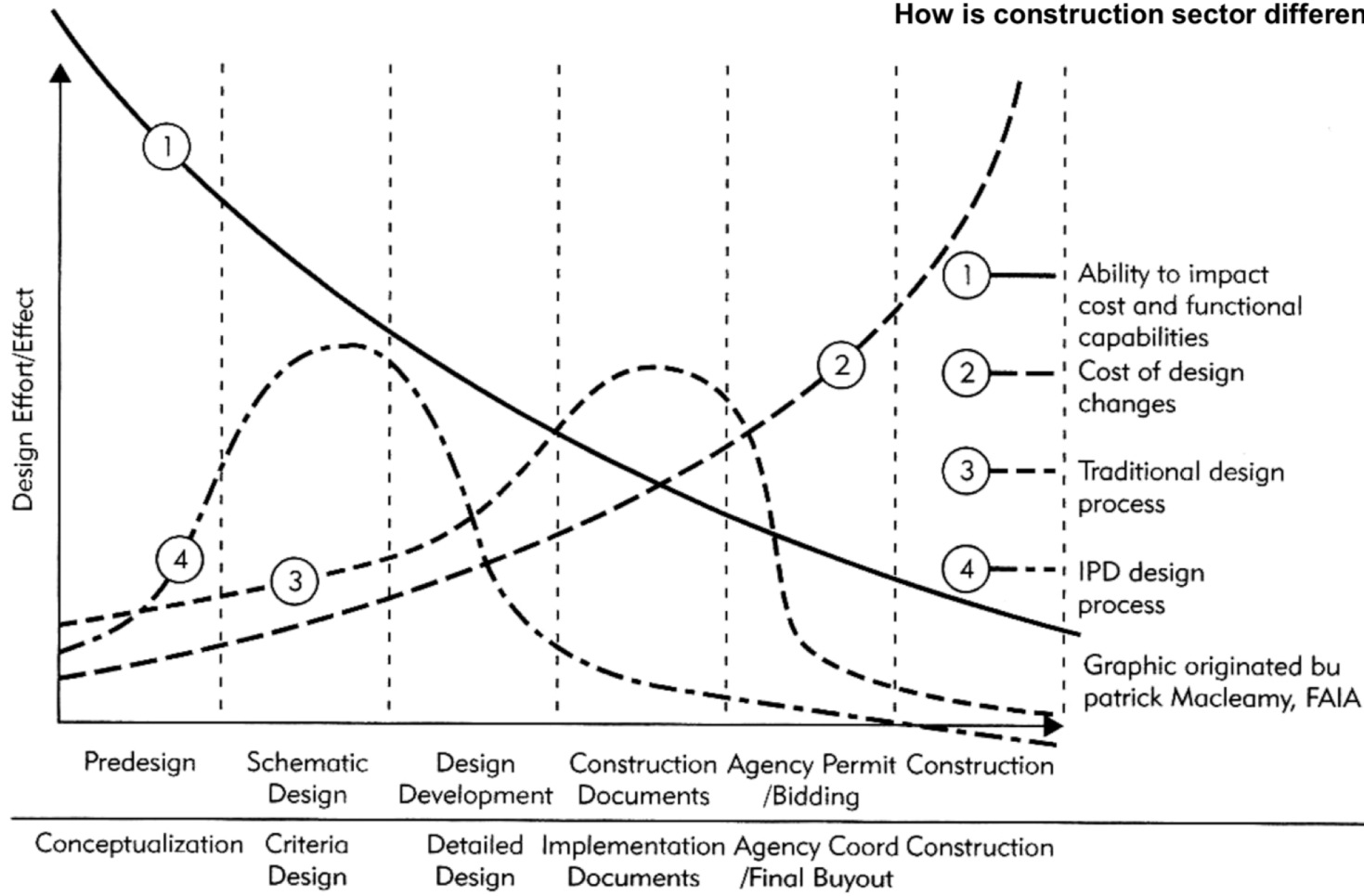


EXHIBIT 2 A generic development process. Five phases are shown, including the tasks and responsibilities of the key functions of the organization.

How is construction sector different?



Compare to Production Manager's role in manufacturing?



- Job comes to work-station!
- Production-line is well- established
- Location, order, schedule, flow, etc known
- No cross-job interference
- Positions are rarely temporary

Site management! Each site is unique!





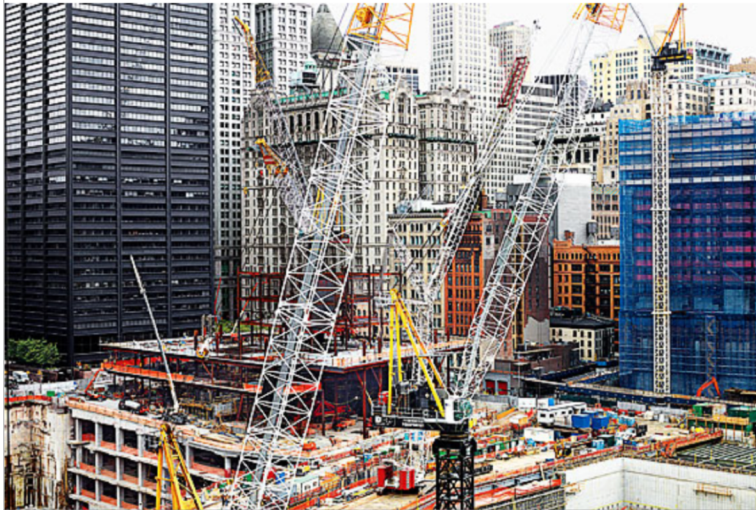
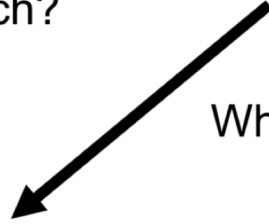
How is construction sector different?



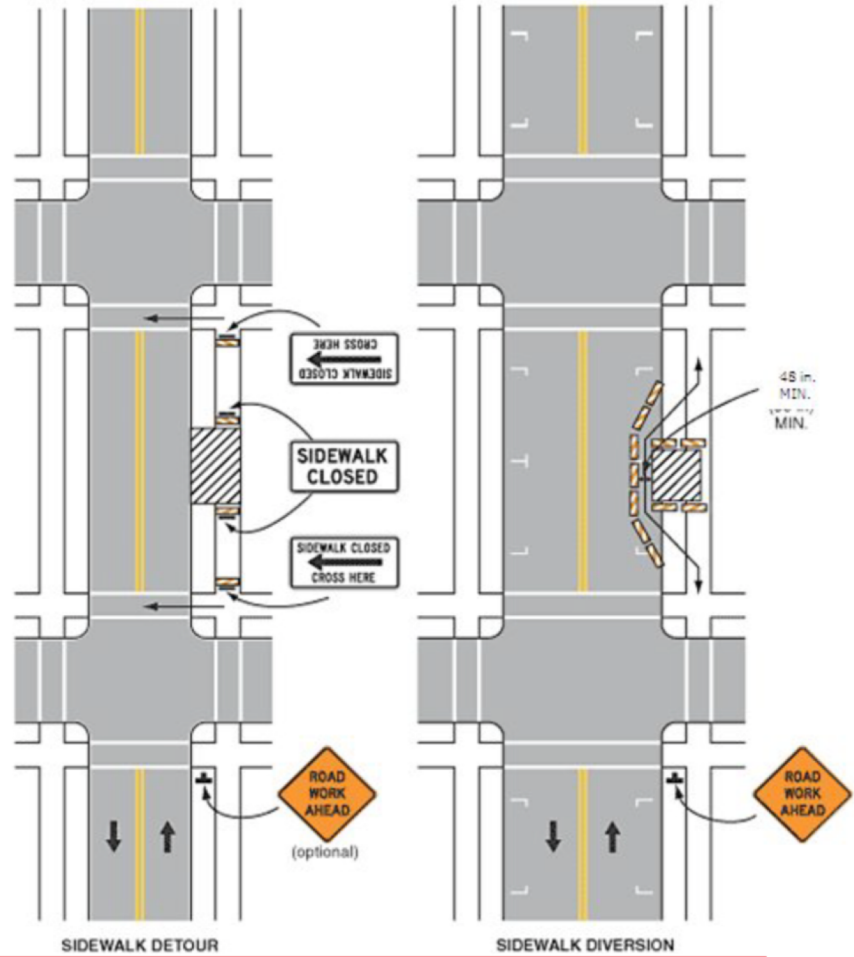
Where? When? How? How much?



Who? Where? When?



Where? When? How much?



Equipment management!

| Evaluation of crane selection – Crane no. 1. | | | | | | |
|----------------------------------------------|----------------------------------------------|-------------|---------|-------------------------|--------|----------------|
| Ref. | Objectives | Alternative | | | | |
| | | MUSTS | ARB-38 | Go/No go | | |
| A | Track-mounted crane | Yes | | | | ✓ |
| B | At least 25 m boom as lift crane | 36.6 m max. | | | | ✓ |
| C | Meets EU/US emissions directives | Yes | | | | ✓ |
| D | Capable of conversion to excavator | Yes | | | | ✓ |
| E | Capable of lifting 3 tonnes at 14 m radius | 3.6 tonnes | | | | ✓ |
| F | Max purchase price £45 000 | Yes | | | | ✓ |
| C | Conforms to ISO statutory regulations | Yes | | | | ✓ |
| No. | WANTS | E/T | Ranking | Information | Rating | Weighted score |
| 1 | Delivery less than ten weeks | E | 10 | Six weeks | 8 | 80 |
| 2 | High lifting capacity | T | 10 | 30480 kg max. | 8 | 80 |
| 3 | Easy excavator conversion | T | 9 | One day | 5 | 45 |
| 4 | Real time 3D guidance system | T | 9 | | 5 | 45 |
| 5 | Good service facilities | E | 8 | | 7 | 56 |
| 6 | Low maintenance costs | E/T | 7 | | 9 | 63 |
| 7 | Low running costs | E | 9 | | 8 | 72 |
| 8 | Simple to set up on site | T | 6 | ½ hr | 9 | 54 |
| 9 | Low ground-bearing pressure | T | 4 | 0.55 kg/cm ² | 7 | 28 |
| 10 | Good safety features | T | 8 | | 6 | 48 |
| 11 | Simple driver controls/view | T | 5 | | 4 | 20 |
| 12 | Independent third drum | T | 2 | 500 x 75 mm | 10 | 20 |
| 13 | Hydraulic powering | T | 4 | | 10 | 40 |
| 14 | Fast slewing speed | T | 7 | 3.55 rpm | 7 | 49 |
| 15 | Fast hoist speed | T | 7 | 45.5 m/min | 7 | 49 |
| 16 | Good maneuverability around site | T | 4 | 1.52 km/h | 6 | 24 |
| 17 | Good range of spares | T | 8 | | 2 | 16 |
| 18 | Long working life/good trade-in price | E | 7 | Ten years – £2 050 | 8 | 56 |
| 19 | Hydraulic transmission | T | 3 | | 9 | 27 |
| 20 | Audible and visible safe load ind. indicator | T | 10 | | 2 | 20 |
| 21 | Automatic power boom lowering | T | 2 | | 10 | 20 |
| 22 | Proximity detector and alert | T | 6 | | 10 | 60 |
| 23 | Low purchase price | E | 10 | £44 050 | 7 | 70 |
| E | Economic element | | 27% | 43 | | |
| T | Technical element | | 73% | 119 | | 341 |
| | Totals | | 100% | 162 | | 1 105 |

Remarks: All musts OK

Modern Construction Management, Seventh Edition. Frank Harris and Ronald McCaffer with Francis Edum-Fotwe.
© 2013 John Wiley & Sons, Ltd. Published 2013 by John Wiley & Sons, Ltd.

 **WILEY-BLACKWELL**

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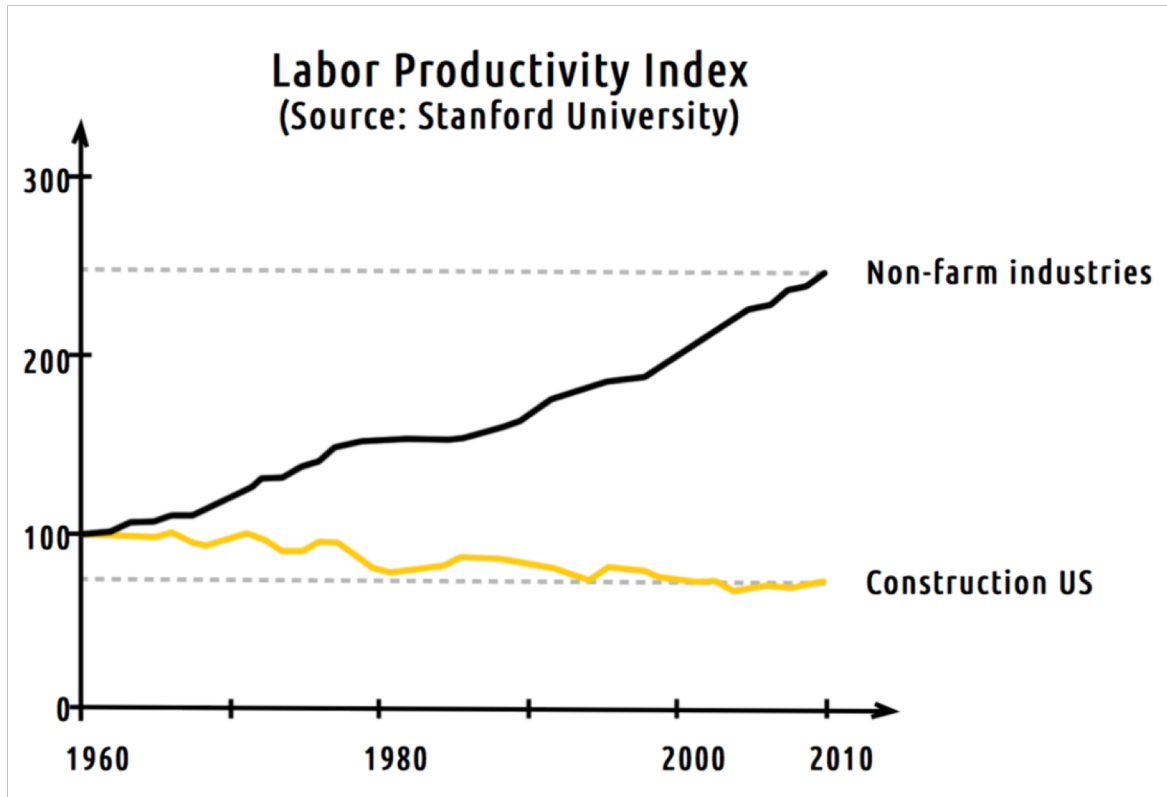
Process differences with manufacturing

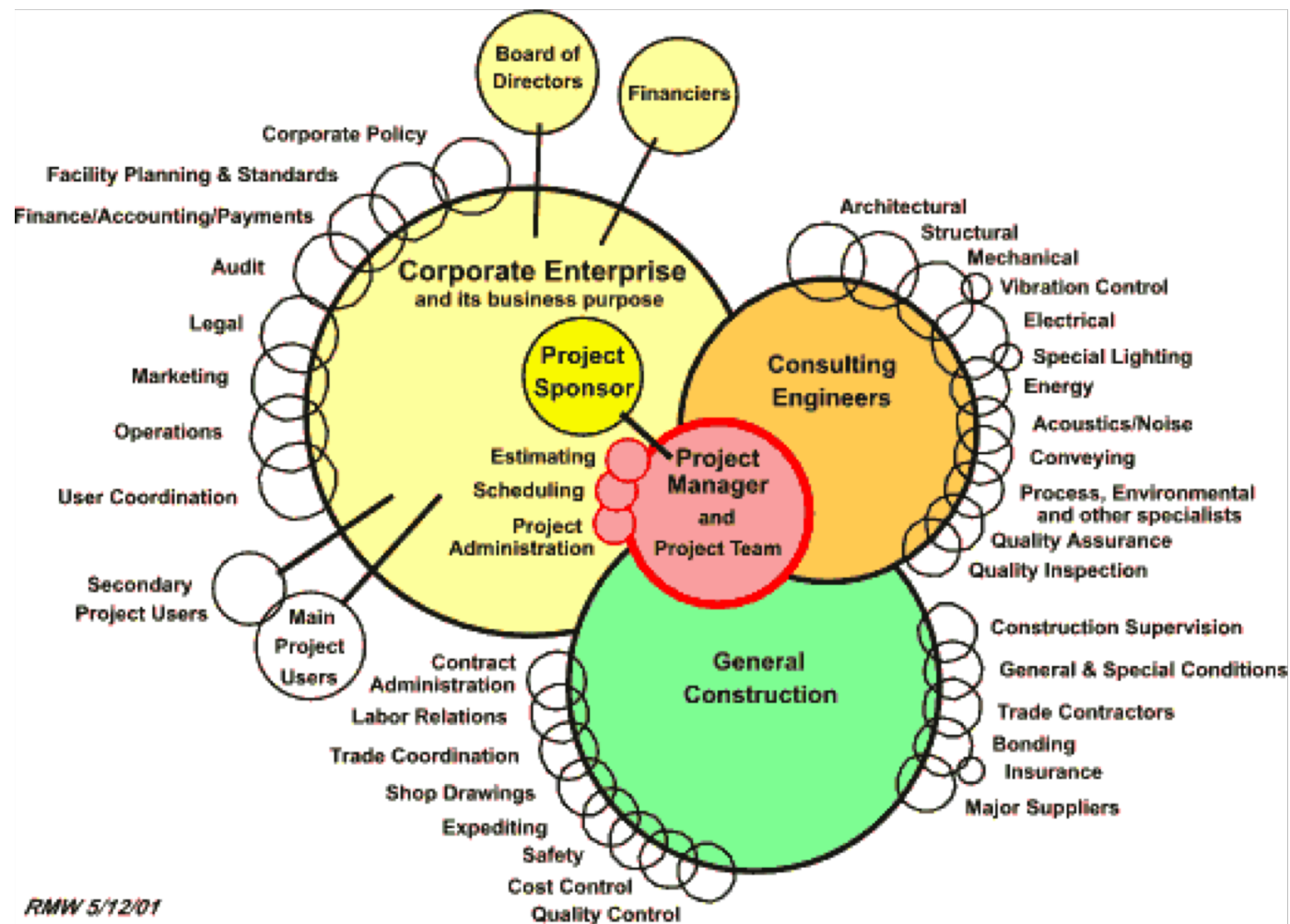
- Limited Mass production?
- Limited Direct digital fabrication? workmanship remains critical!
- No to-scale prototypes
- Supply chain and logistics – product distribution network
- Use-reuse-recycle-replace is less developed
- Level of modularity... lifecycle considerations... less developed
- Business models?
- ...

People!

Are the organizations different too?

Collective skills and productivity





Stakeholder management- Soft skills

- Are the goals of the stakeholders aligned?
- What is the common goal?
- How do we create a shared understanding?
- How do we build trust?

Network understanding and communication

Sub-contractors, workers... last planners

- It is finally the workers who get the work done
- Are they the right choice...
- Once you have made the selection
 - Planning cannot be entirely top down...
 - It should be a push-pull process...
 - Workers on the field know how long it will take!
 - Their work depends on others before them...

Human Resource Management

- Team changes with each project
- Not everyone is needed at the same time
- Not all work is continuous

Getting **Right people to Right job at the Right time** needs thorough planning!

But can you plan everything upfront?

Culture and work practice

- Varies from office to office, region to region
- Varies across disciplines and trades
- Learning on field is often based on apprenticeship
- Formal and informal networks

Established traditions and practices over long term. What and how do you change that?

Contracts rather than collective good

- Traditional models have limited collective responsibility
- Responsibilities get passed over... grey areas at the interfaces
- Determine how risks and benefits are distributed
- Can affect whether parties compete or cooperate
- Increasing use of relational contracts, shared risks and benefits

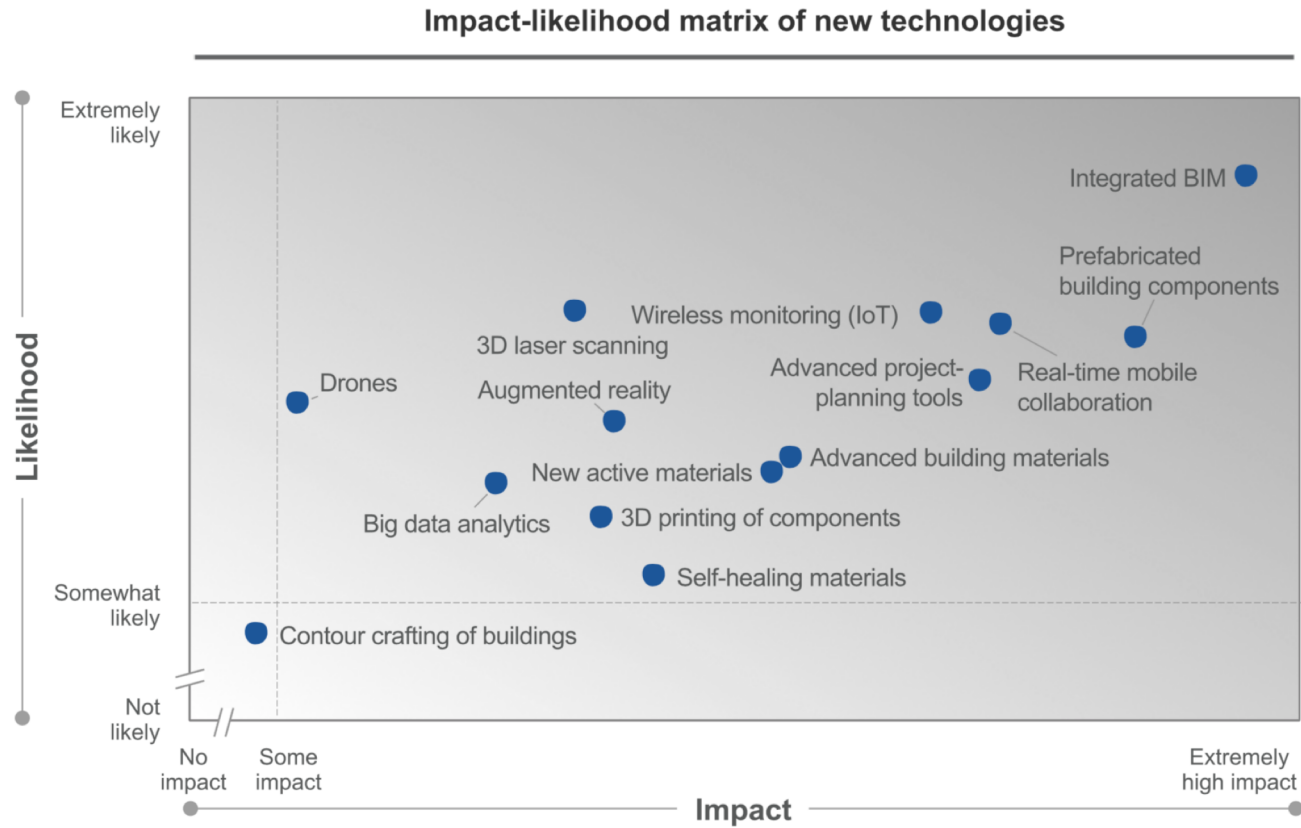
People and organizations

- Fragmented in various ways
- Upto 80% players are SMEs
- Wide range of skills
- Varied skill levels... unskilled to highly skilled
- Project networks...

How is the construction industry changing?

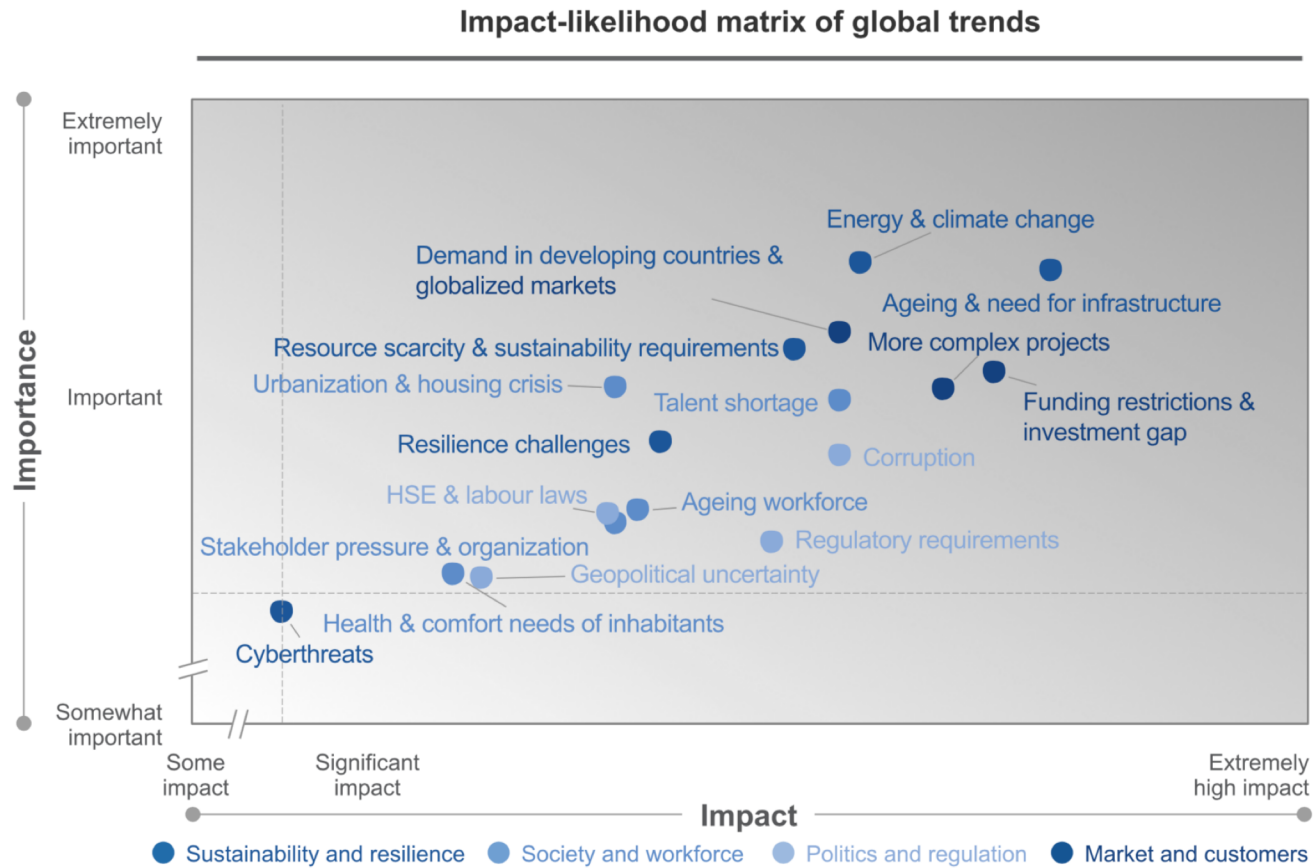
- Industrialization: **Prefabrication**
- **Digitalization** of processes and products
 - Virtual Design and Construction
 - Direct digital manufacturing
 - Automation systems, Intelligent systems
- Changing contractual and regulatory requirements
- New business models: service oriented thinking

Figure 20: Future Impact and Likelihood of New Technologies



Source: Future of Construction Survey

Figure 21: Global Trends – Their Importance for and Impact on the E&C Industry



Source: Future of Construction Survey



ARIGHTGUIDE



Conclusion from this session!

- CM is not one but a combination of many different roles
- Emphasis so far has been more on processes than the product and the people
- Local knowledge and experience is important for many roles
- CM roles will vary according to projects and situations

Books and reference material

Modern Construction Management, Frank Harris, Ronald McCaffer, Francis Edum-Fotwe, March 2013, ©2013, Wiley-Blackwell

BIM Handbook, A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors, Eastman et al, 2008, Wiley & Sons

Building Information Modeling: BIM in Current and Future Practice, Karen Kensek, Douglas Noble, 2014

Questions?

Thank You!