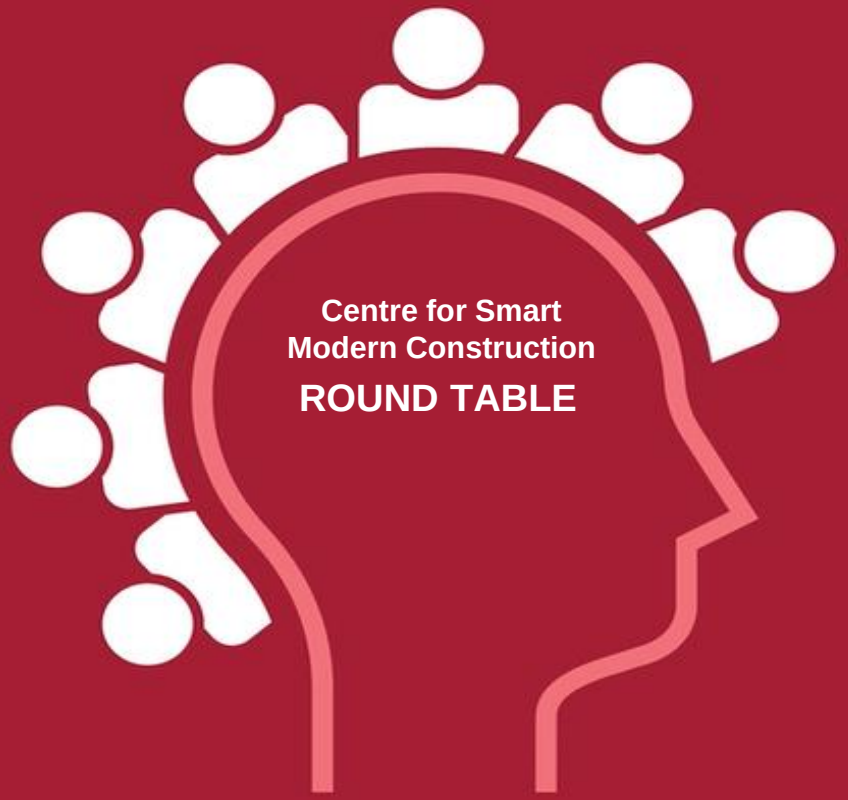

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Centre for
Smart Modern Construction

c4SMC INTER-UNIVERSITY ACADEMIC ROUND TABLE

14th November 2018

Onsite to Offsite - Implications to Construction Skill Profiles

Julie Jupp

Associate Professor of Digital Design and Construction


Transforming the Built Environment
using a through-life perspective of
Model-based Systems Engineering
UTS
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WHAT's THE PROBLEM…?

CHANGES TO PRACTICE

- **Onsite to Offsite:** Areas of continuous change and evolution
  - Activities and workflows
  - Roles and responsibilities
  - Knowledge competencies
  - Relationships and interfaces

SUMMARY OF DISCUSSIONS

IMPLICATIONS TO SKILLS PROFILES

- **Onsite to Offsite:** Areas of impact
  - Classification of skills profiles based on mixes of onsite and offsite processes
  - Quantity/ type of Skills defined by the mix of Onsite and Offsite production
  - Dimensions of skills can be classified according to building sector
- **General Comments**
  - Lack systems perspective
  - System needs to be governed by a clear philosophy
  - Lack multidisciplinary mindset
  - Clock speed of construction education is very slow

OTHERS THAT I SEE AS SIGNIFICANT

IMPLICATIONS TO SKILLS PROFILES

- **Onsite to Offsite Implications**
  - Systems of systems approaches
  - OSM will require more STEM capable professionals.
  - Digital transformation will produce a need for more “data savvy” engineers,
  - Possible trend that reduces average age of AEC workforce
    - Important to track attrition metrics across STEM labour categories to ensure younger professionals can be retained.

OTHERS THAT I SEE AS SIGNIFICANT

IMPLICATIONS TO SKILLS PROFILES

- Goal of digitisation in construction is to increase the number of “A-players” in the workforce.
  - How to define and measure this? (A research project in itself).
- Superiority in digital engineering capabilities and practices in several areas:
  - **Communication** capabilities
  - Capabilities to support **definition of systems** and creation of product models, parametrisation
  - **Reasoning and inference** capabilities
  - Capabilities to support **interpretation** of and decision making based on analysis of results

STAKEHOLDERS

WHY IS THE IMPACT OF OSM ON SKILLS A PROBLEM THAT NEEDS TO BE SOLVED…?

Create profiles of new skills and knowledge competencies across all of the key stakeholders

Contractors & Fabricators

Engineers & Consultants

Clients & Tenants

Academics

Building Owners

Building/Facility Managers

Banks/ Lending Institutions

Investor & Asset Valuers

Benefits of DIGITISATION for built environment

DESIGN

- Model-based Design
- Clash Detection
- Coordinated Design
- Design for Manufacture and Assembly
- Virtual testing of Construction Methods
- Validation and visibility of completeness across disciplines
- AI / Algorithm enhanced design efficiencies

CONSTRUCTION

- Model-based Construction (3D, 4D, 5D)
- Offsite Construction
- Handover and commissioning
- Defects and liability period
- Live updates and progress visibility

OPERATION

- Smart Building Readiness
- Fault detection diagnostics and energy optimisation
- Maintenance audit traits
- Warranty verification
- Maintenance smart contracts
- Real time tracking of contractors
- Predictive maintenance

USER EXPERIENCE

- Emergency Notification System
- User Experience enhanced
- Space Utilisation Analytics
- Tenant Analytics

FUTURE SKILLS: fusion OF physical and digital

PHYSICAL WORLD

DIGITAL WORLD

Spaces

Software & Devices

People

Data — Control

Context

Measure — Insight, Optimization

Implementation

- Design
- Build
- Occupy

Data — Control

Systems

Measure — Insight, Optimization

Insights

- Modelling
- Production Control
- Offsite/ Onsite Analytics
- Occupancy & Utilization

Data — Control

Processes

Measure — Assistance, Task Completion

Experiences

- Industry Apps
- Employee Productivity, Safety, Health
- Mixed Reality & Cognition
- Location & Wayfinding

DIGITAL CONSTRUCTION

ELEMENTS OF MODERN ENTERPRISE INTEGRATION AND NEW SERVICE OFFERINGS

UTS TEACHING & LEARNING

APPROACH TO DIGITAL CONSTRUCTION

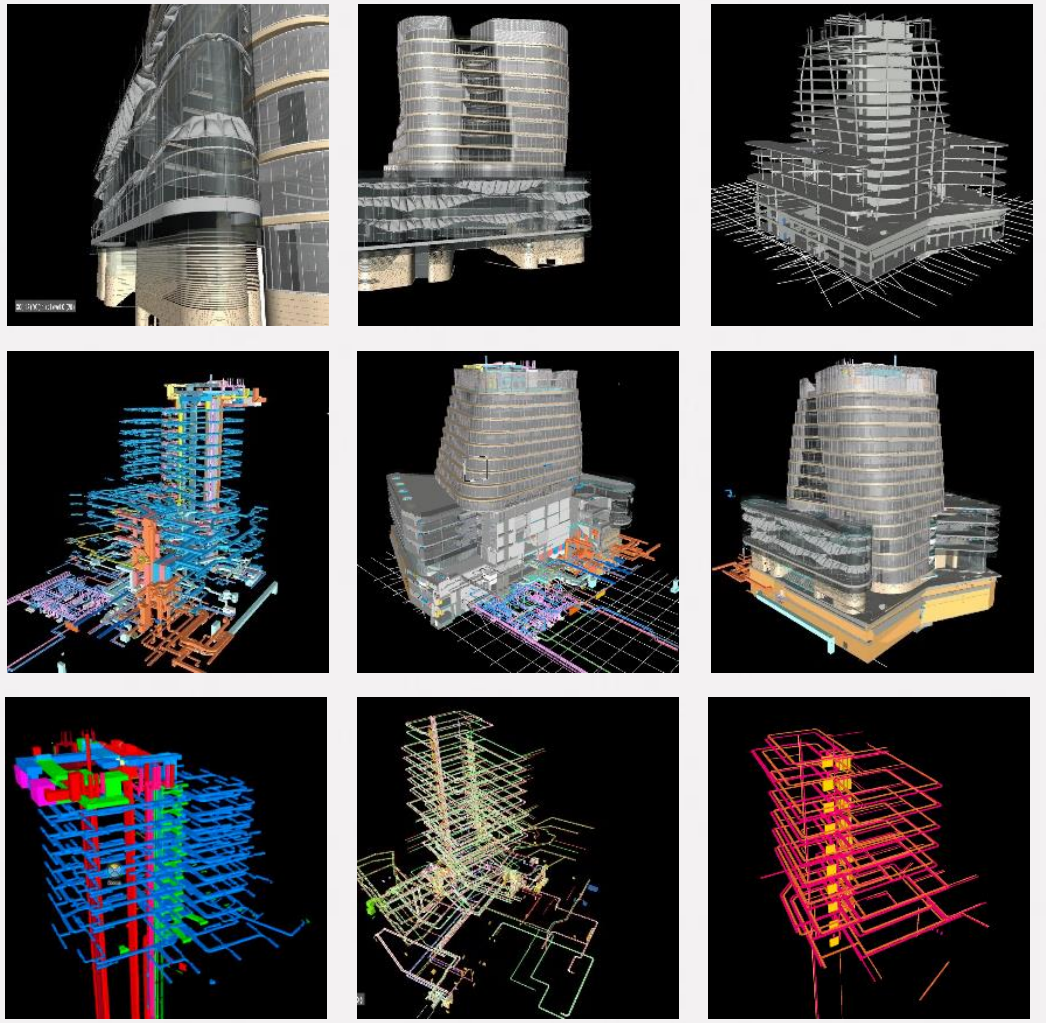
Digital Engineering - Teaching and Learning Approaches

Approach	Purpose and mode of delivery
Instructive 	• Establishes basic principles and competencies in digital engineering topics • Develops competencies of DE relative to general design and construction management roles and activities • Focuses on model viewing, model compilation and model management skills
Illustrative 	• 3D, 4D and 5D models are used as a visual aid and a descriptive means of assisting in teaching traditional design and construction management activities • Applied to subjects which benefit from constant graphic reference to a 3D building model such as construction methodologies and site establishment • Useful in design related subjects such as structural appreciation and environmental design • Focuses on 3D, 4D and 5D model viewing and model management skills
Immersive 	• Students are actively and experientially involved in using 3D, 4D and 5D models and related datasets as a means to assist problem solving and integrated, collaborative decision making • Underpinned by problem based learning approach • Emphasis on group based work • Focuses on model authoring, model compilation and model management skills

INDUSTRY COLLABORATION IN TEACHING & MENTORING

Digital Design and Construction Subject Stream:

1. Subjects are underpinned by immersive, problem based learning approach
2. Focuses on 3D, 4D and 5D modelling, model compilation and information management skills
3. Students are actively and experientially involved in live projects and datasets as a means to provide context to teaching, assist problem solving, and support integrated, collaborative decision making
4. Emphasis on group based work and role playing
5. Supported by industry mentors from various AEC/O disciplines
6. Enabled by leading industry practice and new digital workflows



UTS TEACHING & LEARNING

IMMERSIVE DIGITAL CONSTRUCTION EDUCATION

TEACHING BASED ON:

- Collaborations with leading industry practitioners - Hansen Yuncken, AECOM, Ridley/ Willow, Mirvac, Richard Crookes Construction, Lend Lease, Built Corp
- Curricula is reviewed and revised each year so as to ensure that only the latest workflows, toolsets and protocols are being taught to students.
- Use of real world industry projects to run our digital studios and therefore use a problem-based approach to teaching Digital Engineering and BIM.
- Industry invited as mentor students to discuss best/ worst practice, provide anecdotes, and demonstrate workflows.
- Provides students with concrete examples of how industry are utilising DE/BIM/ OSM methods and developing the appropriate digital processes and methods to support model-based approaches to building design, construction and asset management.

TEACHING NOTE BASED ON:

- Only a ‘chalk and talk’ approach - the level of cultural change required in industry won’t be achieved through passive instruction.
- ‘Picks and clicks’ approach to just teaching the software.

UTS TEACHING & LEARNING

IMMERSIVE DIGITAL CONSTRUCTION EDUCATION

DIGITAL TECHNOLOGIES STREAM:

- Three core subjects, covering 3D, 4D and 6D aspects of DE.
- Broadly, all subjects provide students with learning opportunities in:
  - Specification of information requirements,
  - Management of model-based information and linked asset data, and
  - Communication of information in model-based project meetings.
- Each subject then focuses on the execution of specific workflows and standards to support:
  - 3D design and spatial coordination,
  - 4D construction scheduling and simulation, and
  - 6D data specification, validation and verification procedures (for the delivery of as-builts for operations).
  - My UTS colleagues here also teach a 5D cost modelling component, focusing on partial 5D (rather than full 5D), which considers quantities only and not labour rates extracted from a 4D model.

SKILLS SYNC EVENT

BRINGING INDUSTRY INNOVATION LEADERS AND TECH SAVVY STUDENTS TOGETHER

skills sync

UTS Construction Project Management
Educating Tomorrow's Technology Leaders

INVITATION

Please join us for the inaugural drinks reception of Skills Sync

event: skills sync
date: Tuesday 27th June
time: 5:30-7:30pm
location: CB5C.02.020

building 5C | level: 2 | Rm: 020
digital interactive pod space

Please register your attendance at:
www.eventbrite.com.au/e/skills-sync-tickets-35405635208

Skills Sync celebrates 2nd & 4th year student works from the Construction Project Management degree at UTS. Students from the digital design and construction subjects will showcase 3D model coordination and 4D construction simulation outputs.

This social event is intended to provide a point of contact between industry and education so as to promote UTS students who have developed valuable construction focused BIM competencies in the use of associated technologies, workflows and standards.

This year, academics were joined by key teaching partners from Richard Crookes Construction, BuildCorp, FJMT Architects, CAD Group, Hansen Yuncken, and the UTS Program Management Office. Real-world building models from the UTS Central construction project were utilised in the university's digital teaching studios.

Sponsored by:

AUTODESK.
Buildcorp
SYDBIM
RICHARD CROOKES CONSTRUCTIONS
Ridley
lendlease
AECOM
hansen yuncken
UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

skills sync 2018

UTS Construction Project Management
Educating Tomorrow's Technology Leaders

UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

INVITATION

Join us for skills sync at the University of Technology Sydney

event: skills sync
date: Tuesday 26th June
time: 5:00-6:00pm structured forum
6:00-8:00pm drinks and networking
location: 1 Quay Street, Haymarket
building 5C | level: 2 | rm: 020
digital interactive studio
CB5C.02.020

Please register your attendance at:
https://skillssync2018.eventbrite.com.au

Skills Sync celebrates 2nd & 4th year students from the Construction Project Management degree at UTS. Students from the degree's digital design and construction subjects will showcase 3D model coordination and 4D construction simulation outputs.

The event will link like-minded industry professionals and students to promote the value of digital construction technologies and processes. A social event will proceed a structured forum where students will be introduced to companies looking to promote advanced design and construction technologies within their practice.

This year, UTS academics were joined by key teaching partners from Hansen Yuncken, Mirvac, Richard Crookes Construction, and BuildCorp. Real-world building models from the Urbanest Darling Square student accommodation project were utilised in the teaching studios.

Skills Sync 2018 Sponsors:

RICHARD CROOKES CONSTRUCTIONS
hansen yuncken
AUTODESK.
Built.
Buildcorp
mirvac
Ridley
AECOM
lendlease
SYDBIM






Skills Sync - Closing the Loop in University-Industry Alliance

This event provides a point of contact between industry and education so as to promote UTS students who have developed valuable construction focused BIM competencies in the use of technologies, workflows and standards.

This year, academics were joined by key teaching partners from Richard Crookes Construction, BuildCorp, FJMT Architects, CAD Group, Hansen Yuncken, and the UTS Program Management Office.

Knowledge competencies

some defining characteristics...

concept dev.

design/ prototype

verification / validation

drafting

modelling

model management

cost & time

risk management

quality management

information management

ICT support

hardware maintenance

software troubleshooting

compliance

change mgmt.

configurations / BOM views

supplier mgmt.

contract mgmt.

sourcing analytics

collaboration

protocol exec.

data governance

skills

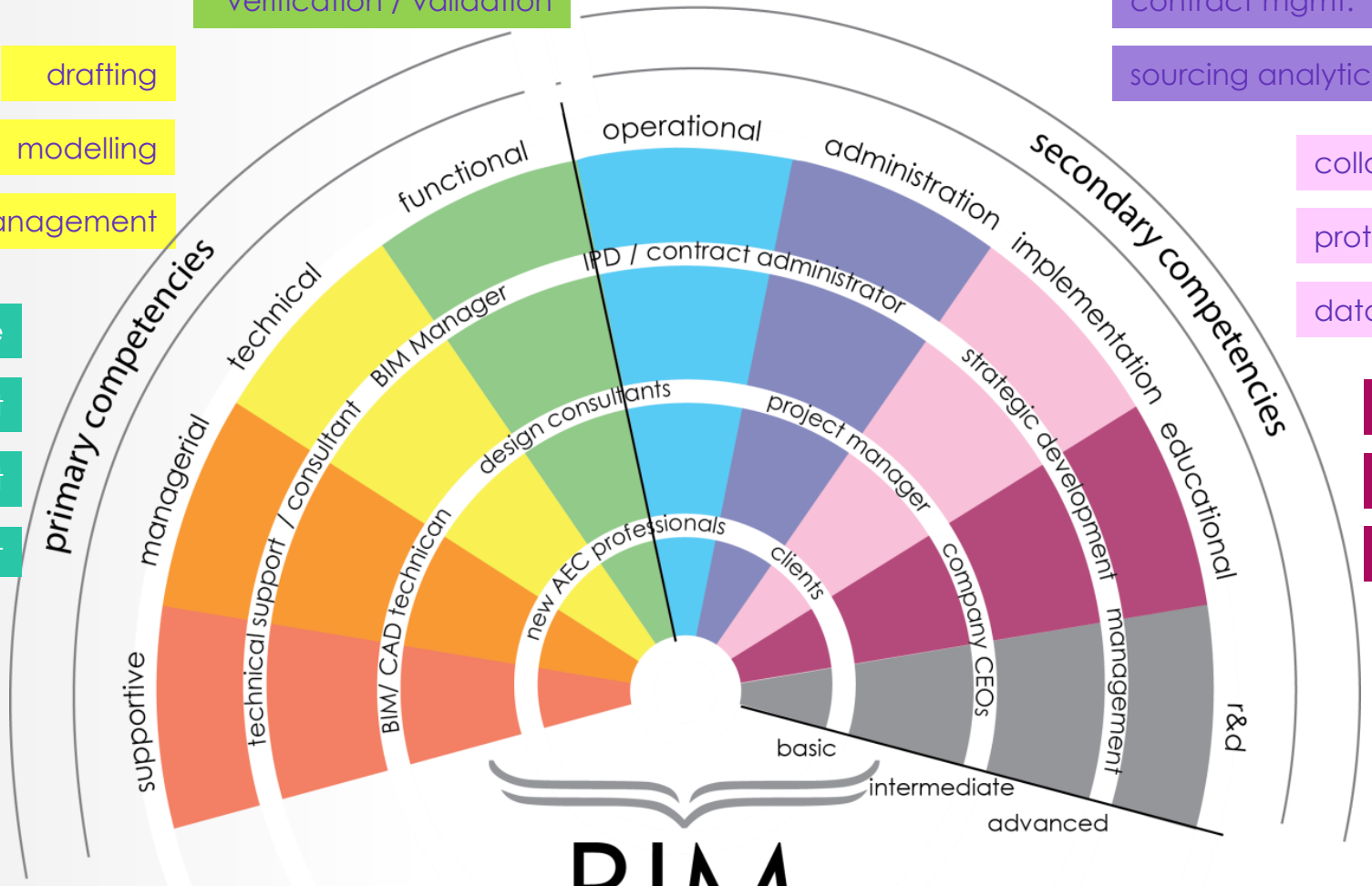
training

development

initiatives

innovation

engagement



BIM

KNOWLEDGE

COMPENTENCIES

Knowledge competencies

some defining characteristics...

concept dev.

design/ prototype

verification / validation

compliance

change mgmt.

configurations / BOM views

supplier mgmt.

contract mgmt.

sourcing analytics

product modelling

coding & parametrizing

enterprise process integration

collaboration

protocol exec.

data governance

cost & time

risk management

quality management

information management

skills

training

development

ICT support

hardware maintenance

software troubleshooting

initiatives

innovation

engagement

business process analysis

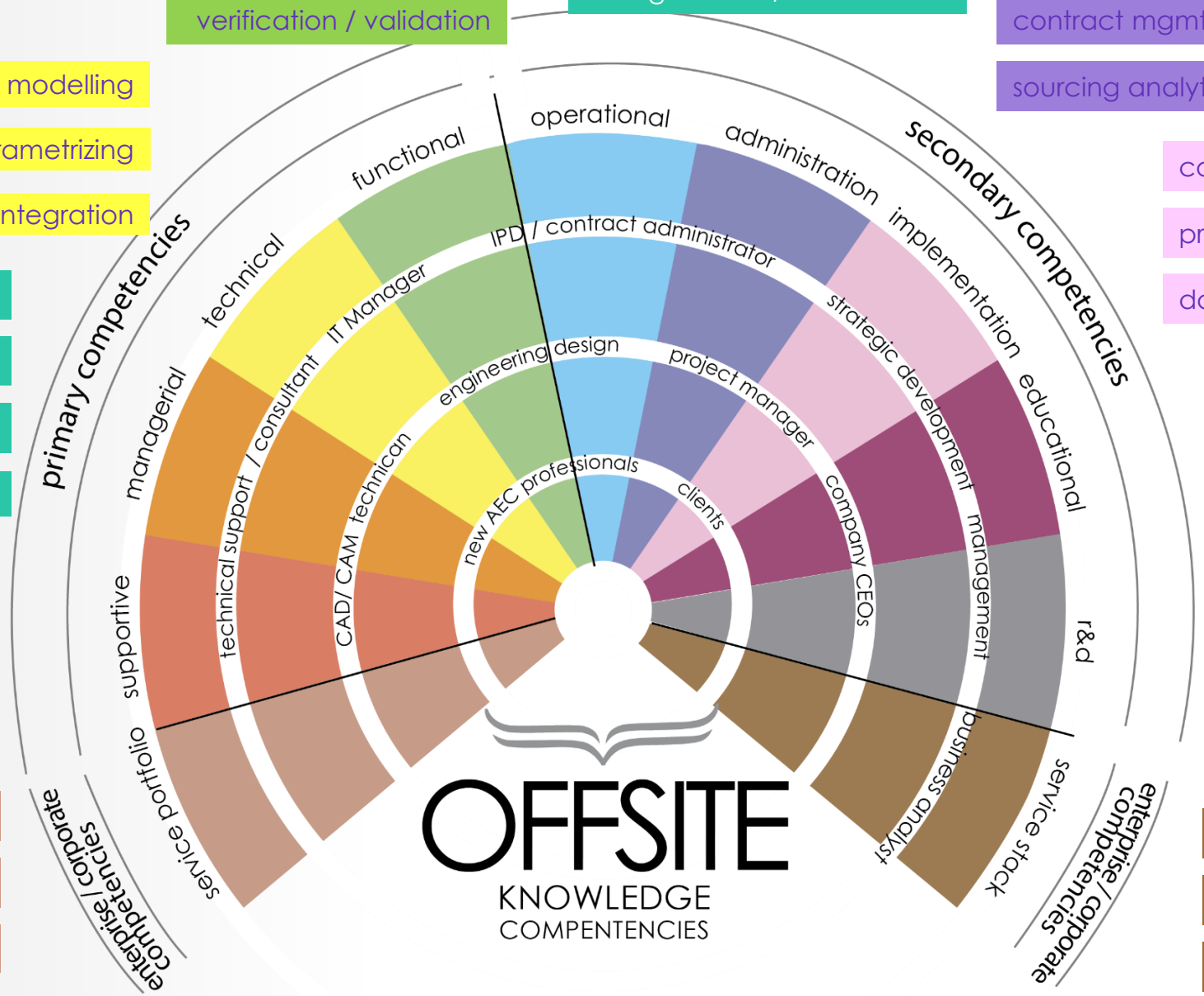
measurement & maturity assessment

product rationalisation & roadmap formulation

end to end

system customisation

migration & upgrades



LEARNING FROM ADVANCED MANUFACTURING

CROSS INDUSTRY COMPARISON

1. OVERHAULING ANTIQUATED IT SYSTEMS

2. LIFECYCLE THINKING

3. GENERATE NEW BUSINESS MODELS

4. DATA AND ANALYTICS AS A SERVICE

5. STRATEGIC ALLIANCES WITH EXTERNAL PARTNERS

6. STRATEGIES AND SYSTEMS FOR TALENT IDENTIFICATION

7. KNOWLEDGE SHARING ACROSS THE SUPPLY CHAIN

	CONSTRUCTION CONTEXT	MANUFACTURING CONTEXT
Individuals *and groups*	Large numbers of employees, Low knowledge intensity	Lower numbers of employees, High knowledge intensity
Organisations *and org. units*	Low barriers to entry, Negative perceptions of ITs and its ROIs	Higher barriers to entry, Positive perceptions of IT and its ROIs
Teams *all types*	Short time frames, transient locations, Low inter-dependencies	Longer time frames, permanent locations, Higher inter-dependencies
Markets *and sub-markets*	Highly fragmented, Few large players, Many customers, and SMEs, Lower R&D spend, Predominantly regional markets	Highly consolidated, Only a few major players, Fewer customers and SMEs, High R&D spend, Global markets

Comparing industries

some defining characteristics…

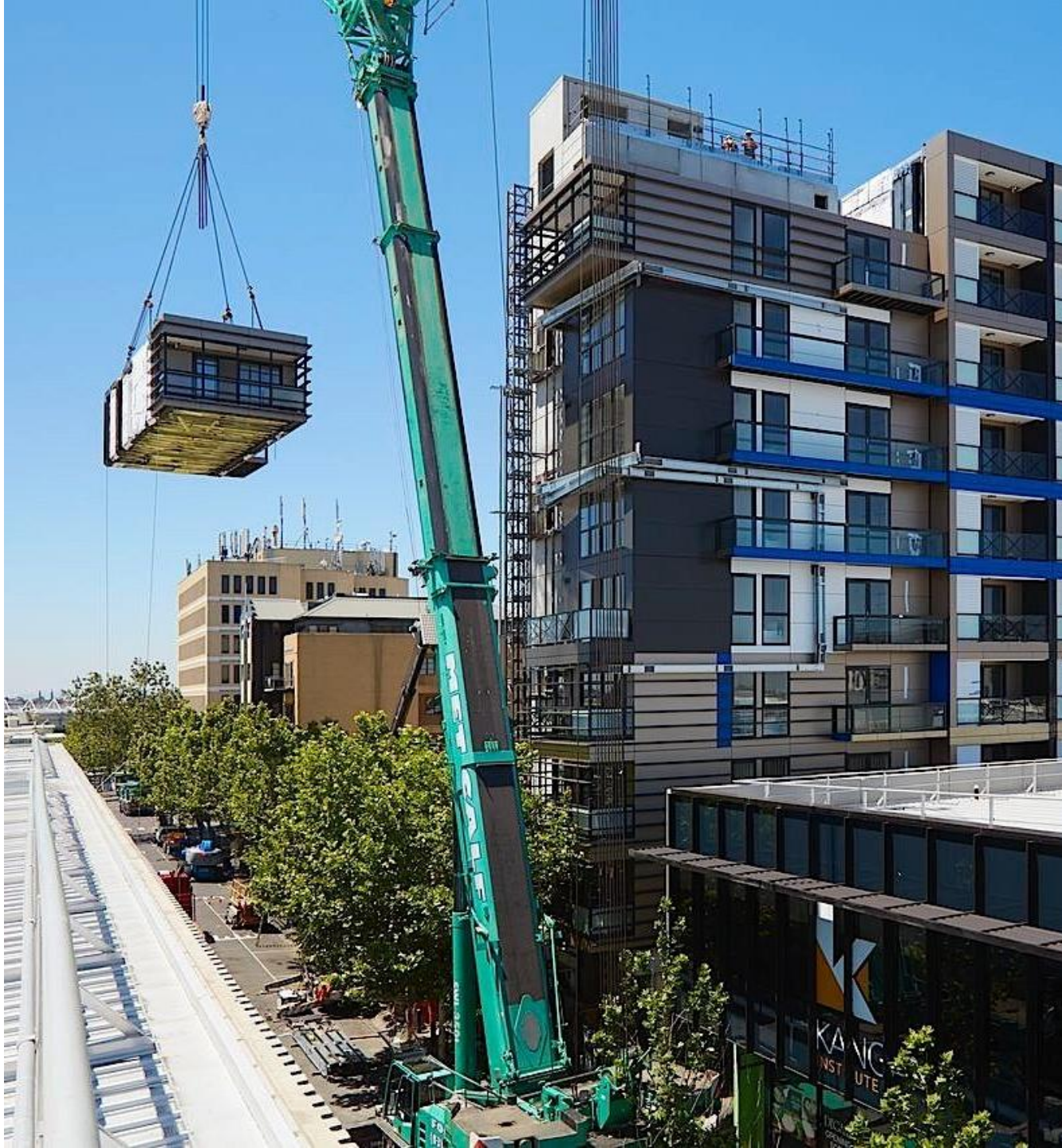
V's

DIGITISATION IN DISCRETE MANUFACTURING

CHANGES TO PRACTICE

Lessons from complex discrete manufacturing…

- Reduction in complexity through clear principles
- Achieving the elusive standard engineering processes takes time (10+ years)
- Continued focus on organisational issues
- Better management of dynamic environment

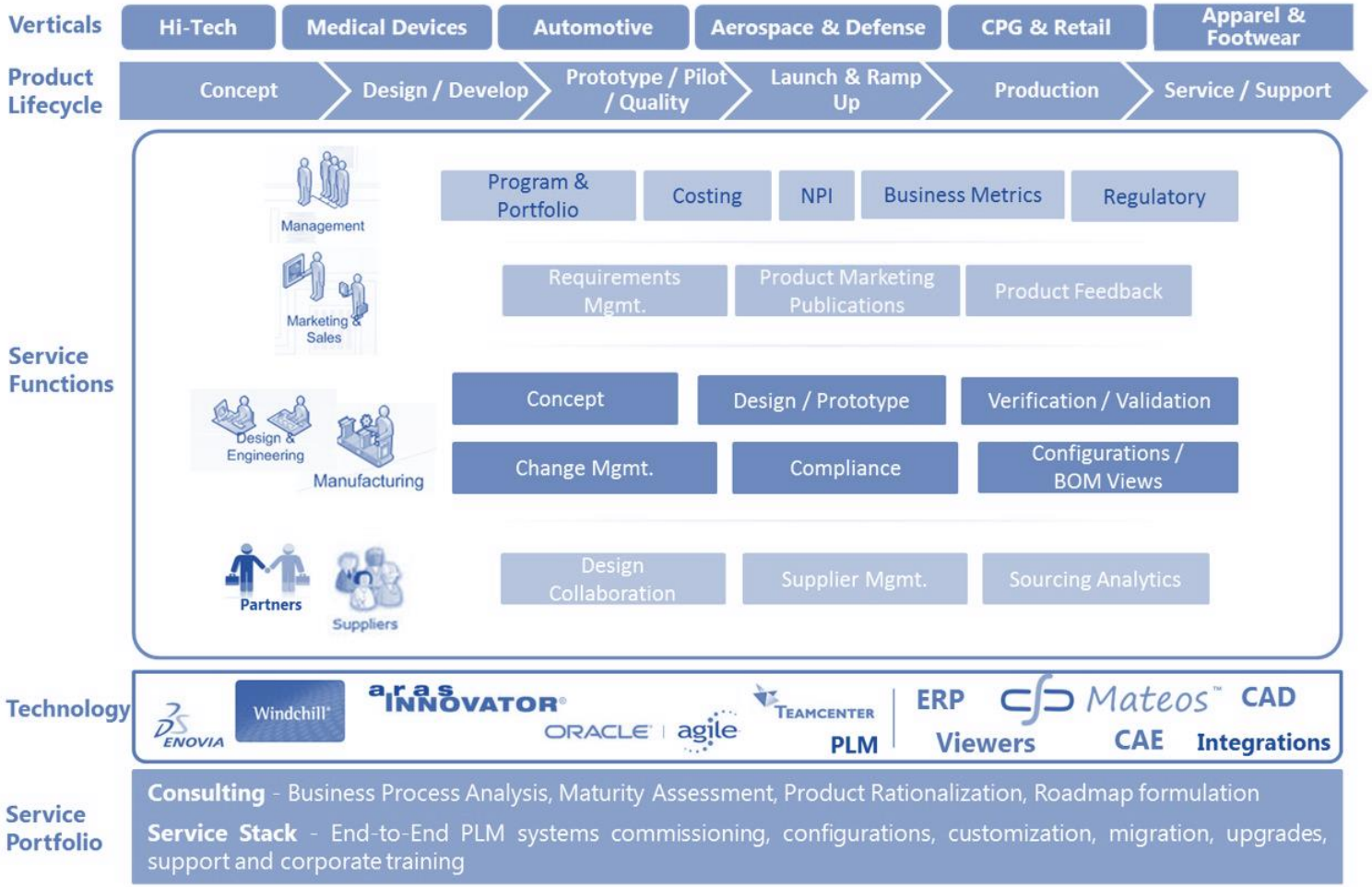


IMPLEMENTATION

OSM ECOSYSTEM

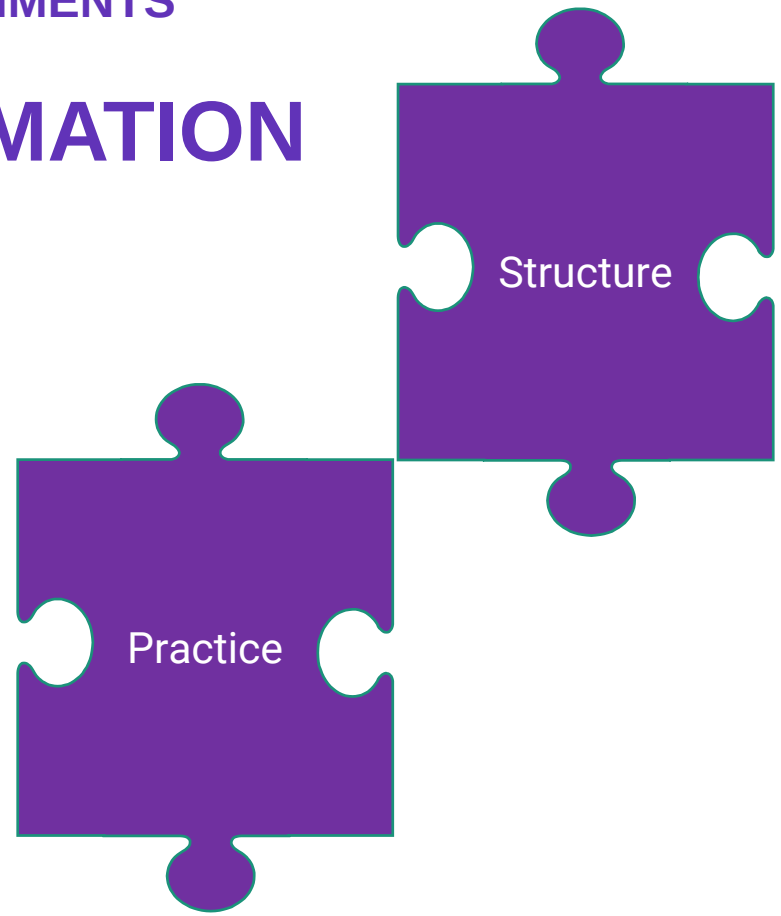
Transformation of industry mindset and not just a IT system adoption.

- Adaptation and collaboration across the extended enterprise.
- Skills profiles based on:
  - Understanding new OSM business models/ mixes
  - Building competencies across main Service Functions
  - New approaches to opportunity of off-site performance measurement & ROI
  - Parametrisation of building systems and product rationalisation,
  - Structuring and liaising between new responsibilities defining the ‘take-make-deliver’ stakeholders defining OSM business models
  - Mindsets of continuous improvement and innovation



TEACHING AND LEARNING ENVIRONMENTS

DIGITAL TRANSFORMATION IS DIFFICULT FOR ACADEMICS

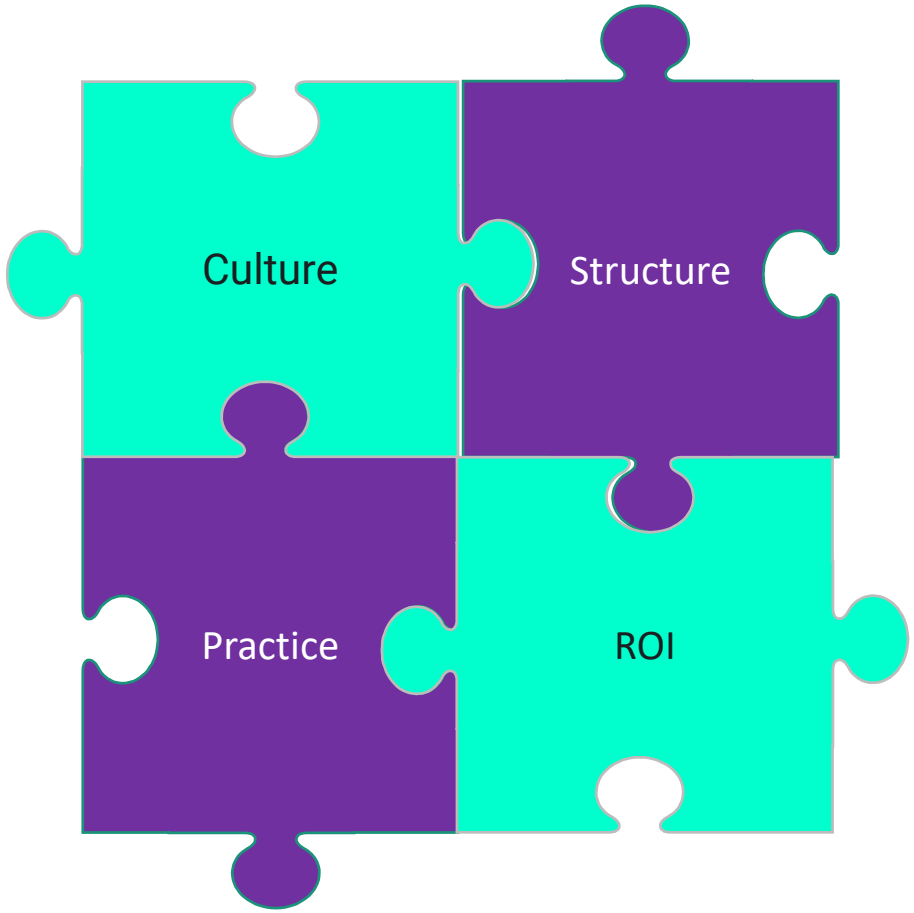


STRUCTURE
Planning, development and resourcing of OSM capabilities and enablers evident in organisation's infrastructures

PRACTICE
Ways of working, methods for deployment, skills and knowledge enabling OSM

CULTURE
Ethos of industry/ organisation, which demonstrates commitment to OSM

PRACTICE
Ways of working, methods for deployment and knowledge which enable BIM / PLM deployment



STRUCTURE
Planning, development and resourcing of OSM capabilities and enablers evident in organisation's infrastructures

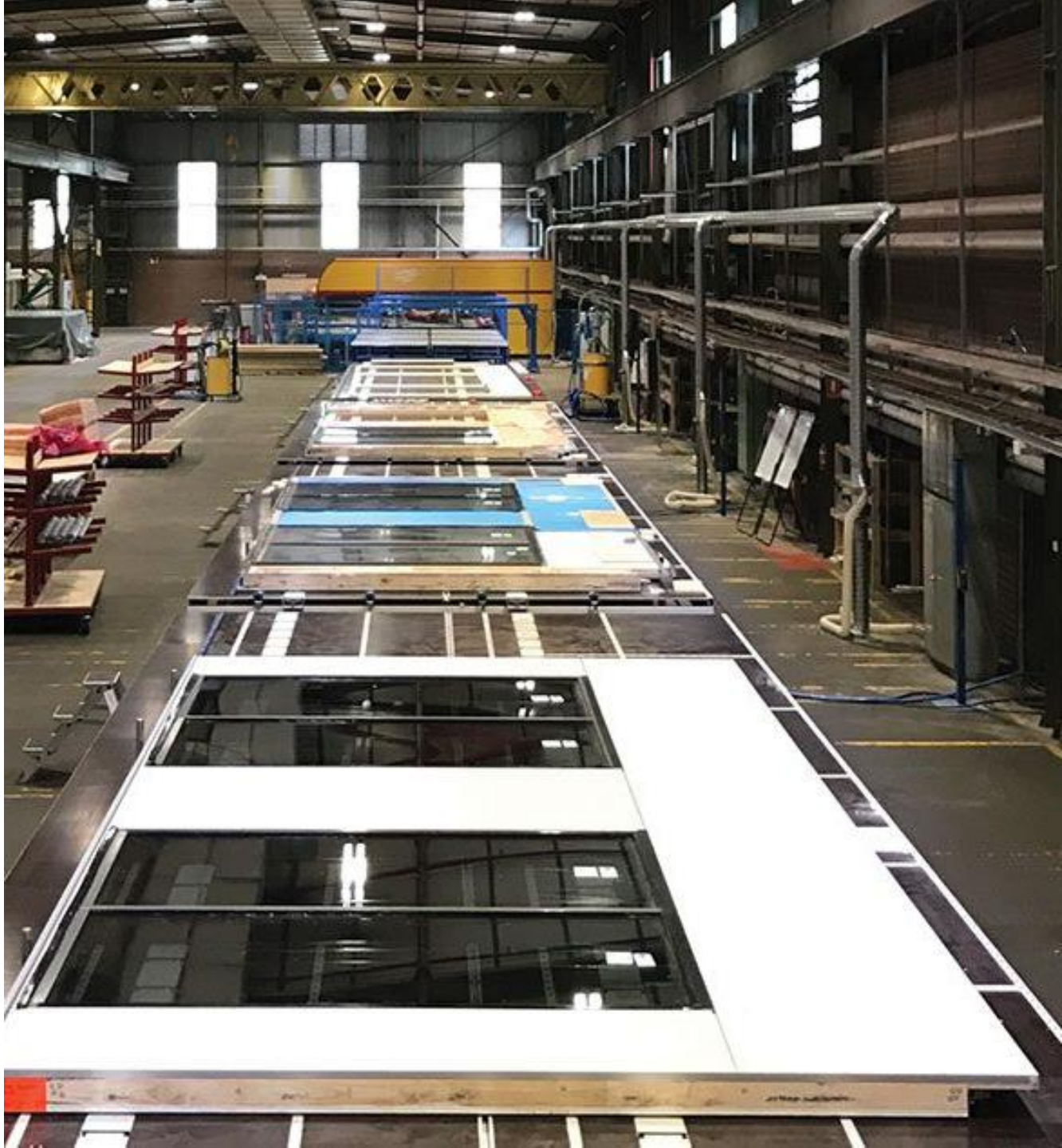
ROI
Monitoring and evaluation systems, which enable organisation to measure change affected by OSM

WHERE TO FROM HERE…?

CHANGES TO PRACTICE

Even more change is needed…

- Away from technology centric approach to Digital Engineering /BIM towards implementation of data driven workflows and standardised engineering processes
- Increasing focus on collaborative planning processes
- Development of knowledge competencies surrounding new business / corporate processes
- Greater levels of industry rationalisation



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THANK YOU

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