Overview

MY BACKGROUND
- Pre academia
- Academic roles
- Non academic roles (internal and external)

CHALLENGES AND SOLUTIONS
- Clients and developers; projects and programs
- Focus on major influencers
- Adoption of new technologies
- Change and collaboration
- Structure and behavior
chains...clusters...networks

journey

*From Katherine Gorge to Federation Square and beyond*
SUPPLY CHAIN LENS
CLIENT AND MARKET LEADERS

Prof Kerry London
2019 CANBERRA AUSTRALIA

chain metaphor

Supplier's suppliers: agents, OEM manufacturers etc.
Subcontractors: specialist, supply and install, equipment hire etc.
Materials & product suppliers: agents, distributors, secondary manufacturers
Consultants: architectural, engineering, cost project management
Contractors: construction managers, developers
Client: building owners, developers
Regulators Policy makers
Financier
Users: tenants, owners, public
Ways of looking at the chain

- 5 different levels
- Network and Regional Clustering modelling and research is difficult

Policy analysis
International emergence of a Government call to action

- 1990-2005
- 5 countries: Singapore, UK, US, South Africa, Australia
- Emerging awareness
- Industry was interpreted as fragmented and a problem or specialized and within the context of cooperation/competition
- Normative vs Positive
SUPPLY CHAIN THEORY AND PRACTICE

- 1980-2005
- 4 themes
- Distribution, production, strategic procurement management, industrial organizational economics
- Construction lack of research in IO ie networks and clusters

Cross disciplinary conceptual model

- IO model: Structure Conduct Performance model; structural and behavioural characteristics
- Structure of an industry and conduct of firms interact (strategy) to produce firm and industry performance characteristics; performance produces profitability and can in turn influence structure (ie size & market dominance) and progressiveness towards technology which will in turn influence demand
- Government intervenes to regulate and/or influence structure, conduct, demand etc
SUPPLY CHAIN PROCUREMENT structure and behaviour: mapping

- Over 1500 procurement relationships
- 13 subsectors
- 5 case studies

SUPPLY CHAIN SECTOR AGGREGATED MAPS
moving from positive to normative model

- Where is market power?
- At what tier?
- How can we catalyse change?
- Where is the risk?
- Where are we using power?
- Where are we relying upon influence?
- Change for efficiency, innovation and/or productivity
SUPPLY CHAIN PROCUREMENT MODELLING
normative model ...

Toyota Production System

- Womack’s “The Machine that changed the world”
- Reduce Waste
- Lean Production and Lean Construction [TPS]

Nischiguchi’s “Strategic Sourcing”
- Historical economic context;
- structural reorganization to achieve transformation ie TPS
- Industrial organization economic perspective and clusters and networks
SUPPLY CHAIN PUBLICATIONS
foundational principles

20 YEARS RESEARCH PORTFOLIO CONNECTED STUDIES

Interconnecting threads:
supply chain theory and practice
improve industry or respond to societal problems
AHSCA charter

The Alliance’s role is to develop strategies to enable the vision that through rigorous research we shall develop, implement and test defined changes to improve the efficiency, effectiveness and capacity to ensure a sustainable Australian housing industry through:

- Cultural change and continuous improvement
- Supply chain management
- Innovative products and processes

Frasers, CSR, Boral, MBA, HIA, WSU, Metricon, VBA, FMG Eng

Who is part of the Alliance?

CULTURAL AND BEHAVIOURAL CHANGE FOR A MORE EFFICIENT, EFFECTIVE AND ETHICAL INDUSTRY
How can we improve our staff skills?
With Dr Kalfhan, Dr Maqsood

- **Approach 1: 2007-08**
  Qld govt and BCC project implemented Supplier Group Strategy Map: normative model

- **Approach 2: 2010-12**
  VIC EPA Housing project: we let the data analysis guide us given the context: created a tool given the descriptions and analysis we did: emergent ie positive model
Organisation

Action

research

Raise awareness

and begin

conversations
Know
Apply
Change
rules

External supplier management

Know the rules

Rules Microscope Plan

Strategy

Procurement Plan

Supplier

Supplier and Team Council strategy aligned with corporate objective

Applications

Supplier to provide supplier and make subcontractor account for location and job classification

Contact needs for data transfer to ensure supplier is accepted with key business objectives such as commercial, innovation, service, quality, sustainability

Applied the rules

Supplier Microscope

Sustainability policy accepted into the ‘level’ and made of all staff on all job and venue information depends upon all things are equal

 assert vendor awards and the venue transformation objective of the organisation and their results within in the subject these objective

Strategy generated

Nullification systematically based on individual risk and necessity (e.g. operate in areas where small operating risks

Consistent process to ensure dialogue with venue transformation specialist activities

Strategies of engagement

Sustainability policy accepted into the ‘level’ and made of all staff on all job and venue information depends upon all things are equal

Assist vendor awards and the venue transformation objective of the organisation and their results within in the subject these objective

Procurement

Supplier Microscope

Sustainability policy accepted into the ‘level’ and made of all staff on all job and venue information depends upon all things are equal

Assist vendor awards and the venue transformation objective of the organisation and their results within in the subject these objective

Application

Supplier to provide supplier and make subcontractor account for location and job classification

Contact needs for data transfer to ensure supplier is accepted with key business objectives such as commercial, innovation, service, quality, sustainability

How do you apply what you have learned?

Once you have completed this module, you will be able to work out the clear evidence that the management and the employees in your organisation and you can identify what actions need to be taken to improve engagement in your organisation.

Coordination and development

Business culture measures and strategies and make visible plant wide

strategy to make venue transformation efforts part of annual agreement

Employee, feel empowered to make a suggestion to venue transformation opportunities

Formally integrate decision making culture feedback into ongoing processes and strategies through the formation of an internal decision development and implementation of venue transformation strategies.
1 decision framework

9 elements
I. purpose
II. risk management
III. ownership
IV. business plan
V. integration
VI. competencies
VII. culture
VIII. technical support
IX. knowledge management
Reviewing and Approving Design with BIM


Prof Kerry London
2019 BRISBANE AUSTRALIA
Past project...2014
China Australia Industrialised Building Project
Integrated International Construction Supply Chains - Knowledge Transfer for Seamless Off-site Housing Systems

- Conducting joint public guest lectures and workshops in universities of China.
- Visiting the relevant off site housing systems manufacturing facilities in China.
- Capturing, sharing, transferring and documenting knowledge related to off site housing systems acquired before, during and after the visit.

China Challenges
Modular Housing stakeholders

- Gaining certification from foreign countries’ government, and meeting foreign countries’ regulations, standards and requirements
- Transportation delays impact servicing of contracts, increase lead times and affect profitability, company credibility
- Profitability is decreasing because of the increase in competition
- Communication with clients on design, changes of design and scope; lack of communication between design and construction units & drawing errors
**China Challenges:** High rise developer

**Government role**
- No support in the beginning for development of new technology
- Little policy/regulation on new technology
- Cost on generating new technology

**Technical**
- Lack of technologies
- Size of the parts can vary and are difficult to manufacture

**Skills**
- Lack of skills across range of stakeholders (labours, traders, professionals);
- Lack of experience in new technologies: mfrs don’t know how to make components; designers don’t know how to design for etc...

**Cost**
- Increased cost of building. Increase by 100-500RM8/m²

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**Australia Challenges**

**Economics and market**
- Insufficient demand from housing contractors for profitability and ROI
- Market stability
- Fear of being innovator (first to market) only to have technology copied before ROI is achieved (ip)
- Fear of imported products/systems that are less costly
- Economic risk in start-up capital costs for land and factory

**Technical**
- New products/systems bring with it new challenges
- Lack of knowledge of technology and thus R&D investment
- Lack of onsite capability to problem solve installation
- Unexpected site constraints delay installation : IR
- Lack of compliance to current regulations and thus increased time to negotiate new approvals for compliance
Australia Challenges

Skills
- Lack of technical knowledge for onsite installation
- Level of PM capabilities (reliance of subcontractor system)
- Assurance in quality
- Lack of predictability/standardization of construction methodology
- Lack of input at early decision making stage
- Lack of Building Information Modelling

Economics and market
- Nervousness of equivalent quality provided by alternatives
- Competition: Cost of alternative product/system does not affect the price point for a particular customer range
So where to now?

Informed and positioned the ARC Linkage project: Shared understanding & we could talk about:

- innovation
- off site manufacturing
- supply chains

BUILT ENVIRONMENT & URBAN TRANSFORMATION:
OFF Site (OSM) Manufacturing Collaborative Practices to Deliver Change

Housing sector challenges

- **ROOT CAUSE**
  - Inefficiency in construction process

- **CHALLENGE**
  - high levels of collaboration

- **SOLUTION**
  - OSM addresses fragmentation

- **OBSERVATIONS**
  - Fragmentation
  - Increasing construction time
  - Craft based construction

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What were our project goals?

**OBJECTIVES**
- Identify drivers & barriers to OSM
- Examine the nature of collaboration in OSM networks
- Explore collaboration and effectiveness link

**OUTCOMES**
- Theoretical contributions: change, innovation, collaboration, supply chains
- Collaboration models for practice
- Training materials; recommendations for housing policy
What is OSM?
The manufacture and assembly of components, systems, pods, and/or complete modular constructions in a controlled environment away from the construction site, often with the use of industrialized methods.

**Building components**
- windows, roof trusses, prefabricated concrete columns and beams, etc

**Building systems**
- timber cassette floors, panel wall systems

**Pods**
- Kitchen and bathroom pods

**Modular detached units**
- affordable housing, volume customised housing, disaster relief shelters, construction camp dwellings, mining camp offices

**Modular housing units**
- Complete units stacked into low-medium or high-rise buildings
How did we investigate?

2015-2017
- 5 X OSM supply chains
- 29 X interviews
- Intensive qualitative analysis
- Project Steering Committee every 3 months
- Academic publications

2016-2017
- Identification of 102 themes from data
- Categorization into nine Collaborative Practice Elements
- Events

2017
- Development of suite of training materials based on elements

2018-2019
- Testing and refinement
- Commercialisation
- IP and Licensing
- Marketing assets

Methodology

- QUESTIONS
  - Experiences
  - Who collaborated with whom
  - Nature of collaboration
  - Best practices, areas for improvement

Conduct case studies

Build model
- Draw from literature
- Draw from empirical observations

Validate model
- Present model to selected panel of experts
- Revise model based on analysis

Test model
- Develop training OSM collaborative practice materials

Present model to selected panel of experts
- Revise model based on analysis
- Develop training OSM collaborative practice materials
What did we investigate?

CASE 1
VIC
MNE
Systems
Low to medium rise

CASE 2
SA
SME
Modular detached

CASE 3
TAS
SME
Components
Housing and commercial, low to medium rise

CASE 4
VIC
Startup
Components
Housing, low-rise, detached

CASE 5
VIC
Startup
Components
Housing, low-rise, detached

Who does OSM?

Size
Micro
SME
MNC

Maturity
Startups
Growth

Position
Designer and Constructor consortium led
Manufacturer consortium led
CASE TYPOLOGIES

### Case Typologies

#### Firm Characteristics

<table>
<thead>
<tr>
<th>Level of Maturity</th>
<th>Startup</th>
<th>Growth</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>MICRO</td>
<td>C2</td>
<td>C3</td>
</tr>
<tr>
<td>Level of OSM</td>
<td>COMPONENTS</td>
<td>SYSTEMS (SMALL, MEDIUM, ENTERPRISE)</td>
<td>COMPLETE HOUSE</td>
</tr>
<tr>
<td>Nature of Product</td>
<td>HOUSING, DETACHED</td>
<td>SINGLE STOREY</td>
<td>MULTIFAMILY</td>
</tr>
<tr>
<td>Complexity of Design</td>
<td>LOW, ZERO OR SMALL PORTFOLIO OF COMPLETED OSM PROJECTS</td>
<td>MEDIUM GROWING PORTFOLIO OF OSM PROJECTS</td>
<td>HIGH SUSTAINED HISTORY OF CARRYING OUT OSM PROJECTS</td>
</tr>
<tr>
<td>Involvement of a Champion in Pushing for OSM</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>HIGH</td>
</tr>
<tr>
<td>Case of Transition from Traditional Mindset to OSM Mindset</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

*C* stands for “Case”, C1=Case 1

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#### OSM Drivers Across Firms

<table>
<thead>
<tr>
<th>Cost Reduction</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality/Craftsmanship Related to Customization</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Capturing New Market Niches</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Worker Safety/Comforth</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Social Sustainability (Managing Impact on Communities)</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Environmental Sustainability (Waste Management, Energy Efficiency)</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Process Predictability, Precision, Control</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
<tr>
<td>Speed and Efficiency</td>
<td>C3</td>
<td>C4**</td>
<td>C1</td>
</tr>
</tbody>
</table>

*Modified from high; cost reductions tend to be offset by transport costs of transportables
** C4 data is based on claims, as a startup, these are yet to be demonstrated*
LINK TO PERFORMANCE

- Capturing new markets/niches
- Better quality, craftsmanship
- Addresses productivity constraints
- Less cost (in some cases)
- Speed and efficiency
- Process predictability and control
- Increased worker safety and/or comfort
- Social sustainability (community impact) and environmental sustainability
- More sophisticated designs (in some cases)
- Innovation/learning
- Process flexibility/customization possibilities
- Better waste management

How did we investigate?

Five case studies
Nine collaborative practice elements
Training materials

Data (1200+ pages)
Themes (102) and Categories (4)
Collaborative Practice Elements (9)
What makes OSM work/fail?

...when we’re doing everything, that closes the door to other collaborations, or makes people sort of, not suspicious, but wary of collaborating with us. So it’s wary for architects to collaborate with us because are we their competition? It’s wary for builders to collaborate with us, because are we their competition, when we’re neither.

So the exciting thing about it is that we can partner with other people that aren’t necessarily just the prefab lab or just on a workshop build. We’ve got the opportunity to work with other builders. We’ve got the opportunity to team up with other designers for another design thing.

...when we’re doing everything, that closes the door to other collaborations, or makes people sort of, not suspicious, but wary of collaborating with us. So it’s wary for architects to collaborate with us because are we their competition? It’s wary for builders to collaborate with us, because are we their competition, when we’re neither.

ARC LINKAGE PROJECT (2015-2018)

CASE STUDIES OF OSM What makes OSM work/fail?

So the exciting thing about it is that we can partner with other people that aren’t necessarily just the prefab lab or just on a workshop build. We’ve got the opportunity to work with other builders. We’ve got the opportunity to team up with other designers for another design thing.

Working in teams definitely works better depending on what you’re working on. So certain components are relatively small and minor. It depends on what you’re working on. Sometimes more people is better; sometimes a smaller team’s better, sometimes on your own.

So from assembly teams, to the guys working at the plant, they’re all going to be rotating...[they will also] assemble. Because they’ve all got the same skill levels.

THEME #2: CONFLICTS OF INTEREST

THEME #38: FLEXIBLE EMPLOYEE SKILL SETS

THEME #32: FLEXIBLE STRUCTURE

THEME #37: OPTIMAL TEAM SIZE

THEME #3: FLEXIBLE EMPLOYEE SKILL SETS
Then we checked it and we would go to them and say “This is out. This is not within tolerance.” And they would reply by saying, “It’s only five millimetres. It’s nothing.” And I said to them we need to change our mindset, we need to persist and get more accurate in this and really put the effort in.

And again when I started, there’s no agreements in place, there’s no pricing grid there’s no SLRs, there’s no any of those things. So I’m trying to bring to that, like get some agreements in place. Because I want to understand timeframes, for me, it’s about, time costs quality, and get that, and less of the handshake.

…engineers will always be involved nice and early because in prefab very often everything has to be – you can’t work it out onsite. So the engineers are producing more documentation than they probably would be in a traditional build. … The prefabrication is a lot more work. Like, documenting that, in that method, there’s a lot more work than just doing a traditional house.

But because we know exactly how much quantity we’re going to have the builders don’t know that so if we talk to a builder— they’ll say ‘my plumber has cost me $3500 for that job to do that house’ and we’ll say, ‘you know what, to buy a bit of plastic, put some pipes in and do all that stuff it’s probably about $700 so tell me how you make up the labour at $3500?’ That’s the conversations we’re having with the builders.
What makes OSM fail?

- THEME #4: INFORMATION-SHARING HURDLES
  - engineering will always be involved nice and early because in archi... things has to be – you are probably... work than just doing a traditional house.
  - Then we checked it and we would go to them and say “This is out. This is not within tolerance.” And they would reply by saying, “It’s only five millimetres. It’s nothing.” And I said to them we need to change our mindset, we need to persist and get more accurate in this and really put the effort in.

- THEME #63: TIGHT TOLERANCES
  - This and going past two percentage in. And they...

- THEME #14: LACK OF FORMAL AGREEMENTS
  - And again when I started, there’s no agreements in place, there’s no price, those things agreements... timeframes, for me, it’s about, time costs quality, and get that, and less of the handshake.

- THEME #22: INCREASED TRANSPARENCY
  - But because we know exactly how much quantity we’re going to have the builders don’t know that so if we talk to a builder they’ll talk to... £3500 for that. I know what... do all that to make up the labour at £3500? That’s the conversations we’re having with the builders.

ANALYSIS STAGE 1

- OSM Drivers (33)
- OSM Barriers (17)
- Collaboration Drivers (28)
- Collaboration Barriers (22)
FORUM DISCUSSION

SKILLS

PROFESSIONALIZATION

MANAGING CHANGE

ECONOMICS/ MARKETS

REGULATIONS/ STANDARDS

COLLABORATION

• Importance of team collaboration around manufacturing
• Importance of suppliers seeing the benefits of OSM to get them on board
• Importance of building alliances, relationships, trust
• Importance of incentives that will make people collaborate better
• Engineers can be communication conduits
• Importance of building the idea that "we can pull this off together"
• Bring supply chain along with you
• Will fail if support is not there
• Initiatives require that one speak to all people involved; the whole supply chain should be involved
FORUM DISCUSSION

RELATED FINDINGS:
• Largely confirmed by findings.
• Collaborative drivers: include involving partners (preferably at early stages), building long-term relationships, incentivizing suppliers, and mobilizing the entire supply chain.
• Importance of team collaboration around manufacturing
• Importance of suppliers seeing the benefits of OSM to get them on board
• Importance of building alliances, relationships, trust
• Importance of incentives that will make people collaborate better
• Engineers can be communication conduits
• Importance of building the idea that "we can pull this off together"
• Bring supply chain along with you
• Will fail if support is not there
• Initiatives require that one speak to all people involved/ the whole supply chain should be involved

FORUM DISCUSSION
BUILT ENVIRONMENT & URBAN TRANSFORMATION:
Off Site (OSM) Manufacturing Collaborative Practices to Deliver Change

Five case studies
Nine collaborative practice elements
Training materials
BUILT ENVIRONMENT & URBAN TRANSFORMATION:
Off Site (OSM) Manufacturing Collaborative Practices to Deliver Change

Highlights

- Interactive collaborative training experience at MBAV
- Customised at a given location
- 2-3 participants interacting with actors
- Evaluation by organisational psychologists
- Two training scenarios
- Deep immersive
- Individual and group assessment
BUILT ENVIRONMENT & URBAN TRANSFORMATION: Off Site (OSM) Manufacturing Collaborative Practices to Deliver Change

What makes up the training package?

- Five case studies
- Nine collaborative practice elements
- Training materials

1. Collaborative Practice Model
2. Collaborative Practices Actions (CPA) and Position Competency Matrix
3. CPA Index
4. Indicator Descriptors
5. Training Scenarios
6. Collaborative Practice Training
BUILT ENVIRONMENT & URBAN TRANSFORMATION:
Off Site (OSM) Manufacturing Collaborative Practices to Deliver Change

ARC LINKAGE PROJECT (2015-2018)

CASE STUDIES OF OSM
• 130+ specific knowledge, skill, and behavioral attributes linked to collaboration

Competencies

Index

• Allows organizations to assign weights to competencies, supporting customisation

• Detailed training instrument for assessing high, medium and low attainment of attributes

Indicator descriptors

Training scenarios

• Carefully-scripted scenarios with hired actors to create an authentic collaborative

Training scenarios

PRACTICE
THEORY

Index

• Grid showing how lines in the script map to competencies

• Grid showing how scenarios and competencies map to specific elements of our theoretical

Scenario structure

Links

 Indicator descriptors

Network creation

• Concept map showing how our empirical data enriches understandings of network creation

Network creation

Leadership

Goals and Norms

Expertise

Change

Resource Investment

Problem Solving

Shared space

Organising Mechanisms

Technical standards

Collaborative Practice Model

Collaborative Practice Model

Leadership
Create a leadership environment for change

Expertise
Design a well-qualified project team

Shared Goals
Envision a compelling OSM project addressing well-described issues

Collaborative Practice Model

Change
Strategise for change & manage resistance

Investment
Invest in people & assets

Shared Space
Create & sustain productive face-to-face & virtual interactions
BUILT ENVIRONMENT & URBAN TRANSFORMATION: Off Site (OSM) Manufacturing Collaborative Practices to Deliver Change

### Collaborative Practice Action Indicators Descriptors

<table>
<thead>
<tr>
<th>Collaborative Practice Action Indicators Descriptors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem Solving</strong></td>
</tr>
<tr>
<td>Membership &amp; Collaboration</td>
</tr>
<tr>
<td>backlog in delivering projects</td>
</tr>
<tr>
<td><strong>Organizing Mechanisms</strong></td>
</tr>
<tr>
<td>Membership &amp; Collaboration</td>
</tr>
<tr>
<td>effective exchange of information between team members</td>
</tr>
<tr>
<td><strong>Technical Standards</strong></td>
</tr>
<tr>
<td>Membership &amp; Collaboration</td>
</tr>
<tr>
<td>implementation of standard</td>
</tr>
</tbody>
</table>

**Back of house**

PGCS 2019
Kerry London

Future directions

MY BACKGROUND
- Non academic roles (internal and external)

CHALLENGES
- major projects; cost over runs and time delays
- Phd students
  - cultural impact on leadership in oil and gas sector
  - clients on megaprojects and politics
- two speeds and ‘bubbles’
- Bumping up against the internal client organization politics
- Connections between project team and key decision makers
- circles of influence and boundary spanners

OPPORTUNITIES: INFLUENCES AND INFLUENCERS
- Professional associations
- Large clients
- Education institutions; research and teaching