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Centre for Comparative Construction Research (CCCR)

WESTERN SYDNEY UNIVERSITY

Centre for Smart Modern Construction (C4smc)

FROM ONSITE TO OFFSITE CONSTRUCTION:

IMPLICATIONS FOR CONSTRUCTION SKILL PROFILES

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C4smc – Inter-University Academic RoundTable

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Parramatta City Campus, Western Sydney University

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1. KEY QUESTIONS
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KEY QUESTIONS

What happens on a construction site when over 50-percent of what is fabricated on-site today is transferred off-site?

1) How will construction that continues to be defined by traditional trade measure & procurement be redefined to reflect the actual work to be performed on-site?

2) How will the residual work be packaged & organized?

3) What new skills will be required for construction managers & the workforce?

4) How will the regulators of construction prepare & become future ready?

5) What will the primary functions of a head contractor become as projects evolve into places where assembly of OSCM on-site, progressively outweighs traditional work?

6) How can the future of construction narrative for on-site be developed to embrace smarter, better, faster, safer, more compliant, more resilient, less wasteful & cheaper – at least 50% & progressively 30% cheaper?

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KEY QUESTIONS

What happens on a construction site when over 50-percent of what is fabricated on-site today is transferred off-site?

1) How will construction that continues to be defined by traditional trade measure & procurement be redefined to reflect the actual work to be performed on-site?

2) How will the residual work be packaged & organized?

3) What new skills are required for the transformation from onsite to offsite construction?

4) How will the regulators of construction prepare & become future ready?

5) What will the primary functions of a head contractor become as projects evolve into places where assembly of OSCM on-site, progressively outweighs traditional work?

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Skills required for the transformation from onsite to offsite construction

Need for the new skills

Basis for formulating policies & guidelines for the skill & capability development of industry practitioners

Empower industry operators for the expanded role & challenges in the emerging construction landscape

Catalyse successful transition from the current to the future workplace

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FROM ONSITE TO OFFSITE: THE EVOLUTIONARY TREND

Onsite fabrication

- ✓ Traditional (stick-built)
- ✓ 100% labour
- ✓ Traditional tools & equipment

Onsite mechanisation

- ✓ Traditional (stick-built)
- ✓ Tilt-up framed & panellised construction
- ✓ 60% labour
- ✓ 40% advanced equipment.

Offsite fabrication

- ✓ Framed, panelised, modular & whole building less substructure
- ✓ 100% labour
- ✓ Largely traditional tools & equipment
- ✓ Standardized moulds & templates

Offsite mechanisation

- ✓ Framed, panelised, modular & whole building less substructure
- ✓ 40% labour
- ✓ 60% advanced equipment
- ✓ Standardized components.

Offsite automation

- ✓ BIM & computer-aided manufacturing (CAM).
- ✓ Partially automated construction - framed, panelised, modular & whole building less substructure
- ✓ 30% labour
- ✓ 70% advanced equipment & robots operating under artificial intelligence (AI).
- ✓ Standardized & flexible components

Digitalisation of construction

- ✓ Digital construction.
- ✓ Cloud-based construction information & management system; smart connected jobsites
- ✓ Fusion of robotics, AI, IoT, Big Data analytics, neural net, 3D printing, 3D scanning, blockchain & smart contracts
- ✓ 4th industrial revolution in construction

Digital twins in construction

- ✓ Digital representation of the construction process; components, elements, system/unit of the building.
- ✓ Utilizes the IoT devices, AI, Big Data analytics & subject matter expertise/best practice knowledge.
- ✓ used to understand, predict, and optimize performance; improve visibility & reliability; minimize risks; improve productivity

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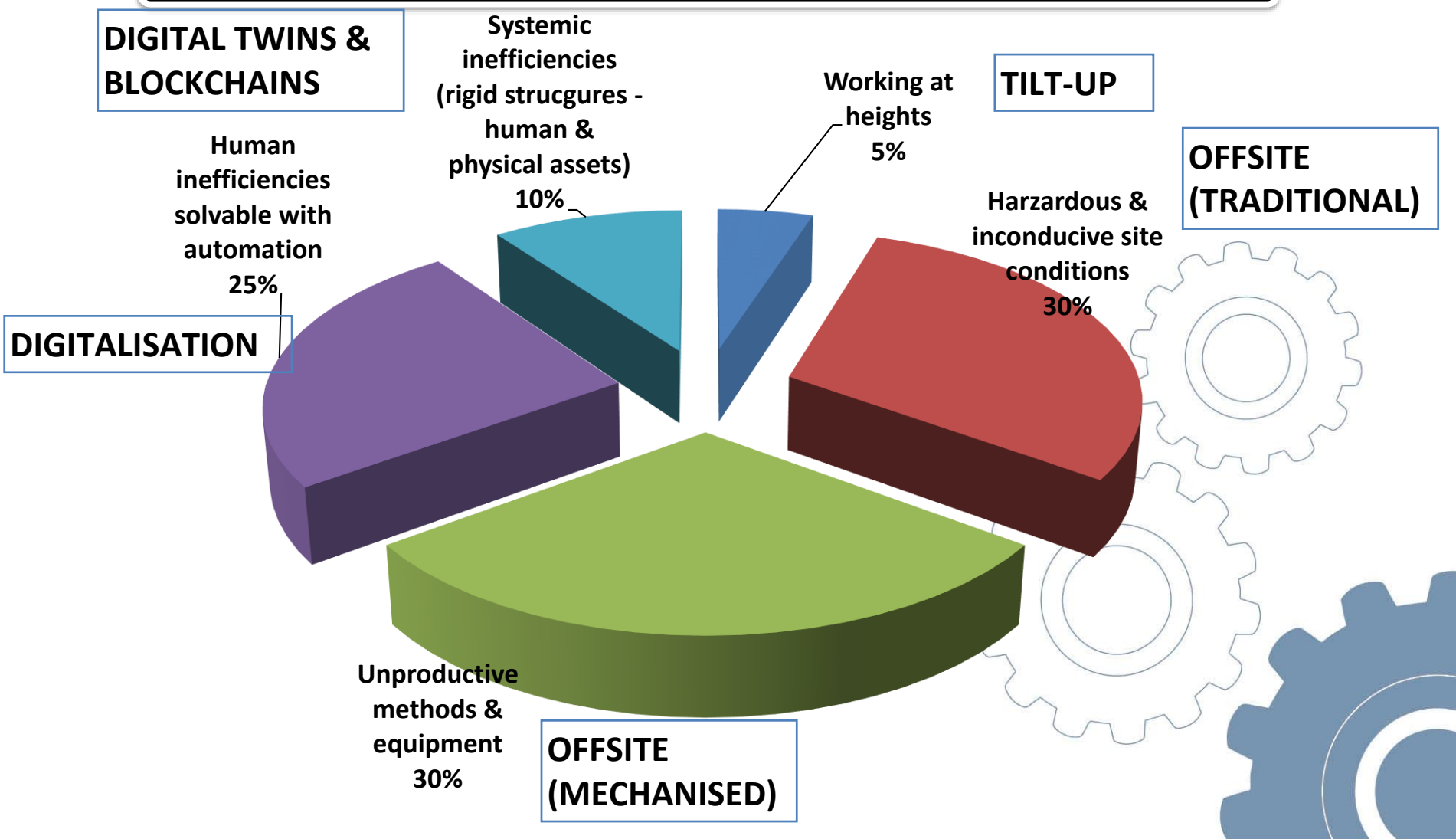
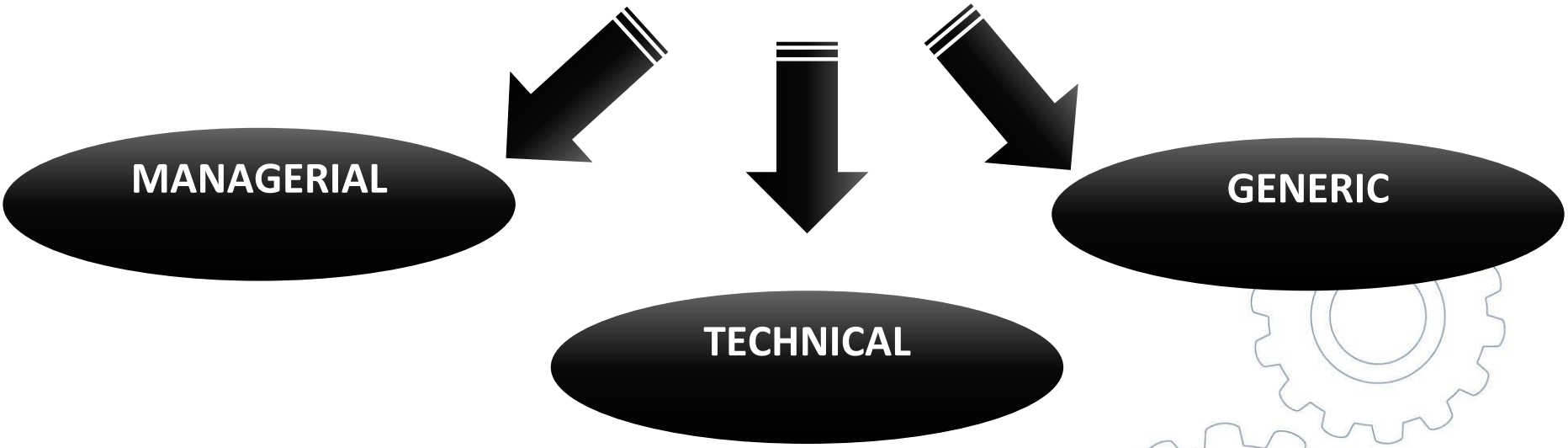
FROM ONSITE TO OFFSITE: THE EVOLUTIONARY TREND



IMPACTED SKILLSETS: THE CATEGORIES



1] INTEGRATION MANAGEMENT & COORDINATION SKILLS

[Extended management & coordination scope to include horizontal & vertical integration of supply chain partners]

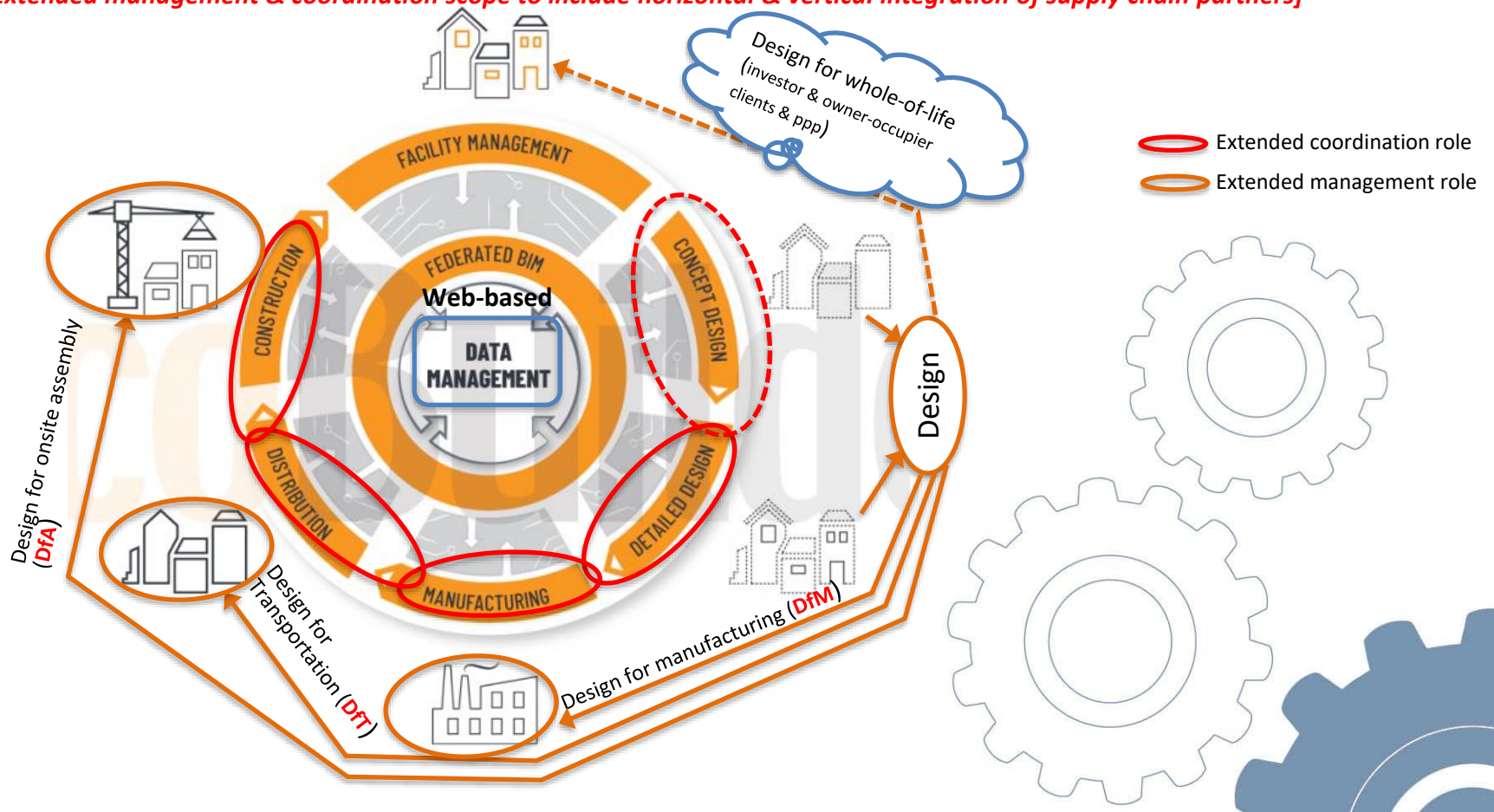


Fig. 2: Harmonising design, OSM, onsite assembly & facility management through horizontal & vertical integrations of supply chain partners [*Source: Adapted from co-Builders, https://cobuilder.com/en/berkeley-modular-cobuilder/*]

TECHNICAL SKILLS: IMPACT SCENARIOS

DECLINING ONSITE SKILLS

- ✓ Onsite technical skills fully transferrable to offsite.
- ✓ E.g. wet construction (superstructure insitu concreting, masonry & finishings); onsite stick & frame construction.

CONTINUING ONSITE SKILLS

- ✓ Onsite technical skills not transferrable to offsite.
- ✓ E.g. Substructure works (earthworks, services first fix, onsite substructure wet construction).
- ✓ Tilt-up construction

EMERGING SKILLS

- ✓ Automated and digital construction skills
- ✓ E.g. CAM, 3D house printing, 3D scanning, IoT, robotics.

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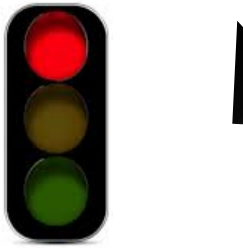
GENERIC SKILLS: IMPACT SCENARIOS



DECLINING SKILLS

- ✓ Paper based documentation and document control
- ✓ Siloed/lone-ranger work approach.
- ✓ Site-based project management.
- ✓ Co-located teamwork

CONTINUING SKILLS

- ✓ Negotiating skills
- ✓ Team building & team work skills
- ✓ Networking skills
- ✓ Market intelligence
- ✓ Client relationship management
- ✓ Partnering.
- ✓ Multi-skilling/multi-tasking

EMERGING SKILLS

- ✓ Computing & ICT
- ✓ Paperless business environment
- ✓ Smart contracting
- ✓ Data analytics
- ✓ Cloud-based project management, workflow and collaboration.
- ✓ Distributed agile team working

CONCLUSIONS

EVOLUTIONARY TREND: ONSITE TO OFFSITE & BEYOND: QUEST FOR PRODUCTIVITY IMPROVEMENT:

Construction skillsets transformations:

***As focus shifts from*:**

- ✓ **Empowering onsite workforce with more productive plant & equipment**
- ✓ **Minimising hazards and inefficiencies inherent in working at heights through onsite ground fabrication and tilt-up approaches**
- ✓ **Minimising onsite hazards & inefficiencies through transfers to factory controlled and conducive work environment**

To:

- ✓ **Partial automation of offsite work processes through robotised approaches**
- ✓ **Replacement as much as possible labour inputs in routine/repeated work processes with digital workflows**
- ✓ **Digital twin technologies (robotics, AI, IoT, blockchain) for optimised scalability, reliability, visibility and productivity**

THANK YOU