



International Council  
for Research and Innovation  
in Building and Construction

Priority Theme

**IDDS**

Integrated **D**esign & **D**elivery **S**olutions

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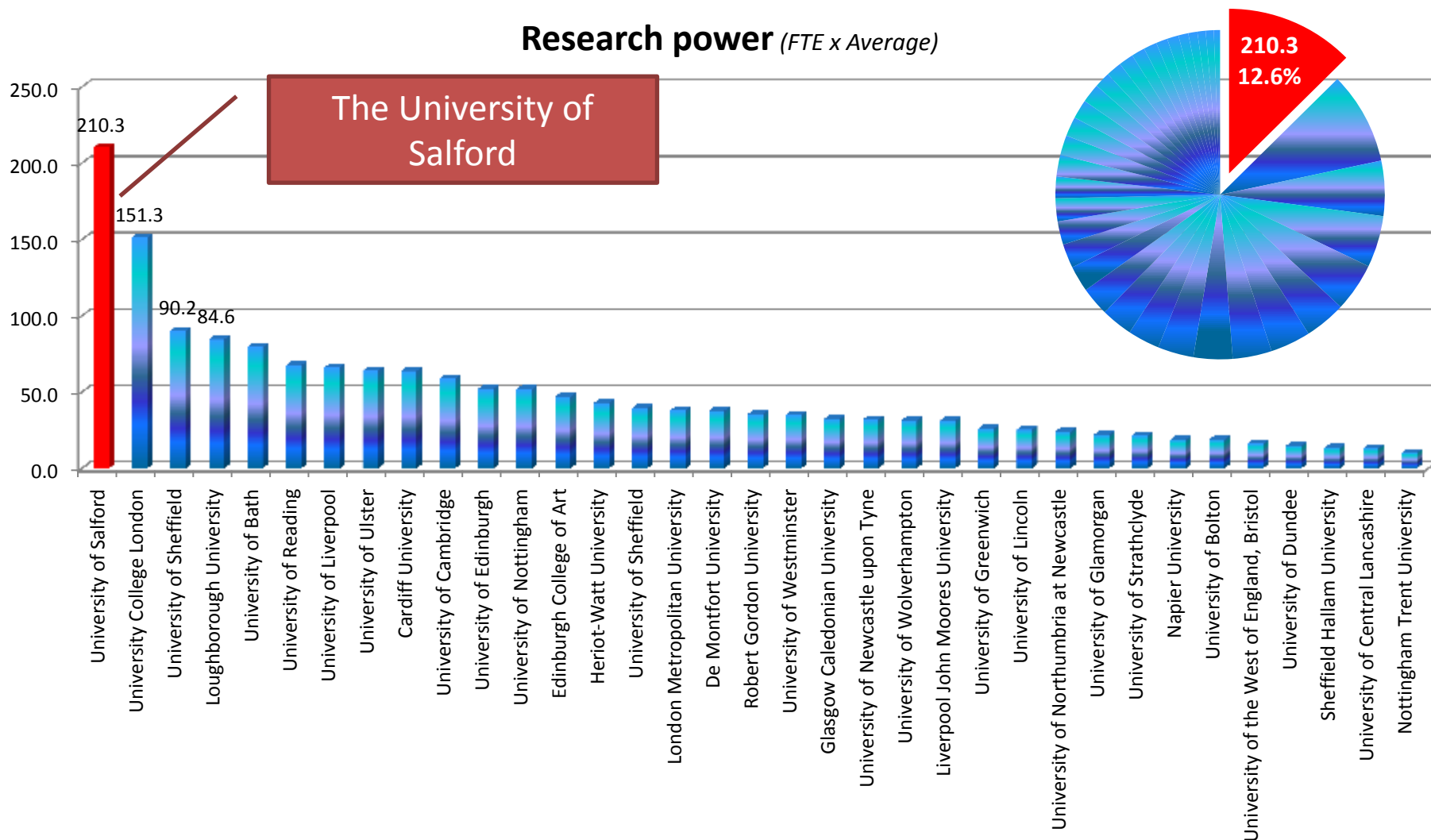
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# Who am I?

Skip to CIB



# UoA 30 (Architecture & BE) - (RAE 2008)





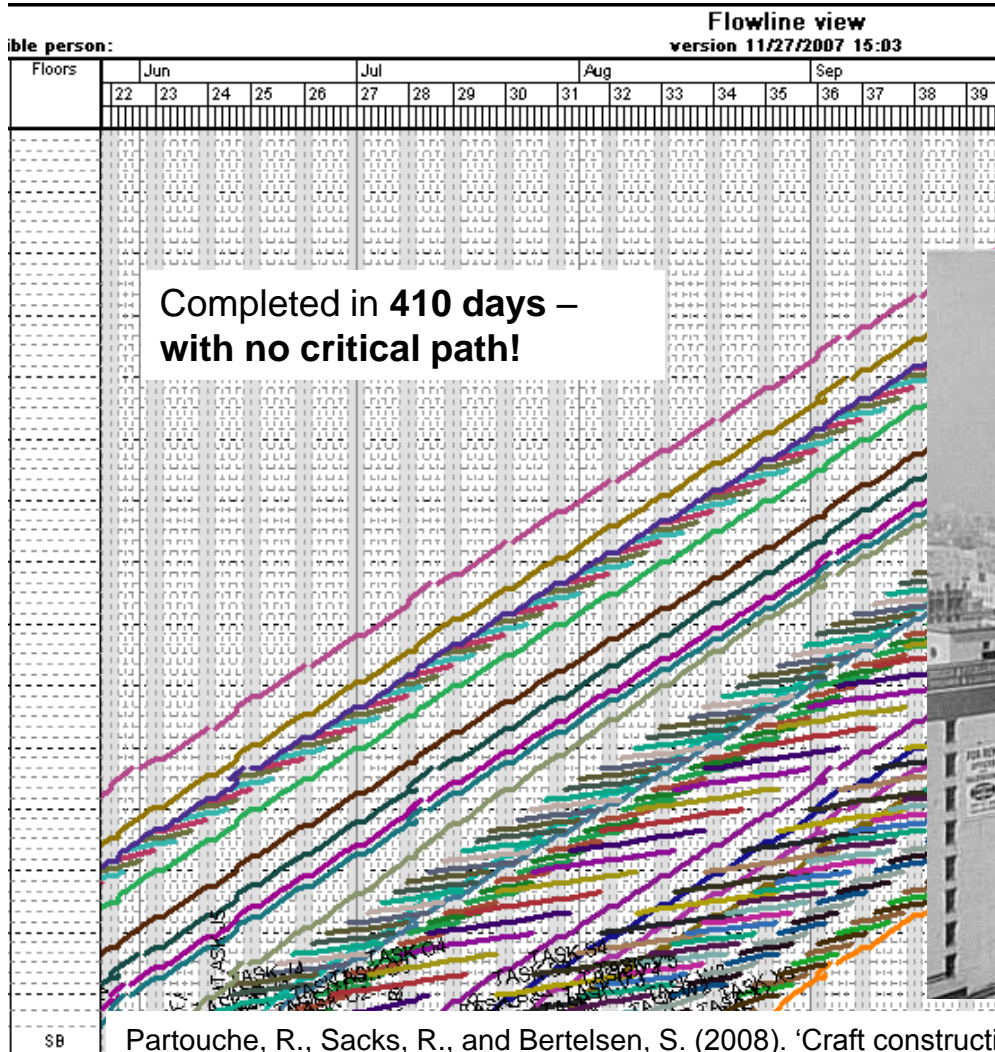
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# Sector Issues

Skip to Integrated Design & Delivery Solutions

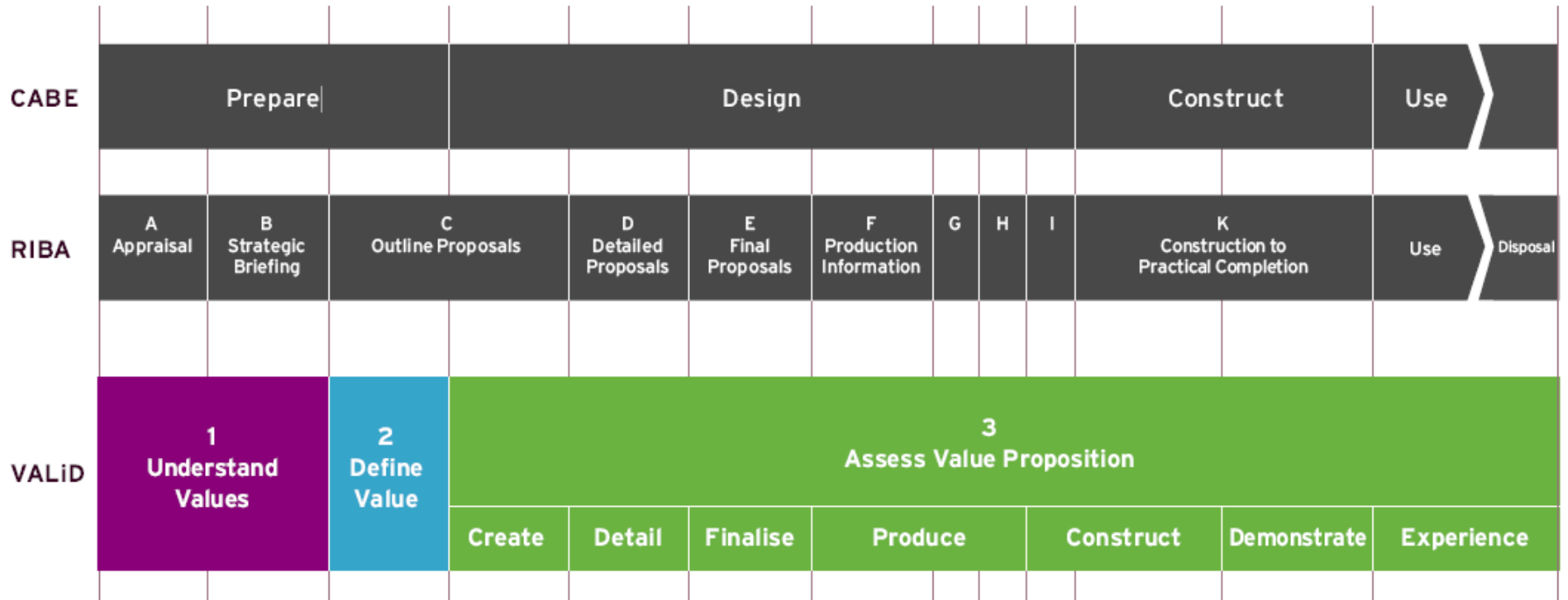


# Empire State Building



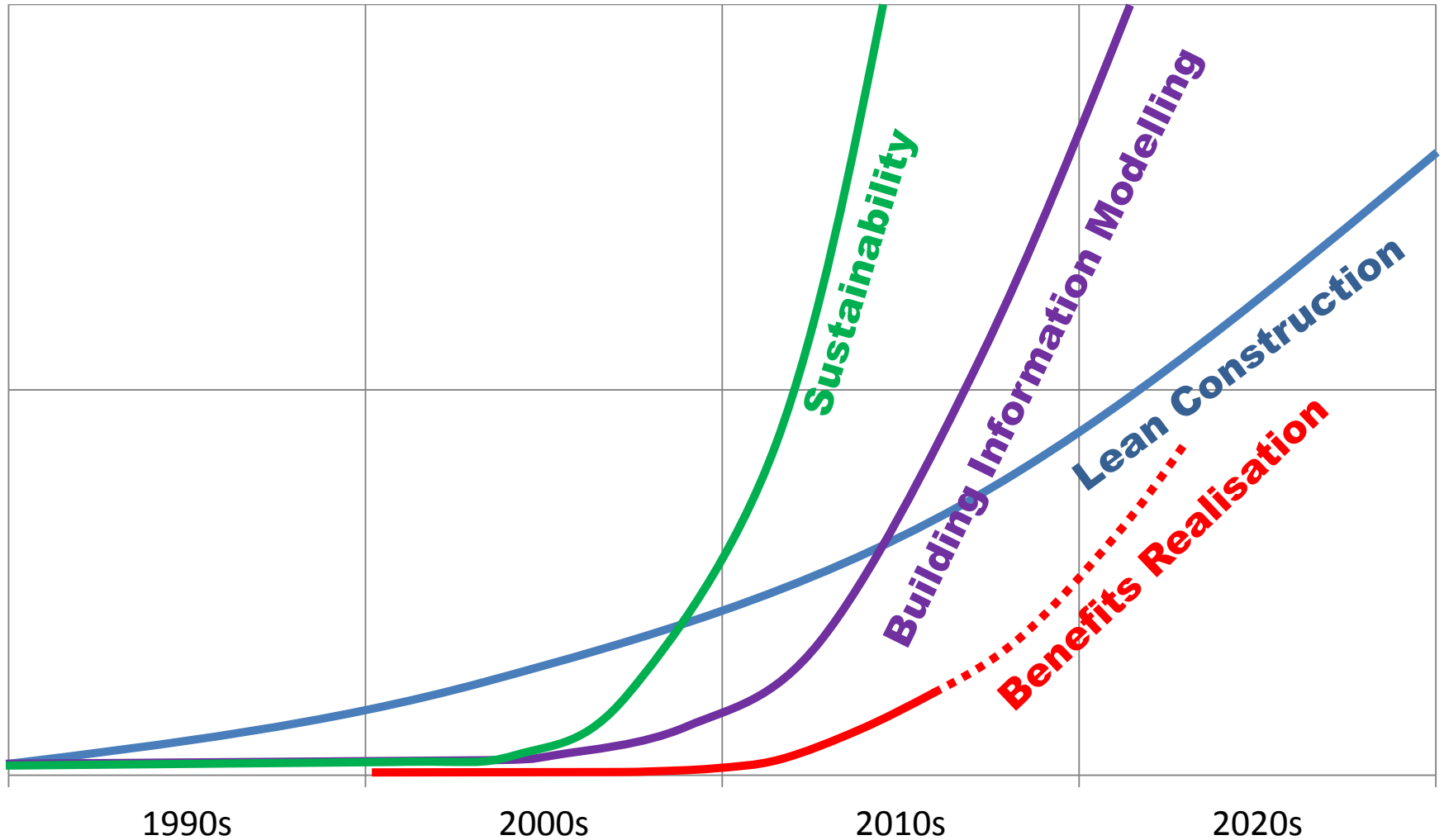
Partouche, R., Sacks, R., and Bertelsen, S. (2008). 'Craft construction, mass construction, lean construction: lessons from the empire state building', Proceedings of the 16th Annual Conference of the International Group for Lean Construction IGLC16, P. Tzortzopoulos and M. Kagioglou, (Eds.), University of Salford, Manchester, UK, pp. 183-194.

# Broken Macro Processes



Source: Loughborough University

# Catalytic Trends for IDDS





# BIM to become part of public procurement process

1 October 2010 | By Anna Winston

*"I am convinced that BIM is the way to unlock new ways of working that will reduce cost and add long-term value to the development and management of built assets in the public sector."*

**Paul Morrell**

Autumn 2010

Chief Construction Advisor to the UK Government  
& Keynote Speaker for IDDS at CIB World Congress

The government's chief construction adviser Paul Morrell has said that Building Information Modelling (BIM) will become a requirement for the procurement of public buildings.

Yesterday, Morrell indicated that the use of BIM on public building projects would be mandatory from next year.

"To unlock new ways of working that will reduce the cost to the development and management of built assets in the public sector, but the move needs to be supported by the works for government clients and which draws on proven practices," said Morrell.



## RELATED ARTICLES

[Do architects have a future?](#)

13 August 2010

[Columbia Building](#)

A trial team is currently testing the use of BIM on public building projects and will report its findings to the Construction Committee. Morrell said that he hoped that the report would be a commitment to a timed programme of work.

Official announcement of the BIM requirements in public projects will happen on 22<sup>nd</sup> June 2011. Based on preliminary information it will be mandatory in all projects with budget £5 million+

<http://www.bdonline.co.uk/news/uk/bim-to-become-part-of-public-procurement-process/5006655.article>







*Change Order*

*Original Contract*

40 YAMAHA



# Sutter Health Castro Valley – The First IDDS Solution?

- Eleven party Integrated Forms of Agreement (IPD)
  - 100% of profit was at risk versus a 50% share of any savings
  - truly collaborative relationships
  - whole team meeting every two weeks for two days
  - “all kinds of misunderstanding were uncovered”
  - abandonment of ‘design intent’ as an end in itself
- Lean Construction
- Building Information Modelling
- Need to deliver 30% faster to beat regulatory change (seismic)
- Triple victory: on budget; on time; and with all goals intact

# IDS Formation 2006 - 2008

- CIB Board approves Integrated Design Solutions Priority Theme proposed by Matti Kokkala & Arto Kiviniemi of VTT and Bob Tatum Stanford to:
  - complement and unite the three existing themes (Sustainable Construction, Performance Based Building, and Revaluing Construction)
  - strengthen the other themes' link to the CIB working commissions and task groups
  - be a strategic tool for the objective of creating a common focus for the disparate areas of research by the working commissions and task groups





## CIB White Paper on IDDS "Integrated Design and Delivery Solutions"



CIB Publication 328  
ISBN: 978-90-6363-060-7



# IDDS

# IDDS White Paper

This global priority theme is aimed at transforming the construction sector through the rapid adoption of new processes, such as Integrated Project Delivery (IPD), together with Building Information Modelling (BIM), and automation technologies, using people with enhanced skills in more productive environments.

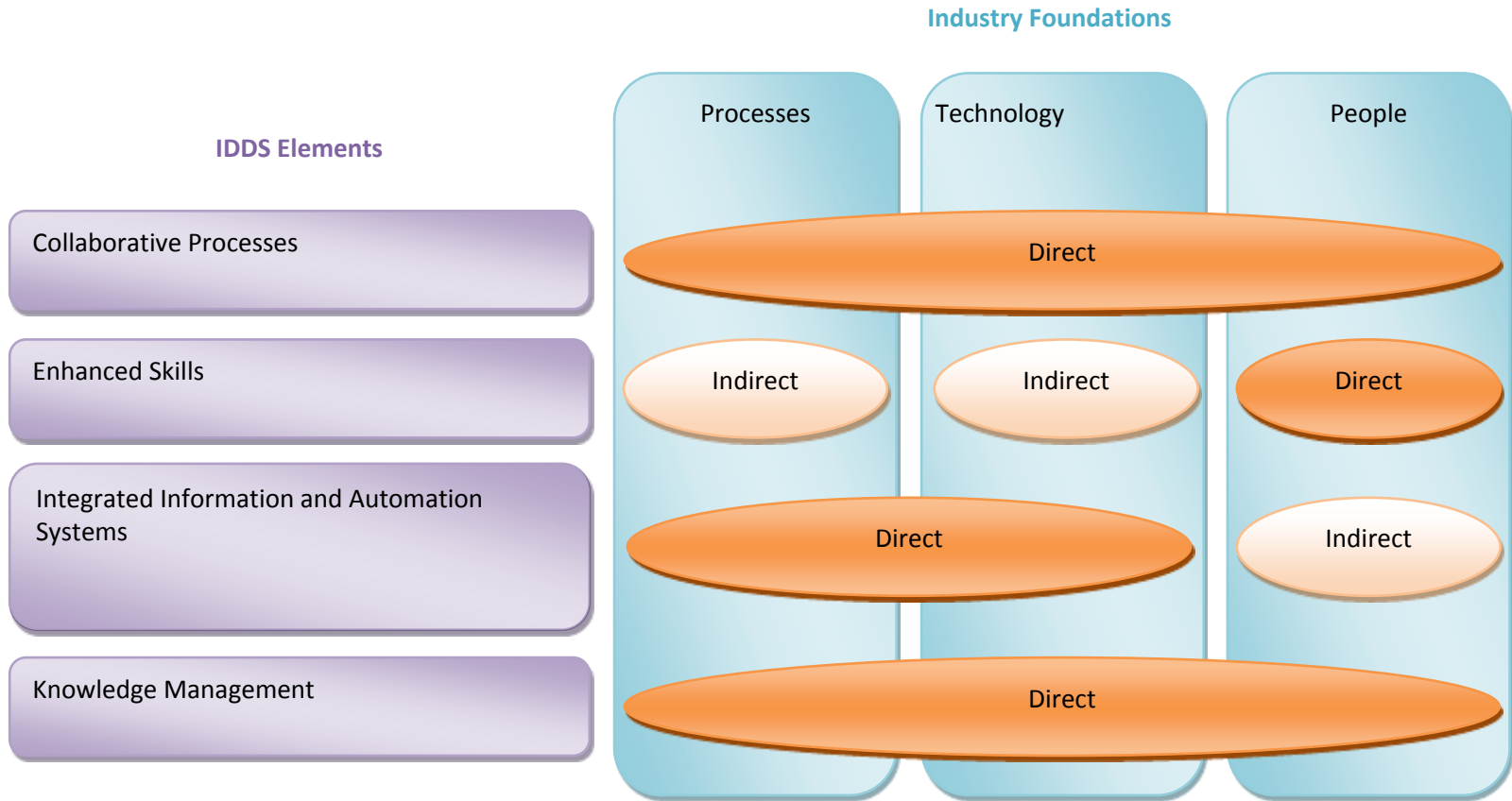
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The development of IDDS is about radical and continuous improvement, rather than development of a single optimal solution.

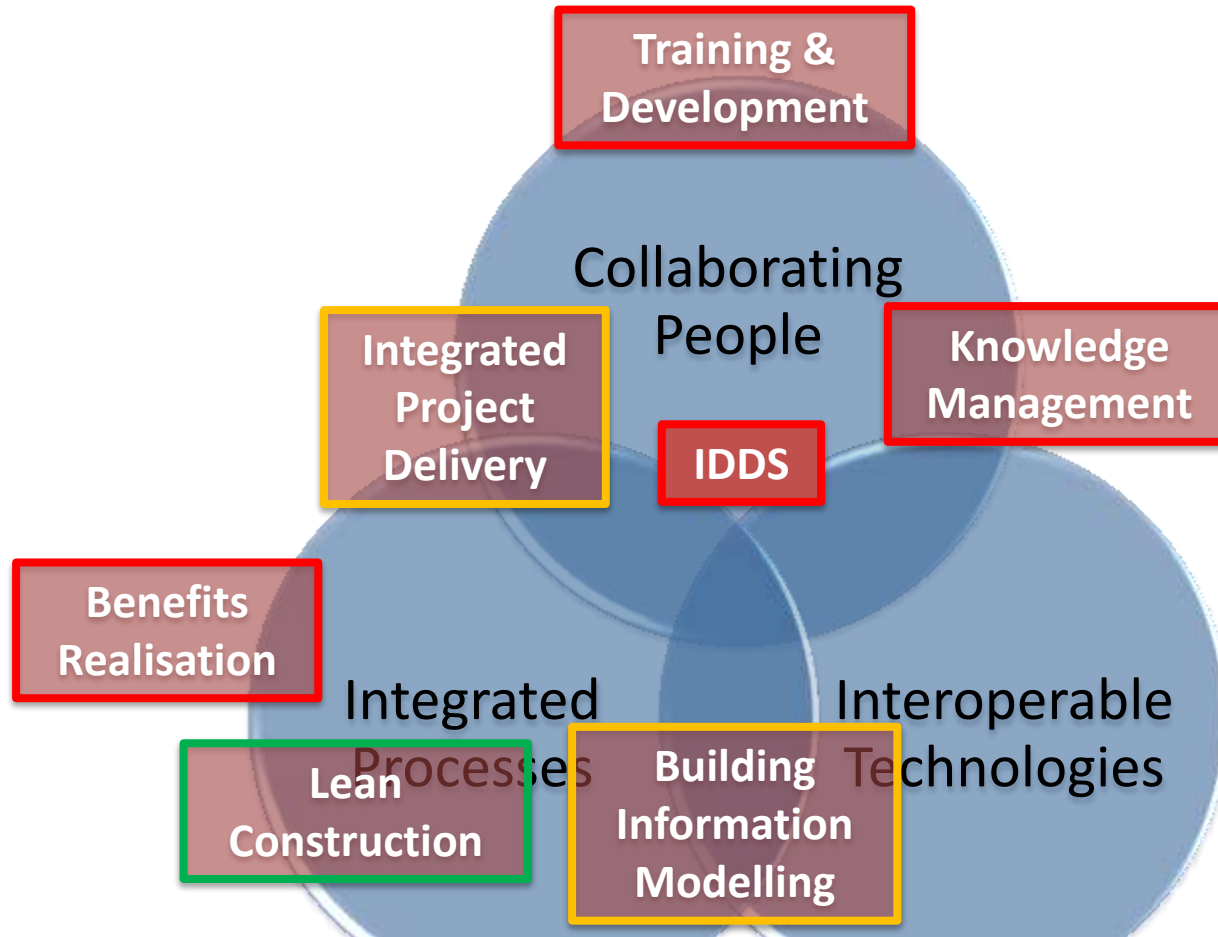
*Integrated Design and Delivery Solutions use collaborative work processes and enhanced skills, with integrated data, information, and knowledge management to minimize structural and process inefficiencies and to enhance the value delivered during design, build, and operation, and across projects.*



# Impact of 4 Key IDDS Elements on Industry Processes, Technology & People



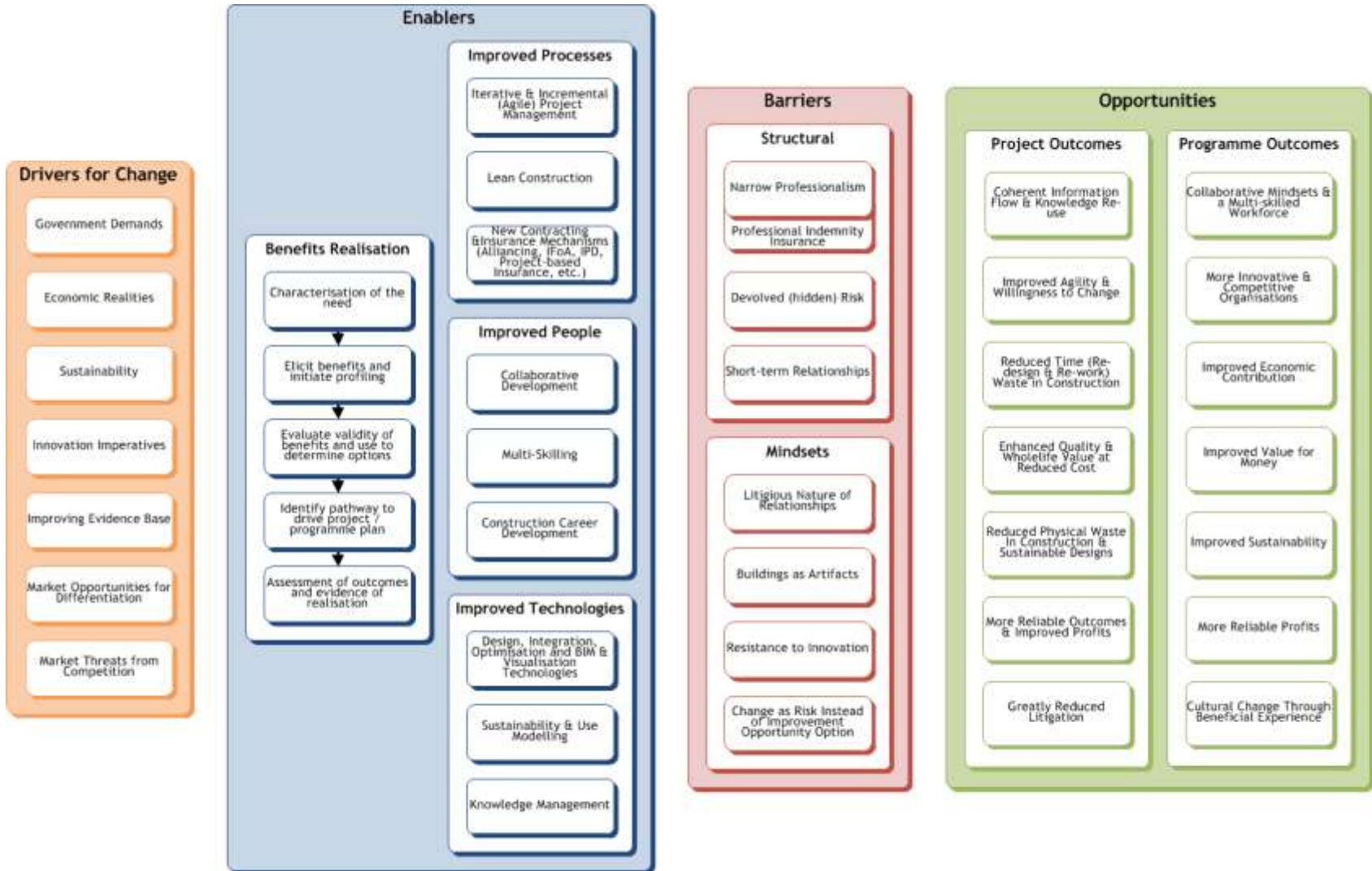
# The Three Imperatives



to minimise all forms of **waste**,  
whilst delivering greater assured **value**  
for **sustainable** whole lifecycle **outcomes**



# IDDS Possibilities



*“It is very nice to see a clear vision presented in context of the many barriers/limitations to implementing it ... this type of work is very important to us practitioners ... your paper is making my work easier and for that I greatly appreciate your efforts blazing the trail so that others can more easily push the mule train forward.”*

**Commander Jack Dempsey**  
US Coast Guard  
Autumn 2010  
(Commenting on the IDDS White Paper)

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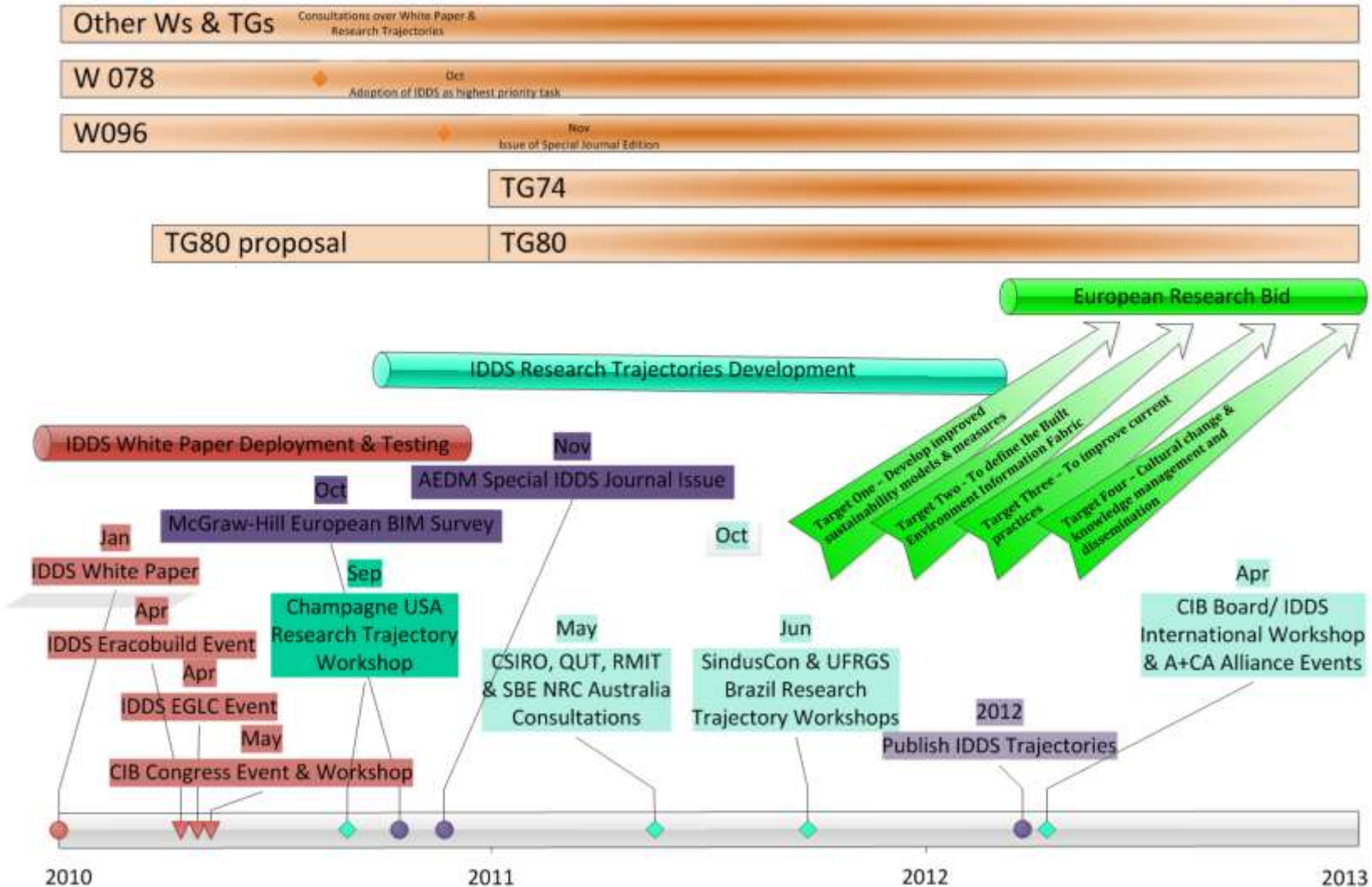
h of construction, and its impacts in  
time. It should be noted that much  
and new construction professionals,  
of this will be possible without the  
and enable such aggressive change.

ificantly shortened timespans from  
time is money, there will inevitably  
improvements in reliable delivery  
of Building information Modelling  
trajectory of improvement. We  
will stem from such improvements  
and delivery of sustainability at both  
in footprints and other sustainable

#### straints

much of Scandinavia) have fallen  
raw-Hill SmartMarket report on the  
re group). However, in addition to

# IDDS Progress & Plan



# Current IDDS Core Group

- Coordinator – Bob Owen (Salford UK)
- Joint Coordinator – Associate Professor Dr Robert Amor (Auckland NZ)
- Dr John Dickinson (NRC CA)
- Dr Bill East (ERDC-CERL US)
- Makoto Kataoka (Shimizu JP)
- Professor Dr 'Sami' Kazi (VTT FI)
- Professor Dr Arto Kiviniemi (Salford UK)
- Professor Robin Drogemuller (QUT AU)
- Assistant Professor Dr Andrew McCoy (Virginia Tech US)
- Dr Anita Moum (NTNU NO)
- Mark Palmer (NIST US)
- Associate Professor Dr Matthijs Prins (Delft NL)
- Professor Dr Geoffrey Qiping Shen (Hong Kong Poly Uni PRC)
- Professor Dr Tom Regan (Texas A&M US)



# CIB Global Congress IDDS Workshop

- Outcomes
  - **Education** - The clearest message from the workshop was a need to address the education of those entering the professions as well as those already within the industry. The panel and audience were strong advocates for a more integrated approach to the education of professionals
  - **Business models** - The need for new business models was widely seen as vital
  - **Process change** - Current processes must change to address fundamental issues in the construction industries
  - **Sustainability and social issues** - Sustainability and social issues are serious drivers for reform but understandings are under-developed
  - **Technical issues** - Technical issues were not seen as paramount; we have technology and tools but need a greater focus on changing behaviour and demonstrating value





# IDDs Research Trajectories - DRAFT

<p>Target One</p> <p>Develop improved sustainability models &amp; measures</p>	<p><i>IDDs should enable a more coherent approach to sustainability modelling and achievement, whether at the building or area scale</i></p> <ul style="list-style-type: none"> <li>▪ Expand human behaviour modelling</li> <li>▪ Develop Human Building Interfaces</li> <li>▪ Develop performance &amp; consumption models</li> <li>▪ Develop knowledge-based architectural program</li> <li>▪ Coherent information flow and reusable knowledge development</li> </ul>
<p>Target Two</p> <p>To define the Built Environment Information Fabric</p>	<p><i>An information fabric should be developed which extends to campus/city scale models will be required to solve emerging infrastructure network problems and facilitate integration of traditionally disparate domains</i></p> <ul style="list-style-type: none"> <li>▪ Support building operations &amp; assets</li> <li>▪ Modelling on installation scale but integration into geographic scale</li> <li>▪ Information systems lifecycle &amp; interoperability</li> <li>▪ Context-based individualised interaction</li> <li>▪ Collaborative project development process &amp; legal framework</li> <li>▪ Presentation of information on construction and use</li> </ul>
<p>Target Three</p> <p>To improve current practices</p>	<p><i>IDDs must provide the cohesive element to overcome the obstacles of trying to tackle fundamental change to current practices, particularly through improved knowledge management</i></p> <ul style="list-style-type: none"> <li>▪ Further adapt industrial design processes for the product and its manufacture</li> <li>▪ Design, construction &amp; supply chain improvement</li> <li>▪ Technology development</li> <li>▪ Electronic submission and approval systems</li> <li>▪ Facilities &amp; operations management</li> </ul>
<p>Target Four</p> <p>Cultural change &amp; knowledge management and dissemination</p>	<p><i>It is essential that we capture knowledge and re-use it both in practice and education, so that we can foster improvement at the pace of the fastest, rather than at the pace of the slower majority</i></p> <ul style="list-style-type: none"> <li>▪ Industry/enterprise business process re-modelling</li> <li>▪ Develop new and expanded collaborative roles/ technologies</li> <li>▪ Development new pedagogy for integrated design and construction curriculum</li> <li>▪ Types of Knowledge Management needed for technology transfer vs. steady state:</li> <li>▪ Dissemination and diffusion model</li> <li>▪ Performance management &amp; measurement</li> </ul>



# Significant IDDS Workshops

- IDDS Lectures & Workshops, University of Illinois at Champaign/ US Army Corps of Engineers. Champaign, IL, USA, Sep 10
- Australian Industry IDDS Roundtable Discussion & IDDS Research Symposium, Royal Melbourne Institute of Technology & IDDS Workshop at The Commonwealth Scientific and Industrial Research Organisation, Highett, Australia, May 11
- SindusCon-SP 2<sup>nd</sup> BIM Conference & IDDS Workshops at SindusCON HQ, São Paulo and Universidade Federal do Rio Grande do Sul, Porto Alegre, São Paulo, Brasil, Oct 11
- CIB W078 & W102 Conference & IDDS Workshop, Sophia Antipolis, France, Oct 11
- Built Environment Industry Innovation Council Meeting, BuildingSMART National BIM Roadmap Workshop & IDDS Workshops at Queensland University of Technology and University of Technology Sydney, Australia, March 2012





*“There is a real synergy between the development of BIM, IPD and sustainability that is not always recognised and developed. The benefits to the client and society from better Asset Management will exceed those available by design and construction many times over for a well-managed facility.”*

**Tom Fussell**

Spring 2012

Queensland Government Department of Works, Project Services Executive Director and Chief Architect, at the IDDS Workshop at QUT



## CIB Priority Theme

*Improving Construction and Use through*

**Integrated Design & Delivery Solutions (IDDS)**

### Research Trajectories Paper

April 2012

Prepared by the CIB IDDS Core Team, comprising:

- Joint Coordinator – Bob Owen (Salford UK)
- Joint Coordinator – Professor Dr Robert Amor (Auckland NZ)
- Dr John K Dickinson (NRC CA)
- Professor Robin M Drogemuller (QUT AU)
- Dr Edward William (Bill) East (ERDC-CERL US)
- Dr Makoto Kataoka (Shimizu JP)
- Professor Dr Abdul Samad (Sami) Kazi (VTT FI)
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- Dr Anita Moum (NTNU NO)
- Mark E Palmer (NIST US)
- Neill Pawsey (Fiatech International)
- Associate Professor Dr Matthijs Prins (Delft NL)
- Professor Dr J Thomas (Tom) Regan (Texas A&M US)
- Professor Dr Geoffrey Shen (Hong Kong PolyU PRC)

Former members include:

- Professor Kerry London (RMIT AU)
- Professor Clyde B (Bob) Tatum (Stanford US)

# CIB IDDS Research Trajectories Paper

1. Aims
2. Problem / opportunities of domain structural constraints
3. What will the world be like in five years?
4. What will the world be like in ten years?
5. Research on IDDS within CIB and our goal
6. Research trajectory targets
7. Status – IDDS Meetings & Workshops
8. Implementation Plan



# Target One – Develop improved sustainability models & measures

*Sustainability has the ears and minds of the world's scientists and politicians and the construction sector has a major role to play in achieving sustainable outcomes, whether for new-build or conversions. IDDS should enable a more coherent approach to sustainability modelling and achievement, whether at the building or area scale.*



# Target One – Sustainability / 1

- Facilities Management to be based on the **criteria** of space utilisation, operational performance and planned maintenance
- Expand **human behaviour modelling** to drive sustainable design and operations and enable intelligent resource use control
- Develop **Human Building Interfaces (HBI)** to provide feedback to human occupants of facilities and engage them in sustainable operations
- Develop models that **correctly predict performance**
- Develop multi-domain, scientifically valid models that need **little end user data loading**



# Target Two - To define the Built Environment Information Fabric (BEIF)

*An information fabric which extends to campus/city scale models will be required to solve emerging infrastructure network problems and facilitate integration of traditionally disparate domains. Example applications include support for contingency planning, mitigation, response, and recovery, and for the modelling of traffic flows and wider area sustainability modelling and planning. The fabric should use the building as the context but integrated into its surroundings. The concept of BEIF should be seen as a mid to long-term goal of IDDS.*



# Target Two – BEIF / 1

- ***The BEIF will support:***
  - **Operation** of the building
    - Location of components
    - Sensor data integration across domains
    - Predictive maintenance and operations
  - **Assets** in the building
    - Localization and corresponding state of movable and fixed assets
    - Using building models as assets to support day-to-day operations and emergency responses
    - Sensor systems will be managed as assets in their own rights
    - People will be considered as assets and consumers of the fabric





# Target Three – To improve current practices

*Numerous studies and implementations show that fundamental process improvement, such as industrialisation of construction and supply chain integration, is neither readily adopted in the sector nor easy to get right. However, such radical change is essential in order to achieve significant improvements in cost effectiveness and waste and energy reduction. IDDS can help to provide the cohesive element to overcome the obstacles of trying to tackle fundamental change to current practices, particularly through improved knowledge management.*



# Target Three – Practices / 1

- ***To further adapt industrial design processes for the product and its manufacture***
  - Foster **agile, iterative, incremental, concurrent design** involving all those who will have a role in designing, delivering and operating the building, not just the architect/ design consultant
  - Identify barriers and opportunities to **employ production system development simultaneously with design**
  - **Extend lean production throughout the process** beyond lean construction and Last Planner, and support its wider deployment

# Target Three – Practices / 5

- ***Construction improvement***
  - **Iterative & incremental simulation/ optimization of construction**
  - **Modelling of specialized construction methods** for simulation of alternative contractors and project plans
  - Development of automated laser scanning to point cloud conversion and feedback of current conditions to design and build iteration for future stages
  - **Significant reduction of injuries** through:
    - Greater use of BIM for safety planning
    - Development of automated tracking and collision avoidance systems for both plant and personnel. E.g., exclusion zone monitoring; RFID active tracking; individual personnel alerting systems, etc.

# Target Three – Practices / 6

- ***Supply chain improvement***
  - Expansion of **electronic tendering and supply to the model**, e.g.
    - Suppliers to publish IFC models of components & assemblies on web
    - Content created according to National/ International Standards and Guidelines
    - Parameters standardised - accredited association members to approve
    - Sustainability aspects of all components incorporated into parametrics

# Target Three – Practices / 7

- ***Technology development***
  - Develop new human-computer interfaces for improved domain-specific languages and tools
  - **Improve the Human-Computer Interaction to better serve the domain's needs**
  - Use of **whole-life cycle integration** of the building, including construction, operation, maintenance, re-use, demolition and re-building, as the catalyst for developing:
    - Standardized object entities within data modelling
    - Standardized components in construction
  - Development of new **on-site computer aided navigation and marking up systems**
  - Development of standards for the integration of multi-century data and information on city, regional and national bases – see the BEIF under Target Two



# Target Four – Cultural change & knowledge management and dissemination

*The culture within the construction sector is generally of distrust; however, even in projects where there is no collaborative legal framework, early use of BIM is showing a break-down in traditional adversarial relationships. It is essential that we capture knowledge and re-use it both in practice and education, so that we can improve at the pace of the fastest, rather than at the pace of the slower majority.*



# Target Four – Cultural /Knowledge / 1

- ***Influence cultural and structural change***
  - Industry/enterprise **business re-modelling**
    - Foster collaborative mind-sets
    - Develop multi-skilled workforces
    - Facilitate virtual vertically integrated enterprises for the project and beyond
  - **Legal changes**
    - Model managers are becoming the major facilitators of issue resolution but there are emerging signs of collaborative dispute avoidance, even within traditional contract structures
    - Develop audit trails throughout IDDS design, development, build and operation for alternative dispute resolution and to further reduce the litigation/ claims phase
    - Develop new models of what information must, should or could be exchanged and when and between whom. Established new models of liability and responsibility





# Target Four – Cultural /Knowledge / 3

- ***Foster a domain knowledge sharing and use system for practice and education***
  - Development **new pedagogy** for integrated design and construction curriculum (NB. The USA's A+CA Alliance is working towards this now; problem-based learning may offer a solution for some)
    - Develop **data harvesting** for project, programme, portfolio and sector performance learning and improvement
    - **Integrate education and training more closely** to facilitate rapid sector learning – this will stress some current educationalists who are not used to such rapid change
  - Development of new design roles that integrate conceptual designs and technical implementations
  - Creation of automated business process modelling to realise benefits from diverse project team members



# CIB Interactions

CIB Task Group/ Working Commission	Importance	Target
TG59 People in Construction	Proposed	3 & 4
TG66 Energy and the Built Environment	Proposed	1
TG74 New Production and Business Models in Construction	Wholly Important	3 & 4
TG80 Legal and Regulatory Aspects of BIM	Wholly Important	3 & 4
TG84 Construction Reform	Proposed	3 & 4
W065 Organisation and Management in Construction	Partially Important	3 & 4
W070 Facilities Management and Maintenance	Proposed	1 & 2
W078 Information Technologies in Construction	Wholly Important	3
W080 Prediction of Service Life of Building Materials and Components	Proposed	3
W089 Education in the Built Environment	Proposed	3 & 4
W096 Architectural Management	Partially Important	3 & 4
W098 Intelligent and Responsive Buildings	Partially Important	2
W099 Safety and Health in Construction	Proposed	3 & 4
W102 Information and Knowledge Management in Building	Partially Important	2 & 3 & 4
W108 Climate Change in the Built Environment	Proposed	1 & 2
W112 Culture in Construction	Proposed	3 & 4
W119 Customised Industrial Construction	Wholly Important	3

1. Develop improved sustainability models & measures

2. To define the Built Environment Information Fabric

3. To Improve current practices

4. Cultural change and knowledge management and dissemination





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**Any questions?**

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