

# Introduction to BIM: Suitability of Procurement Methodology



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PUJA Conf on Empowering BIM



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# Visualisation, BIM and nD Modelling

- Basic geometric dimensions in visualisation:
  - 2D: traditional planar state (X and Y axes)
  - 3D: 2D plus Z axis >> a point in space > depicting the height
- 3D in Construction:
  - Geometric dimensions **plus**
  - **Visual attributes**, e.g. colour and texture
- 4D Modelling
  - 3D (X, Y and Z axes)  
Plus
  - **Time** sequencing in **visual environments**

# nD Modelling

- 4D Modelling: Use
  - Demonstration of building construction process, before any real construction activities take place, and for whole lifecycle
  - Identification of possible mistakes and conflicts at early stage
    - Clash detection
  - Prediction of the construction schedule, method, etc.
- nD Modelling / Design:
  - Extends the concept of 4D Modelling
  - Further integrates 'n' number of design dimensions or criteria
  - A holistic model to portray and visually project the building design over whole project lifecycle
  - Using the Concept of Building Information Model

# Building Information Modelling

- **The Concept of BIM:**
  - a computer model **database** of building **design information**,
  - which may also contain information about the building's **construction, management, operations and maintenance**
  - The idea evolved with '**object**' **oriented** CAD (Objects: doors, walls, windows, etc.)
  - 'Objects' contain both graphical and non-graphical data of the building in a logical structure » **a highly coordinated repository**
    - Graphical data: drawings
    - Non-graphical data: specifications, schedule, etc.
  - Changes in each item are made at only one place
  - Each project participant sees the same information
  - Increased communication, so reduced time and cost

# The Setting for BIM

- Project Documentation:
  - Construction Contract: 2D drawings and specs
  - Multi-stage communication: Several 2 parties
  - 3D visualization in mind >> may be correct or incorrect
  - Non-availability of physical presence for explanation
  - Changes during project progress > multiple edits
  - Missed opportunities:
    - Early decision on budget / cost,
    - Stepwise work > schematic design, design development, documentation etc. >> waste of time and may be some design works
- Diverse experts and consultants
  - Changes made in isolation, although they have chain reactions
  - Design parameters may lead to conflicting social, economic and legislative constraints: need to make a balance.
  - Highly difficult to coordinate
  - Step by step adjustments, which are laborious, time consuming, costly and may be erroneous

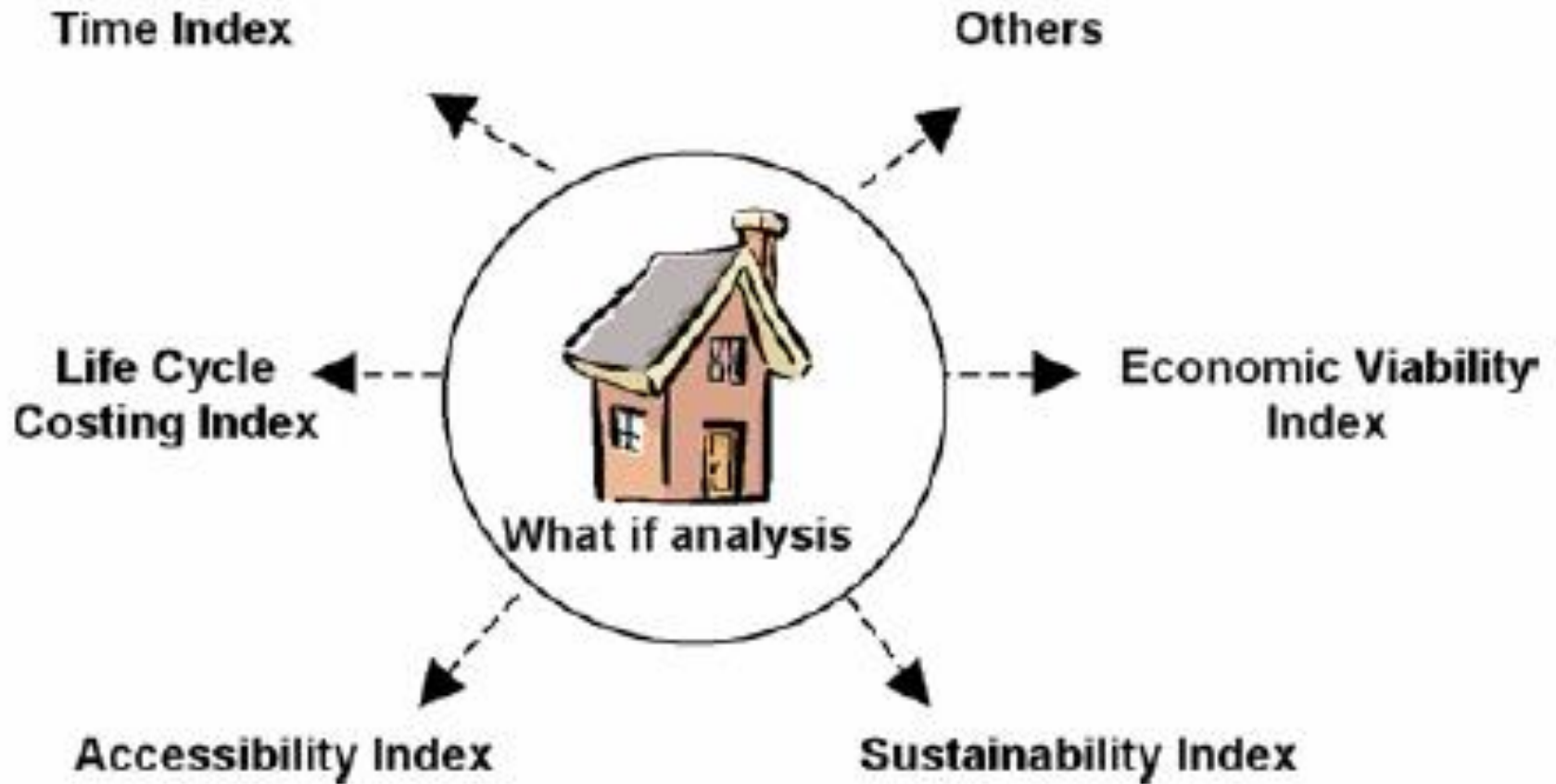
# Goals for process improvement

- Reduce risk:
  - Improve communication: complexity & multi-party involvement
  - Collaborate >> Risk sharing / Joint Risk Management
  - Anticipate problems > improvement of predictability
  - Improve safety > lower insurance rates
- Reduce cost:
  - Study parallel industries >> Lean Construction
  - Prefabricate (MMC) > controlled & predictable construction
- Reduce time:
  - both in preconstruction planning and construction scheduling
- Improve project quality:
  - Both design quality and construction quality
- Improve life-cycle performance:
  - e.g. in Maintainability of components & Energy use

# What BIM / nD Modelling can do?

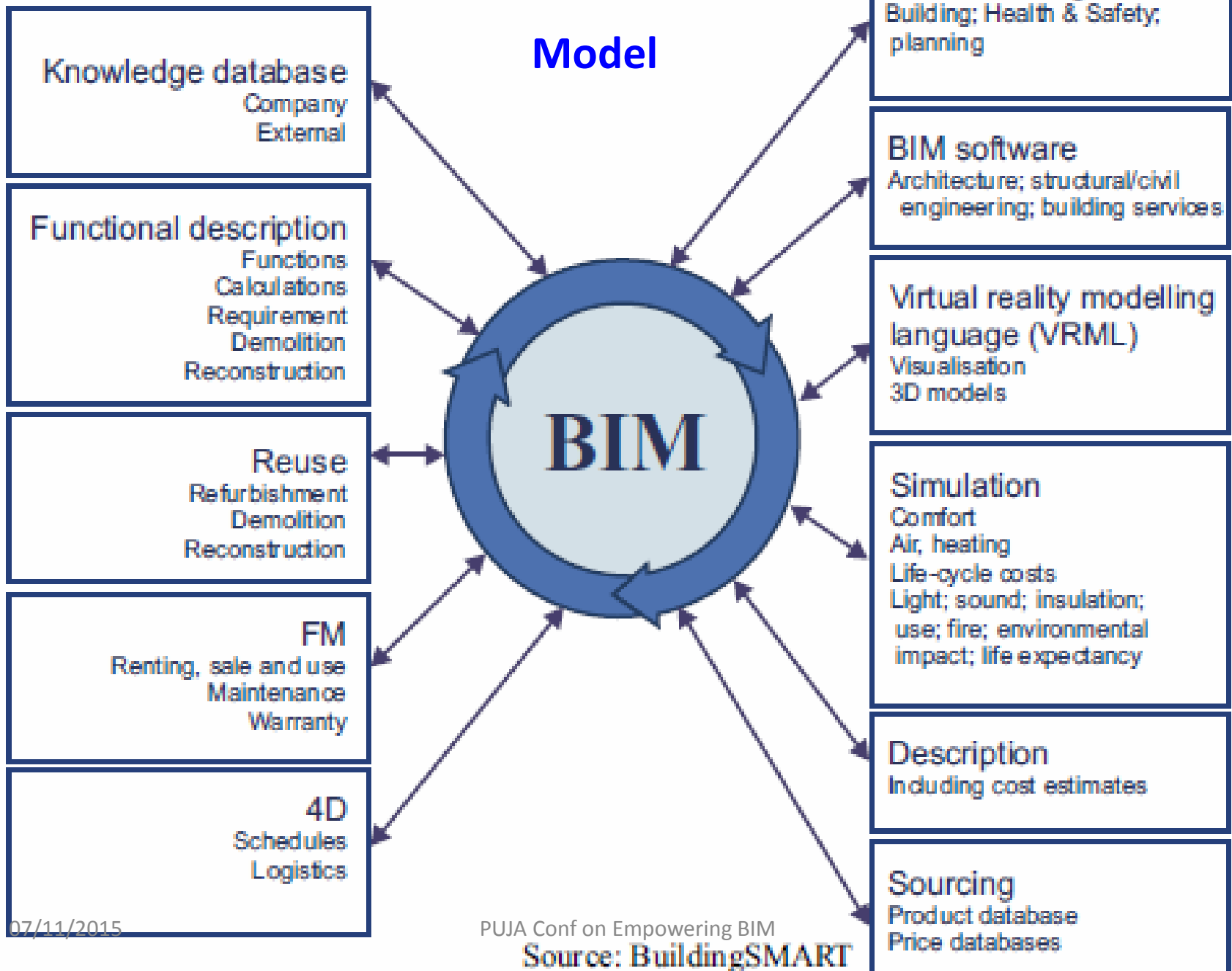
- IT can play a significant role:
  - to improve the efficiency and effectiveness of the **integrated** design and construction process.
  - **Multi-dimensional model**, using various **'what-if'** scenario for demonstrating real cost involvements
  - **Simulate and compare** through project lifecycle for different variables
- Envisaged **trade-offs** include:
  - Predict and plan the construction process
  - Determine cost options
  - Maximise sustainability
  - Investigate energy requirements
  - Examine people's accessibility
  - Determine maintenance needs
  - Incorporate crime deterrent features
  - Examine the building's acoustics, etc. etc.

# 'What-if' analysis indices: Indicative





# Multi-Dimensional Model



Level 0

Level 1

Level 2

Level 3

Maturity

**CAD**

**2D**

**3D**



**BIMs**

**iBIM**

**Lifecycle Management**

**Data**

CPIC

AVANTI

BS 1192 2007

User Guides CPIC, Avanti, BSI

IDM – Common Dictionary  
IFC – Common Data  
IFD – Common Processes  
**ISO BIM**

**Processes**

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Drawings, lines arcs text etc

Models, objects, collaboration

Integrated, Interoperable Data

**Tools**



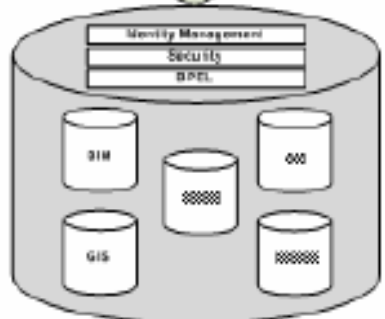
Paper



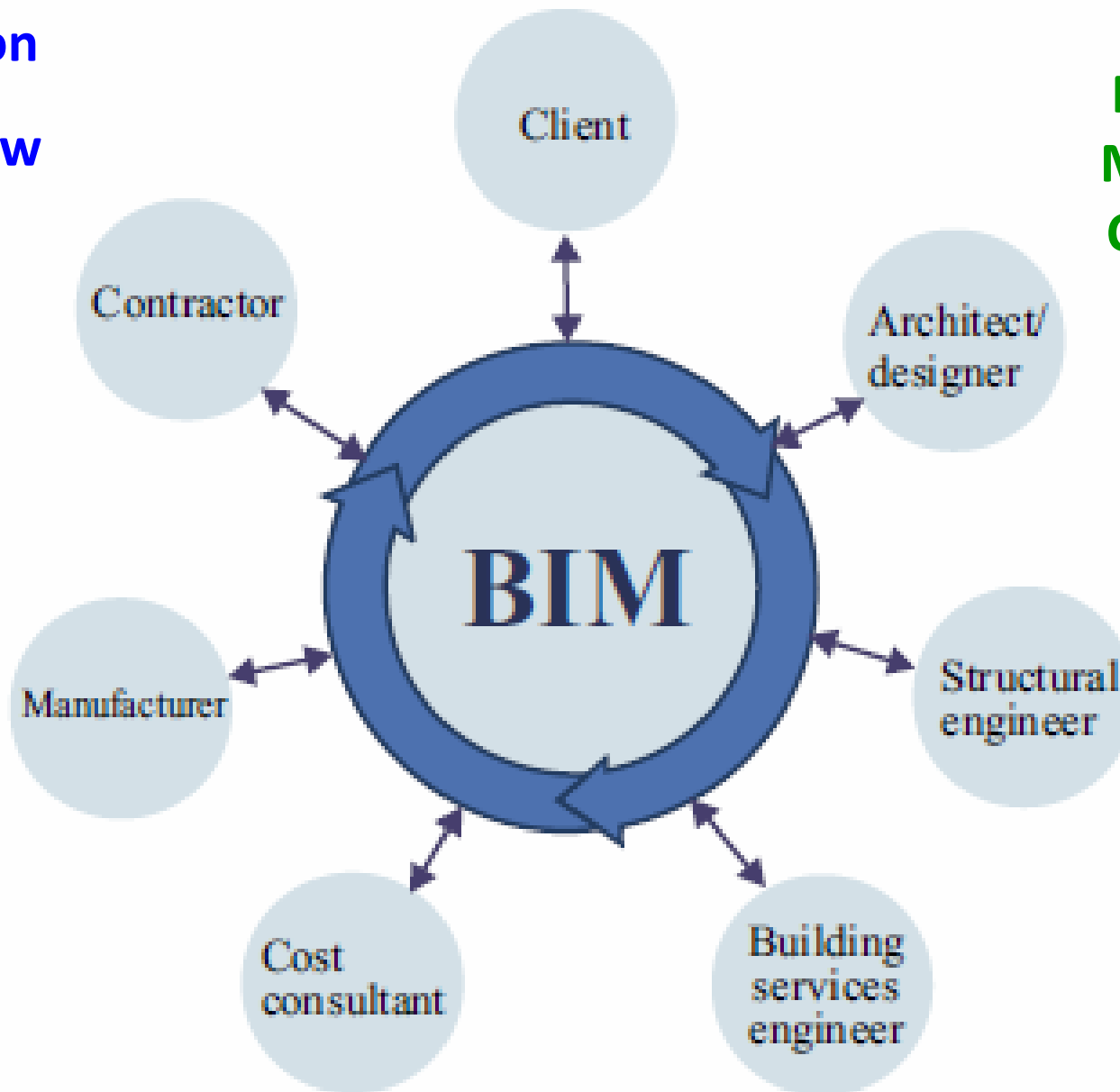
**File Based Collaboration**



**File Based Collaboration & Library Management**



**Integrated Web Services BIM Hub**



Source: BuildingSMART

# BIM and CM Practice

- Major project Delivery methods
  - Design-Bid-Build (ie Traditional)
  - Design-Build (i.e. DB/ D&B / D&C)
  - Management Oriented: CM / MC / CM-at-risk
  - Integrated Project Delivery (IPD)
- Information and Workflow:
  - Preconstruction
  - Communication & collaboration methods
  - Types of Documents
  - Clarification of Information
  - Project Closeout

# DBB: Flow of information

- Preconstruction
  - No information is shared
- Communication & collaboration methods
  - **After documentation**: Drawings
  - Manual *takeoff* or digitiser, requiring clarifications
- Types of Documents:
  - Specification & Sheet drawings: PDF, CAD or Image
  - **No digital information/ files** >> consume time & lack accuracy
- Clarification of Information
  - **Addenda > supplemental drawings**
- Project Closeout
  - Original documents + addenda + O&M manuals

# DB: Flow of information

- Preconstruction
  - Single entity > designer/contractor led > **Integrated team**
  - Design & construction Information streamlining
- Communication & collaboration methods
  - **Client's Initial design** > DB contractor / party
  - Construction begins with partial documentation
  - **Construction and design + client and DB party**
- Types of Documents:
  - PDF, CAD or Image > but with **reduced formality**
  - **Nondisclosure**, or hard copy + **delete digital file**
- Clarification of Information
  - **Performance specification** > Changes with cost updates
  - Point of no return + change orders or additional cost
- Project Closeout
  - Original documents + change orders + O&M manuals
  - **Often hybrid** > paper and digital >> BIM??

# Management oriented : Flow of Information

- Management oriented > Variations : CM / MC / CM-at-risk
  - CM to deliver project with GMP > a stake in 'project development'
  - CM acts as consultant to client at development & design phase, and as general contractor at construction phase
  - Early involvement of contractors/subcontractors in Design & Documentation >> sitting at the same table !!!
- Preconstruction
  - Contractor (i.e. CM) continually inform Design team of cost, based on 'current' documentation
- Communication & collaboration methods
  - Contractor enters the realm of client & design program management
  - Fear: Contractor taking too much control of the project!
  - Balance & collaboration :: information flow & management of project
- Types of Documents:
  - Printed contract documents from a single 'model' > PDF, CAD, ...
  - Distribution: Project FTP, email ... >> Rapid Transfer

# CM-at-risk: Flow of Information

- Clarification of Information
  - Integrated and project focused
  - Preconstruction: direct interaction & input from contractor & SubContractors.
  - Bidding: designers & contractor > maximum info to subcontractors
  - During construction: contractor mediates, since profitability is tied up with contractor's performance and project coordination
- Project Closeout
  - Similar to other methods, but sometimes Facility Manager is brought early to define closeout deliverables.



# Integrated Project Delivery (IPD)

- **IPD is a process:** which
  - Integrates people, systems, business structures & practices
  - Harnesses collaboration of all participants
  - Reduces waste and optimises efficiency
  - Through all phases of design, fabrication/documentation, and construction
- **Preconstruction**
  - Integration of team members from the onset > vertical integration
  - Benefits of using the latest technology
- **Communication & collaboration methods**
  - Everybody works on same platform & shares the same information
  - Shares risk and reward, as against fee or bid price > Incentivisation

# Integrated Project Delivery (IPD)

- Types of Documents:
  - Combination of individual & professional **focused models**
  - A **change** to one element equals a **change everywhere**
- Clarification of Information
  - Continually to the team > free information sharing > **same database**
  - stakeholders have their say, but make **informed decision as a whole**
- Project Closeout:
  - **Facility manager to be involved** during design and construction
  - Ultimately uses the **same model to maintain the facility**
  - Data / tools in usable format than CAD.

# Concluding Observations

- Benefits of BIM are manifold, and BIM, efficient design & sustainable construction all go hand in hand
- Harvesting the benefits of BIM requires a suitable procurement approach to contain it.
- The concept of traditional procurement arrangement seems not match with that of BIM.
- Greater the integration a procurement approach can offer, better it can support BIM, greater the collaboration between parties can happen, greater the benefits that BIM can offer.



Thank you