# CIB Priority Theme

*Improving Construction and Use through*

# Integrated Design & Delivery Solutions (IDDS)

# Research Trajectories Paper

**April 2012**

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# CIB IDDS Research Trajectories

## Aims

The aim of this paper is to set research trajectories for CIB to achieve the aims set out in the CIB White Paper on IDDS "Integrated Design and Delivery Solutions"[1]. The CIB IDDS priority research 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. IDDS is defined as: ***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.*** Input has been sought internationally from other expert groups and from potential industrial collaborators. Initial inputs were used to develop a draft paper and later inputs were used to refine that draft through iterative and incremental expert review.

> *"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)

Our vision is set out below of where the digitisation and computation of construction, and its impacts on people and processes could be in five and ten years' time. Much of this progress will depend on the education and training of current and new construction professionals, supported by new knowledge-centric processes. Of course, none of this will be possible without the further maturing and new development of technologies to underpin and enable such aggressive change.

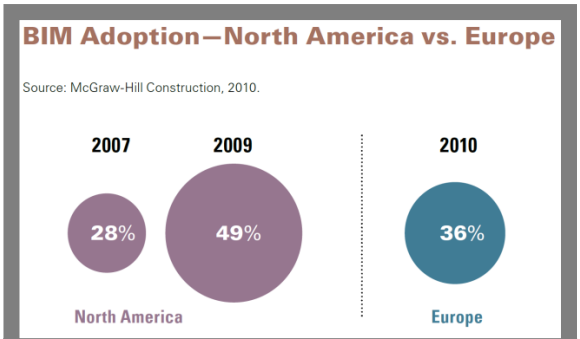
The outcomes of putting this research into practice should be significantly shortened timespans from conception of need to the occupation of new or revised structures. As time is money, there will inevitably be a reduction in construction costs as productivity increases. The improvements in reliable delivery and improved quality currently being seen in relatively simplistic use of Building information Modelling (BIM) (compared to full IDDS) will inevitably continue its on-going trajectory of improvement. We should also consider the wider economic contribution to society that will stem from such improvements and, finally, and by no means unimportantly, the reliable modelling and delivery of sustainability at both the building and estate/ area scale will significantly improve carbon footprints and other sustainable outcomes.

## Problems / opportunities of domain structural constraints

Some parts of Europe (probably with the notable exception of much of Scandinavia) have fallen significantly behind the market leaders, as shown in the recent McGraw-Hill SmartMarket report[2] on the Business Value of BIM in Europe (partially facilitated by the IDDS Core group). However, in addition to an imperative for Europe to 'catch up', there is a wider concern that construction in general has failed to improve its productivity over the years, despite some excellent design and delivery of projects, compared

[1] CIB (2009). IDDS "Integrated Design and Delivery Solutions" (Ed. Owen R.) CIB Publication 328, Rotterdam, Netherlands.
[2] McGraw-Hill Construction (2010). The Business Value of BIM in Europe. SmartMarket Report. H. M. Bernstein. Bedford, MA, USA.

to the current norm. We must also consider the needs of developing and other countries whilst developing these radical new approaches to construction.




McGraw-Hill Survey on the Business Value of BIM in Europe, facilitated by IDDS on behalf of CIB, Summer 2010

Some of the more obvious problems within construction design, delivery and education are shown here:

- Constraints related to variable or cyclic construction cycles
- Organizational constraints
- Skill set constraints
- Poor integration in the supply chain
- Consideration of fabrication optimisation within the design phase
- Need to provide motivating and educational frameworks

## What will the world be like in 5 years?

- Clash detection and visualization will be widely used
- Clients or construction contractors will drive BIM adoption (NB. This is already happening in some cases but is highly variable)
- Wide use of project websites and cloud computing to enable real-time collaboration
- Increasing social mobility
- Sensing/ data fusion
- Improved analytics
- A growing minority of suppliers will provide parametric objects for use in design
- Limited industrialised/ off-site module preparation
- Handover documentation provided semi-electronically moves from minority to majority use
- Use of modified existing contracts
- Governments issue IDDS compatible regulations (this may vary by country/ region)
- Little use of BIM/ follow-ons in less developed countries or for domestic housing
- Joint architect/ engineering degrees in demand
- BIM/ follow-on product literacy will be expected from large contractors and architects
- Literacy will increase in medium and small supply chain companies and sometimes be demanded from them
- Increasing use of scanning to incorporate existing structures and monitor as-built variations
- Increasing synergy between BIM/ follow-on products and GIS
- Increased use of IFC as a Standard because of the need for certifications and conformance to emerging regulations
- Built Environment Information Fabric (BEIF) opportunities defined

## What will the world be like in ten years?

- True carbon accounting possible and enforced
- Generative architecture becomes widespread
- Semi-automated engineering design support becomes normal
- Semi-automated iterative construction optimisation becomes normal
- Design visualisation becomes a reality at the workface (currently minority implementation)

- Conformance measurement variations automatically fed in to vary design for subsequent works
- Competitive advantage and advances in technology drive this effort
- Project management scheduling, procurement and finance modelling becomes semi-automated
- Augmented reality yields real value
- Planning and handover documentation will be provided electronically
- More full-service design and construction companies will exist
- Single point contracts will be used
- Insurance becomes commonly project based
- Some large/ repetitive clients use fully electronic tendering systems
- Governments accept digital models as the core of planning applications
- BIM/ follow-ons become affordable for the huge majority of projects
- Joint architecture/ construction project management/ engineering degrees are popular
- Failure to be IDDS literate may be a cause for mandatory rejection of bids
- IDDS applied to wide-area GIS
- Increased use of BEIF for area planning and monitoring

## Research on IDDS within CIB and our goal

IDDS research should be less about the technology and much more about the integration of people, process, and technology (see the IDDS White Paper for further information). Nevertheless, BIM is already acting as a catalyst in blurring existing business and professional divisions, promoting collaboration and supporting new processes.

> *"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

Several Working Commissions and Task groups have already undertaken to engage with IDDS. For instance:

- W78 (Information Technology for Construction) has an IDDS special session on IDDS during their 2010 conference in Egypt
- W96 (Architectural Management) will have a dedicated IDDS conference in 2013 in Australia
- TG74 (New Productions and Business Models in Construction) has welcomed collaboration with the IDDS priority theme
- The formation of TG80 (BIM Legal and Regulatory Issues) was supported by IDDS and there are obvious extensions to IDDS
- There are several other Working Commissions and Task Groups which are working or have synergies with the theme and all relevant Coordinators will be approached for their views on the research trajectories development (see later).

Progress on some aspects of IDDS has already been implemented in isolated instances; however, this reinforces the need for radically more efficient information and knowledge capture and dissemination mechanisms.

To define the research trajectories will necessarily be an iterative and incremental process and baseline and incremental measurements will be essential to map progress along the trajectory and to adjust, as necessary. Process improvement is the interface between emerging information systems technologies

and people skills, as well as key to other improvements in, for example, sustainability. Our goal should be nothing less than sector transformation to provide significantly greater value for society, clients and designers and builders. The role of governments is important as a driver of such changes, as a major client, and as a regulator and approval body. However, they tend to respond more slowly than private clients, so both must become engaged.

## Research Trajectory Targets

Four research trajectory targets have been suggested so far and these are set out below. Each of these Targets has elements of people, process and technology, as set out in the earlier IDDS White Paper. A later phase of this process will set them against time and/ or priority.

**Proposed IDDS Research Trajectories**

Target One – Develop improved sustainability models & measures
Target Two - To define the Built Environment Information Fabric (BEIF)
Target Three – To improve current practices
Target Four – Cultural change & knowledge management and dissemination

### 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.*

- 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
- Development of models for process, physical and functional waste
    - Reduced physical waste
    - Reduced time
        - increasing "wrench time"
        - reducing non-productive time
    - Reduced rework
    - Low defect rates
    - Supply chain integration
    - More efficient operations (building and use)
- Model specific re-use & recycling goals, including entire site; building to infrastructure network

  - Water use
  - Electricity
  - Transportation
  - Deconstruction
  - Re-use
  - Pollution
  - Scarce resources
- Develop and support a knowledge-based architectural program to develop greater understanding of energy consumption patterns
- More coherent information flow and Reusable knowledge to develop more reliable outcomes

> *"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

### 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.*

***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
- Modelling on installation scale but integration into geographic scale
  - Wide-area BIM
    - Building loads/ requirements/ usage to inform planning of city-wide systems
  - Estates management
    - Operations, sustainability & assets
      - Store design parameters and materials used – e.g. for modification or disposal
      - Multi-year master plan support
      - Use of the building to teach the user how to operate it most sustainably

- Improved building and personnel safety (N.B. confidential information/ security planning must be considered)
- Self-ordering of replacement parts by the building (as current photocopiers)

▪ Disaster mitigation and recovery

- Turning the model into information/ knowledge for users

### *The BEIF must accommodate facilities for the entire duration of the facility*

- Long-term coherence of information
- Durability of information is related to backward compatibility and translation into future versions
- Pervasive individualized knowledge availability, e.g.:
  - Push
    - E.g. Shut the window now
    - Safety issues
    - Context-based response
    - Location of movable properties
  - Pull
    - User directed
- Contiguous upgrade of operating system and software, together with device independence for both delivery of updates and continuous access
- Context-based response/ interaction
- Individualized building response

### *Development of an information fabric*

- Project development process
  - Domain exploration
  - Discrete functional requirements definition
  - Boundary and interaction mapping
- Privacy, provenance, and access to the information fabric will need to consider allocation of responsibility and risk measured against the value of the fabric's content that will be implemented in the context of a legal framework
- Capturing experience of distributed teams' decision processes to assist in creating models for understanding requirements for either face-to-face or distributed collaboration
- Developing and presenting information (e.g. dashboards) on construction and performance in use. It is important that data can't be fudged by the suppliers, thus requiring careful selection of metrics and/ or third party data gathering

## 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.*

### *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
- Study and support industrialised production to improve resource use & sustainability, e.g.:
  - Prefabrication of structural, piping, and duct systems for all residential and commercial construction
  - Prefabrication assemblies
    - housing
    - non-housing
    - medical
    - industrial
- Motivation and inclusion of the whole supply chain, including smaller companies to embrace IDDS change via:
  - Mandate – e.g., as in Scandinavia, the USA and UK
  - Incentivisation – e.g. discounted fees
  - New business models/ structures

### *Design improvement*

- Early designs
  - Reusable object libraries
  - Generative design
  - "General" criteria specification checking
  - Develop more equitable models for the sharing of cost and risk between collaborating designers, builders and operators for the development or even the life of the building
- Common understandings developed to address uncertainty/ lack of confidence in BIM models:
  - Levels of Detail (LOD) defined and adopted throughout disciplines to ensure appropriate and complete information flows
  - Staged model hand-over defined by LOD stage of completion
- Simulation/optimization
- Technical criteria checking
- Development of designer support technologies which help manage iterations and manage the design space
- Elimination of duplicate design processes by including fabricators at design development stage
- Integrated product data sets available as open templates to the supply chain
- Inclusion of supplier/ procurement experience within context of building information modelling

### *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.

### *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

### *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

### *Electronic submission and approval systems*

- Planning & approvals
  - Public agencies should deliver computable specifications and criteria and should also accept digital models for approval, requiring:
    - Conversion of requirements
    - Checking algorithm development
- Components & services
  - Supply chain
  - Tendering
  - Legal
  - Insurance
  - Consultancy

### *Facilities Management*

- Prediction of effective life of the building and facilities from model information
- Clearly established business models for facility maintenance, operations and asset management; including operations of people working in the buildings

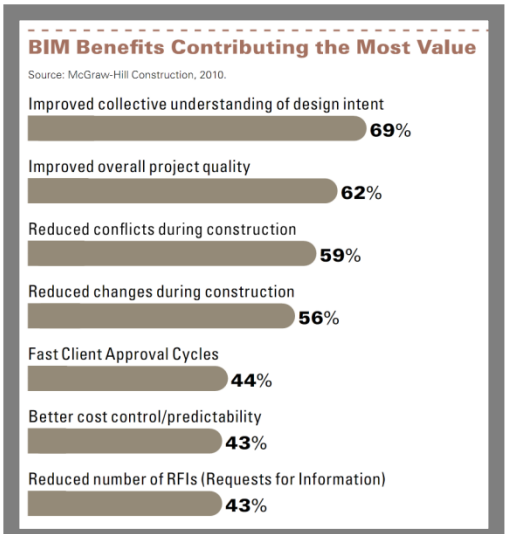
- Re-use of the as-built model for user operations, in addition to facilities management
- As-built BIMs to be linked to Building Management Systems (BMS)
- BMSs to be linked to the BEIF

## 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.*

### *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
- Insurance change
  - Examine the case for changing from professional indemnity insurance to project-based insurance
- Develop new and expanded roles
  - Expanded role of project managers to coordinate and integrate innovation throughout the entire team, including:
    - Risk mitigation
    - Reduced contingencies
    - Reduce/ avoid disputes
    - Whole-life value
    - Dashboards that can't be gamed
    - Model management as a transparent skillset




McGraw-Hill Survey on the Business Value of BIM in Europe, facilitated by IDDS on behalf of CIB, Summer 2010

- 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
- Needs analysis
- Mediation requirements
- Infrastructure semantics and interoperability descriptions
- Security and copyright protection
- Develop a migration path from large to small projects and organisations
- Develop team mental models to improve project collaboration of distributed project teams
- Develop computer-created collaborative working
- Types of Knowledge Management needed for technology transfer vs. steady state:
  - Technology transfer
    - Process management
    - Contract documents
    - Standards development
    - Technical Training from graphics to objects
    - Job descriptions
  - Steady state
    - Quality Control Configuration Plans
    - Standards identification
    - IT mappings
    - Workspaces (specific software)
    - Libraries (specific owners)
    - Control Cycle for Improvement
- Develop a dissemination and diffusion model
  - Implementation in multiple business sectors
  - Use and delivery of IDDS in housing markets
  - Diffusion models for life-cycle innovation
  - Develop roles and relationships
  - Facilitate leap-ahead approaches for developing countries
    - Dynamic characterization and design of indigenous design methodologies
    - Capitalization of local expertise
    - Characterise cultural sensitivities
- Simulation of expected behaviour of building behaviour vs. actual building performance
- Performance management

- Establishment of economic rationale
- Characterization of existing case studies
- Creation of common project metrics to measure consistency of outcomes

## Status

### IDDS Meetings & Workshops:

These research trajectories have been refined through a series of discussions and more formal workshops by several hundred researchers, industrialists and clients, to whom we extend our thanks. The more significant events are set out below:

- 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 2nd 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

### Implementation Plan

The IDDS Priority Theme impacts the overall CIB research plan and affects other Priority Themes, Standing Commissions and Task Groups. Specific foci are set out by the Programme Committee and are attached. Interactions from IDDS to date have included the sponsorship of Task Group (TG)80 Legal and Regulatory Aspects of BIM, and linkages with Working Commission (W)078 Information Technologies in Construction and W096, Architectural Management through their conferences, workshops and academic journals.

There is considerable scope to build further connections with TG74 New Production and Business Models in Construction, W065 Organisation and Management in Construction, W098 Intelligent and Responsive Buildings, W102 Information and Knowledge Management in Building and W119 Customised Industrial Construction, as determined by the Programme Committee.

However, the IDDS White Paper and this document point particularly to the importance of people and their training and culture, and to the linkage between buildings and their environs, including sustainability (energy and whole-life), and change in the sector. These would suggest that TG59 People in Construction, TG66 Energy and the Built Environment, TG84 Construction Reform, W070 Facilities Management and Maintenance, W080 Prediction of Service Life of Building Materials and Components, W089 Education in the Built Environment, W099 Safety and Health in Construction, W108 Climate Change in the Built Environment and W112 Culture in Construction.

These Task Groups and Working Commissions are shown against the Research Trajectories below.

| 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

Additionally, it is suggested that the proposed Built Environment Information Fabric has particular relevance to the new Priority Theme, Construction and Society. Several of the listed Task groups/ Working Commissions have started discussions regarding collaborative activities at the 2013 World Building Congress in Brisbane, Australia. The IDDS Coordinators will approach the Coordinators of the other groups and recruit research target champions to drive each target forward. This paper will also be converted to the standard CIB Research Roadmap format.

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**CIB Comissions as those contribute to defined Priority Themes and have their focus in certain Areas**

| | | CIB Priority Themes | | | Areas of Scientific Interest | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GEN | BT | | BBE | | BP | |
| CIB Task Groups and Working Commissions | | SC | RC | IDDS | | BCT | BPh | DB | BE | MOE | LPP |
| TG59 | People in Construction | | ■ | | | | | | | ■ | |
| TG63 | Disasters and the Built Environment | ■ | | | | | | ■ | ■ | | |
| TG66 | Energy and the Built Environment | ■ | | | | ■ | ■ | ■ | ■ | | |
| TG67 | Statutory Adjudication in Construction | | ■ | | | | | | | | ■ |
| TG68 | Construction Mediation | | ■ | | | | | | | | ■ |
| TG72 | Public Private Partnership | | ■ | | | | | | | ■ | ■ |
| TG74 | New Production and Business Models in Construction | | ■ | ■ | | | | | | ■ | |
| TG75 | Engineering Studies on Traditional Constructions | ■ | | | | ■ | | ■ | | | |
| TG76 | Recognising Innovation in Construction | | ■ | | ■ | | | | | | |
| TG77 | Health and the Built Environment | ■ | | | | ■ | ■ | ■ | ■ | | |
| TG78 | Informality and Emergence in Construction | | | | | | | | | ■ | |
| TG79 | Building Regulations and Control in the Face of Climate Change | ■ | | | | | ■ | ■ | | | ■ |
| TG80 | Legal and Regulatory Aspects of BIM | | | ■ | | | | | | | ■ |
| TG81 | Global Construction Data | | ■ | | | | | | | ■ | ■ |
| TG82 | Marketing in Construction | | ■ | | | | | | | ■ | |
| TG83 | e-Business in Construction | | ■ | | | | | | | ■ | |
| TG84 | Construction Reform | | ■ | | | | | | | ■ | |
| TG85 | R&D Investment and Impact | | ■ | | ■ | | | | | | |
| W014 | Fire Safety | | | | | ■ | | ■ | | | |
| W018 | Timber Structures | | | | | ■ | | | | | |
| W023 | Wall Structures | | | | | ■ | | | | | |
| W040 | Heat and Moisture Transfer in Buildings | | | | | | ■ | | | | |
| W051 | Acoustics | | | | | | ■ | | | | |
| W055 | Construction Industry Economics | | ■ | | | | | | | ■ | |
| W056 | Sandwich Panels | | | | | ■ | ■ | ■ | | | |
| W062 | Water Supply and Drainage | ■ | | | | ■ | ■ | ■ | ■ | | |
| W065 | Organisation and Management of Construction | | ■ | ■ | | | | | | ■ | |
| W069 | Housing Sociology | | | | | | | ■ | ■ | ■ | ■ |
| W070 | Facilities Management and Maintenance | | ■ | | | ■ | | ■ | | ■ | ■ |
| W078 | Information Technology for Construction | | ■ | ■ | | | | | | ■ | |
| W080 | Prediction of Service Life of Building Materials and Components | ■ | | | | ■ | | ■ | | | |
| W083 | Roofing Materials and Systems | ■ | | | | ■ | ■ | ■ | | | |
| W084 | Building Comfortable Environments for All | | | | | | | ■ | ■ | | |
| W086 | Building Pathology | | | | | ■ | | ■ | | ■ | |
| W089 | Education in the Built Environment | | ■ | | ■ | | | | | | |
| W092 | Procurement Systems | | ■ | | | | | | | ■ | ■ |
| W096 | Architectural Management | | ■ | ■ | | | | ■ | | ■ | |
| W098 | Intelligent and Responsive Buildings | ■ | | ■ | | ■ | | ■ | | | |
| W099 | Safety and Health in Construction | | ■ | | | ■ | | ■ | | ■ | |
| W101 | Spatial Planning and Infrastructure Development | ■ | | | | | | | ■ | | |
| W102 | Information and Knowledge Management in Building | | ■ | ■ | ■ | | | | | ■ | |
| W104 | Open Building Implementation | ■ | ■ | | | | | ■ | ■ | ■ | |
| W107 | Construction in Developing Countries | | ■ | | | | | | | ■ | |
| W108 | Climate Change and the Built Environment | ■ | | | | ■ | ■ | ■ | ■ | | |
| W110 | Informal Settlements and Affordable Housing | ■ | | | | | | ■ | ■ | | |
| W111 | Usability of Workplaces | | | | | ■ | | ■ | | ■ | |
| W112 | Culture in Construction | | ■ | | | | | | | ■ | ■ |
| W113 | Law and Dispute Resolution | | ■ | | | | | | | | ■ |
| W114 | Earthquake Engineering and Buildings | ■ | | | | ■ | | ■ | | | |
| W115 | Construction Materials Stewardship | ■ | | | | ■ | | ■ | | | |
| W116 | Smart and Sustainable Built Environments | ■ | | | | ■ | | ■ | | | |
| W117 | Performance Measurement in Construction | | ■ | | | | | | | ■ | ■ |
| W118 | Clients and Users in Construction | | | | | | | | | ■ | |
| W119 | Customised Industrial Construction | | | ■ | | | | | | ■ | |

| Extend of Involvement of Task Groups and Working Commissions | |
|---|---|
| ■ | Same of the Activities and Outcome of this Task Group or Working Commission may be of special importance to the respective Theme or Area |
| ■ | Activities and Outcome of this Task Group or Working Commission in principle always are of special importance to the respective Theme or Area |

| Abbreviations of defined Themes and Areas | |
|---|---|
| Priority Themes | |
| SC | Sustainable Construction |
| RC | Revaluing Construction |
| IDDS | Integrated Design and Delivery Solutions |

| Areas of Scientific Interest | |
|---|---|
| GEN | GENERAL ISSUES: Innovation, Information, Education |
| BT | BUILDING TECHNIQUE |
| BCT | Building and Construction Technologies |
| BPh | Building Physics |
| BBE | BUILDINGS AND THE BUILT ENVIRONMENT |
| DB | Design of Buildings |
| BE | Built Environment |
| BP | BUILDING PROCESS |
| MOE | Management, Organisation and Economics |
| LPP | Legal and Procurement Practices |