



## 2.2 Teamwork solutions



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Department of Mechanical Engineering

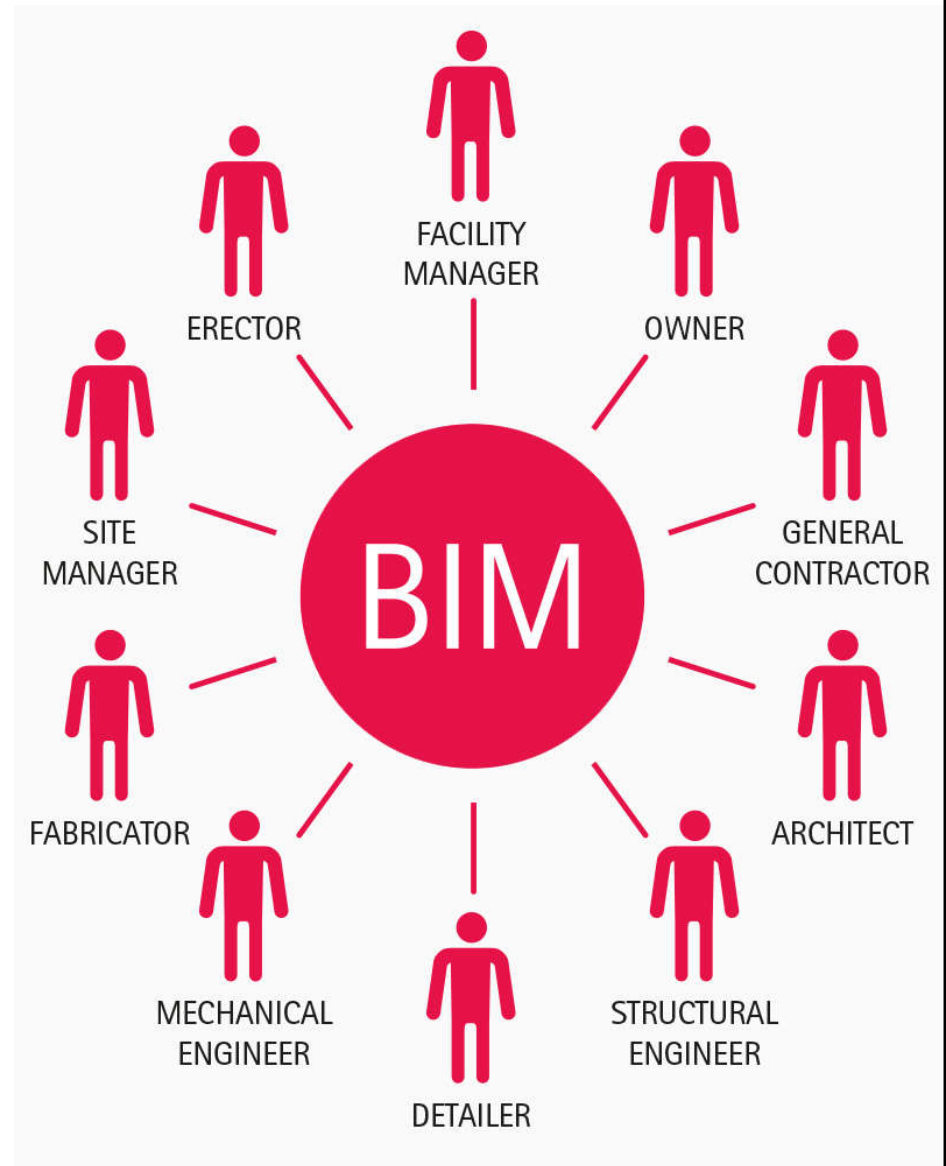
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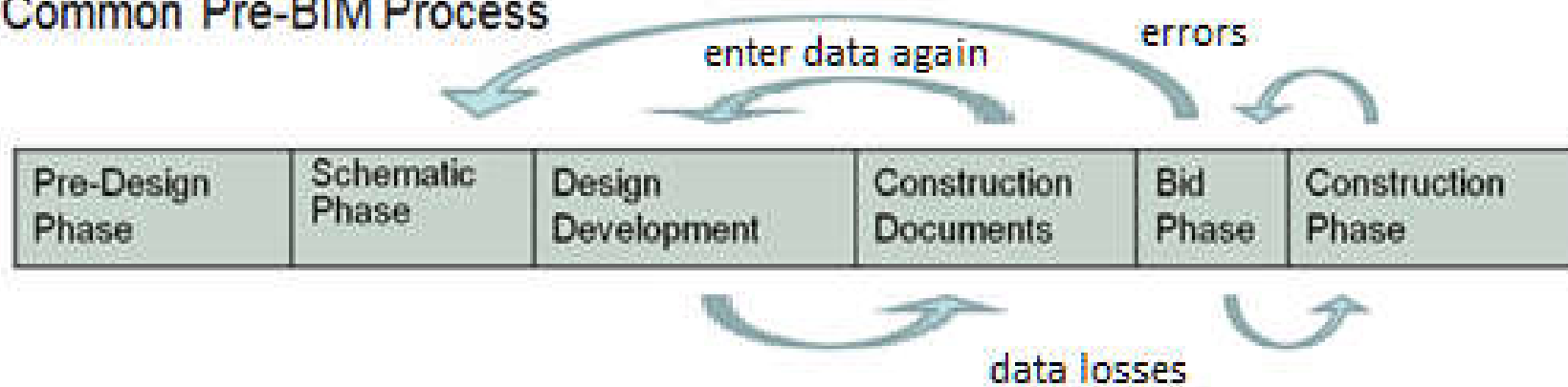
- Team working
- BIM work flow
- Office organization
- Internal collaboration
- BIM project execution
- BIM for lifecycle



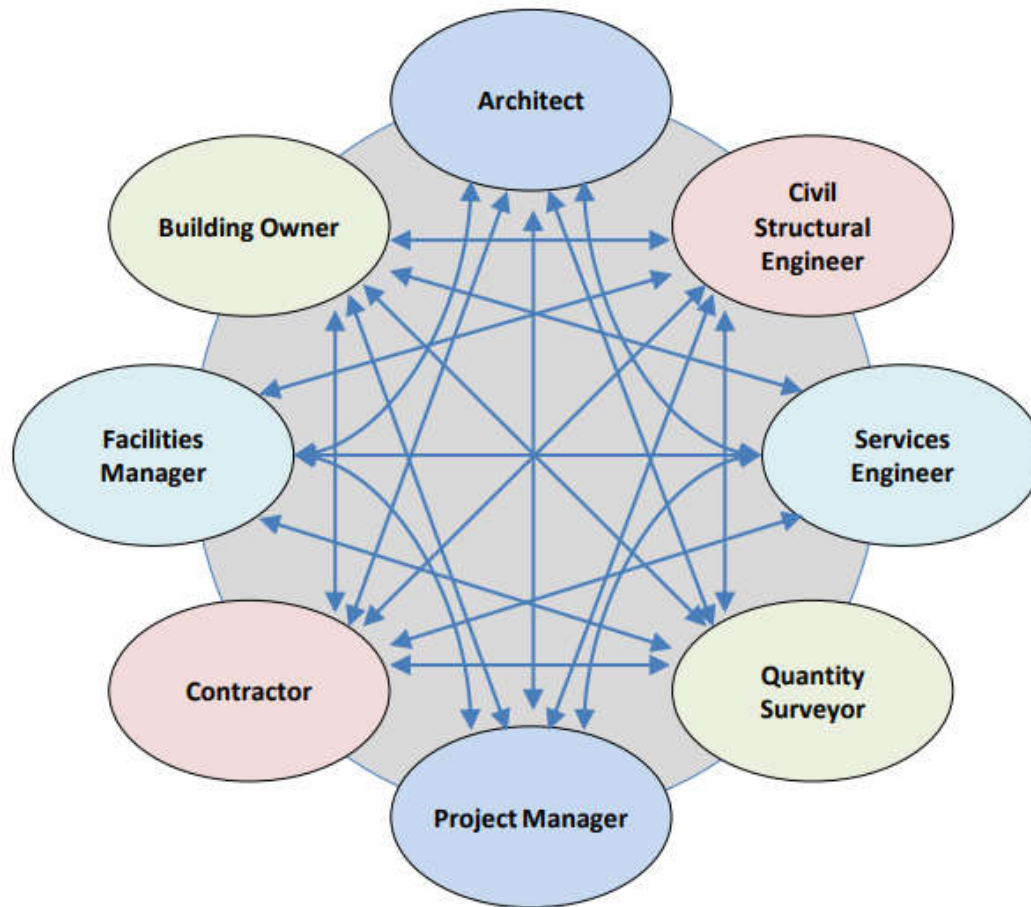
# Current team working in the building industry



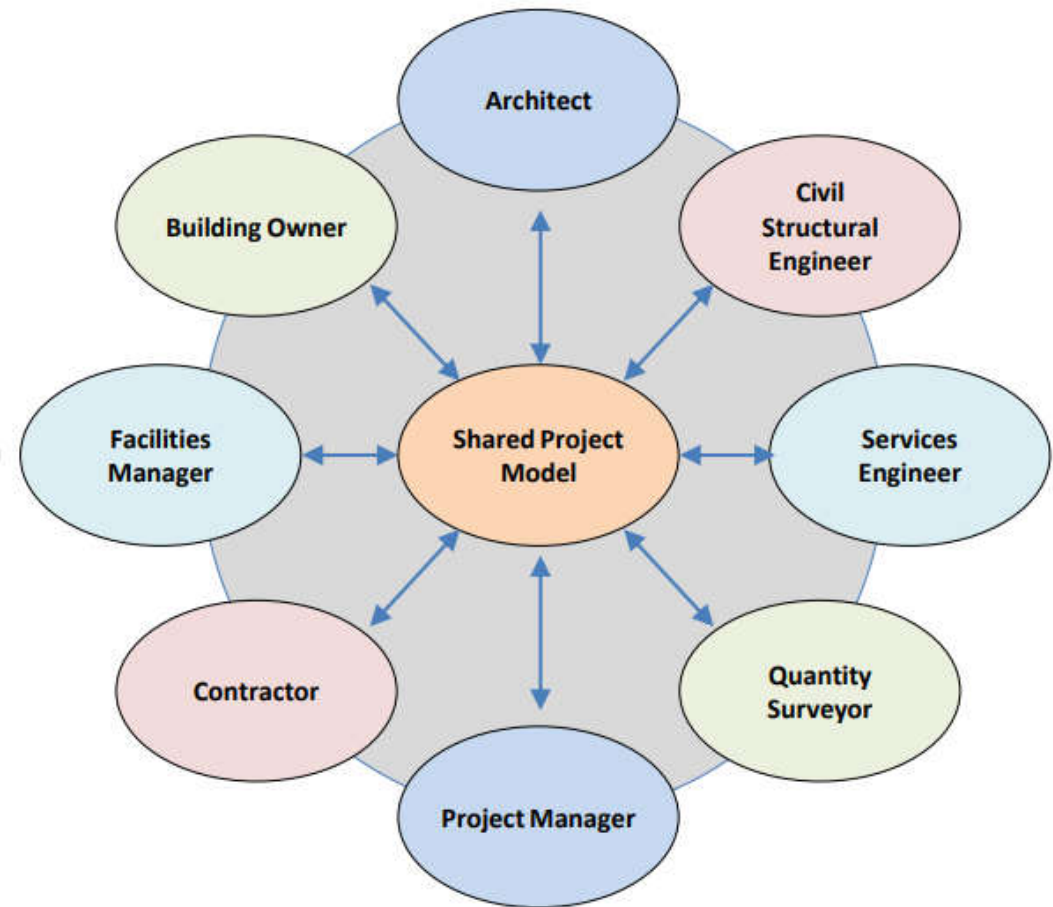
## Common Pre-BIM Process



# BIM can streamline fragmented work processes in construction – “silos”



**Information “Chaos”**



**Shared Project Model**

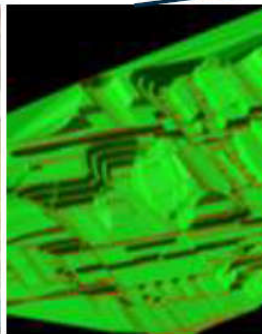
BIM simulates new project management style & culture for all disciplines to collaborate on building projects.



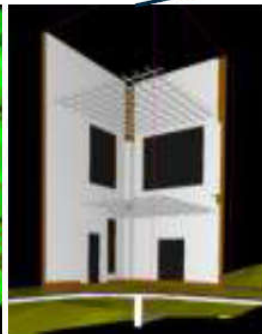
# Using BIM across various disciplines in building, construction and infrastructure



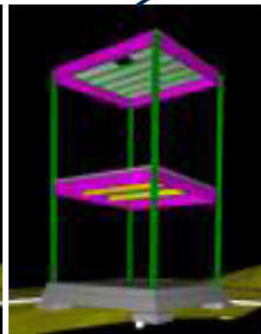
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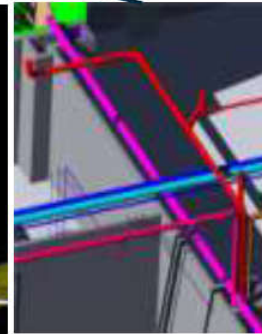
ARCH



STRUCT



MECH



PLUMB



ELEC



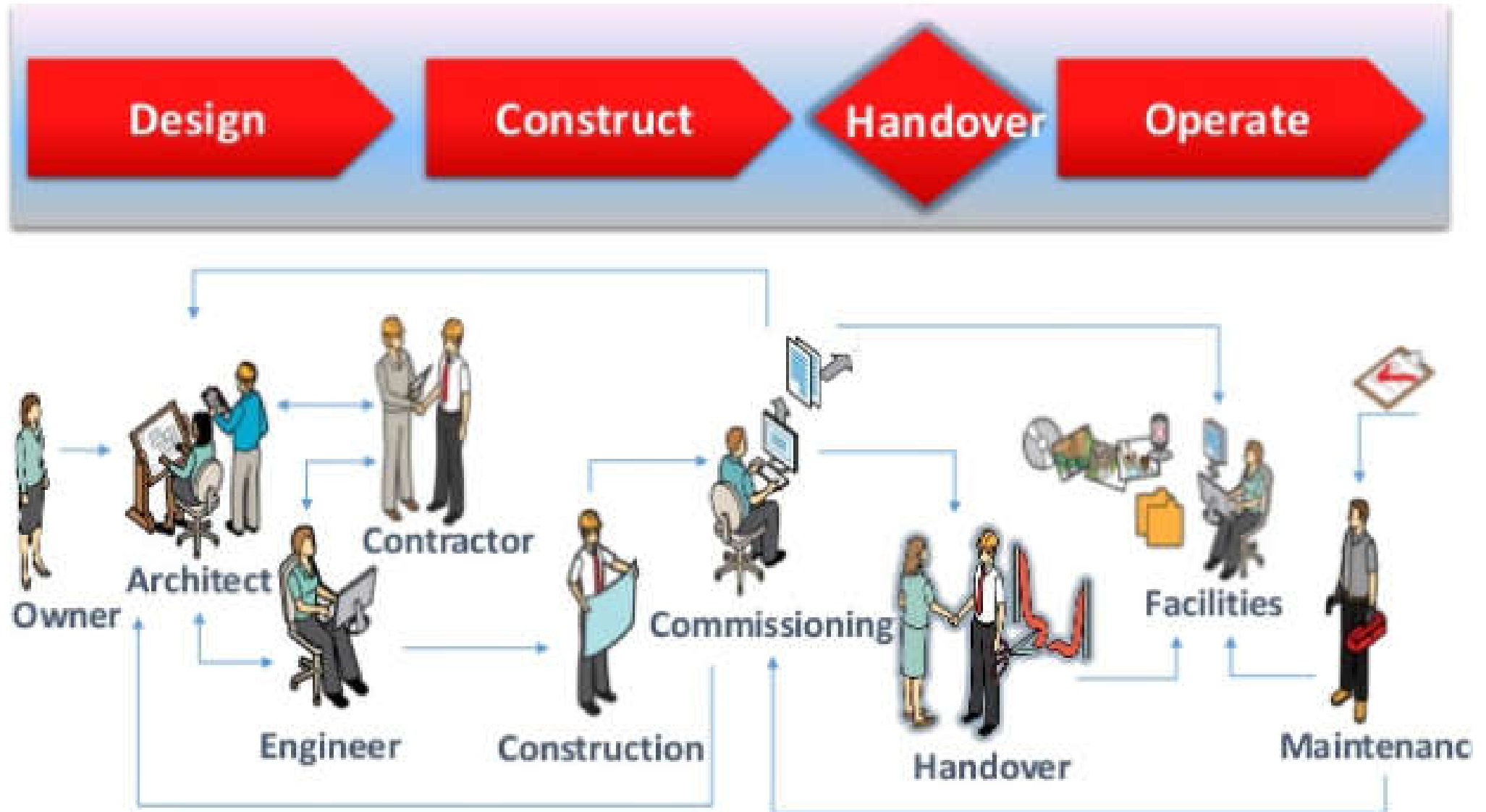
FM

# BIM - The Sky is the Limit



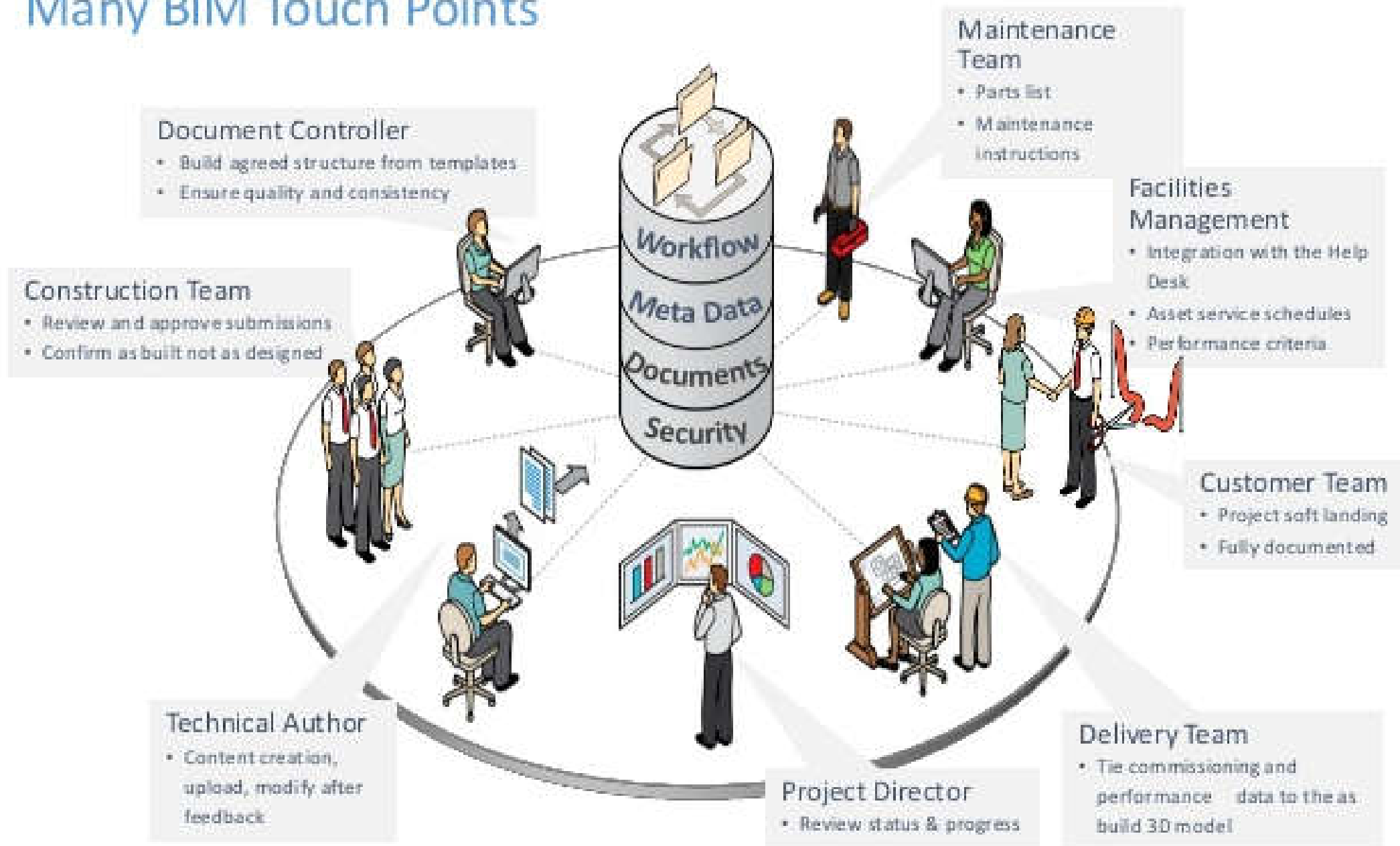
Video: BIM - The Sky is the Limit (6:12) <https://youtu.be/cTX9mQbOjuY>

# Complex information flow in building and construction



# Key Stakeholders

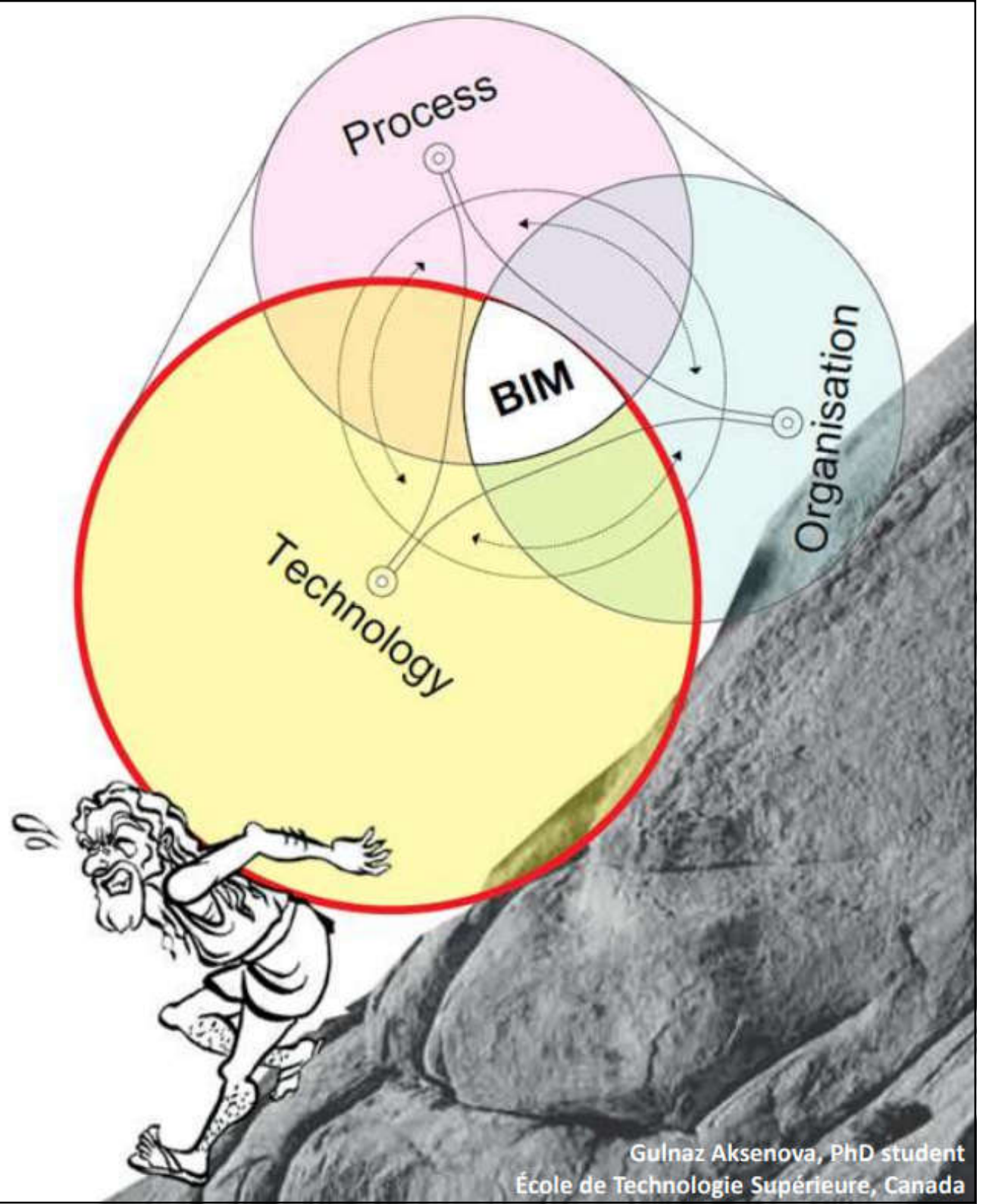
## Many BIM Touch Points





The question is  
**NOT** about the  
technology!

Success BIM =  
Organisation (People)  
+  
Process  
+  
Technology





If you want the winning team, do you select the cheapest players or do you select players with the right skills for every position?



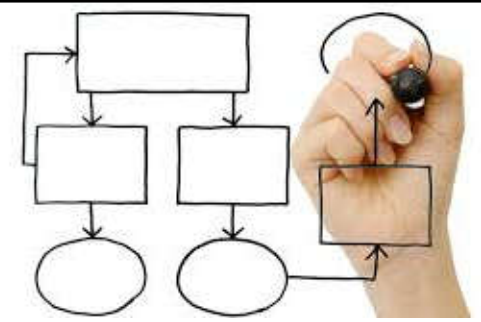
(Source: Prof Arto Kiviniemi, University of Liverpool)

A close-up photograph showing a large number of hands and forearms stacked together in a circular formation, creating a sense of unity and teamwork. The hands are of various skin tones and are wearing different types of watches and bracelets. The background is dark and out of focus.

# Teamwork



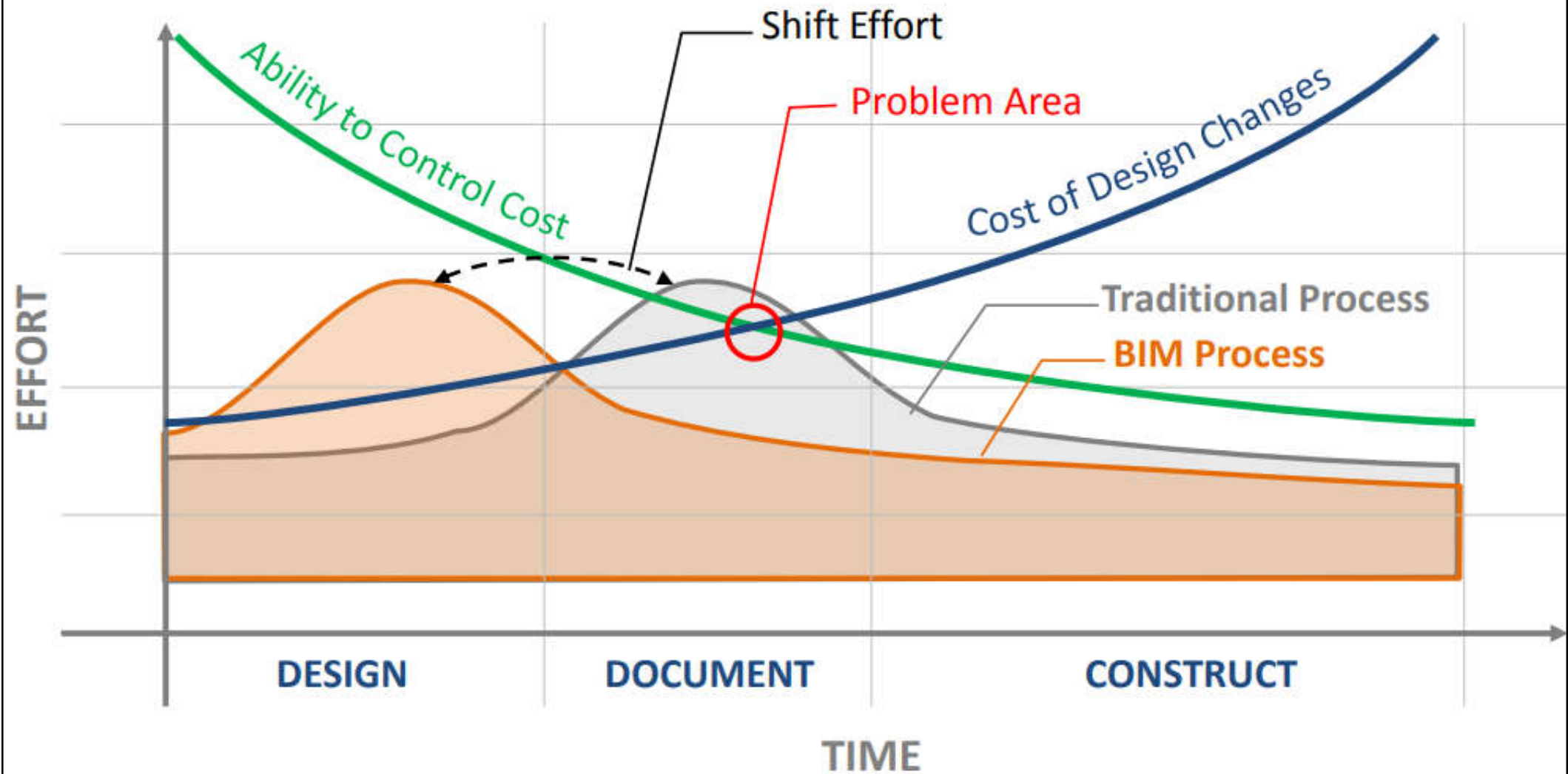
# BIM work flow



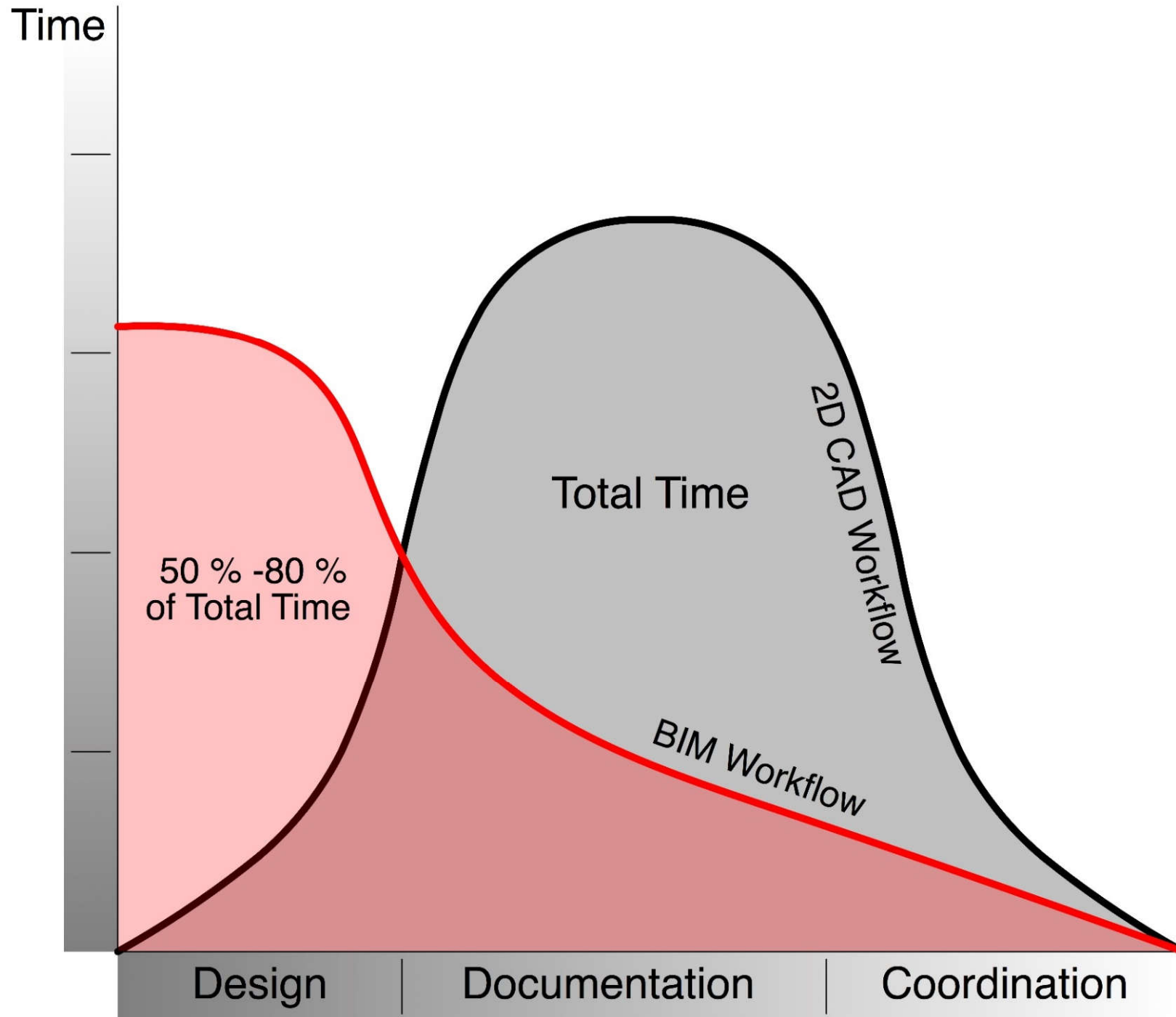
- BIM is a paradigm shift
  - From 2D linear thinking/geometrical method to 3D visual modelling
  - From drawing to digital information
  - From static to dynamic
  - From isolated parts to contextual relationships
- Change in culture and work flow
  - Work is divided up by major building elements in lieu of by drawing sheets
  - Decisions are made earlier as to materials, specifications and quantities



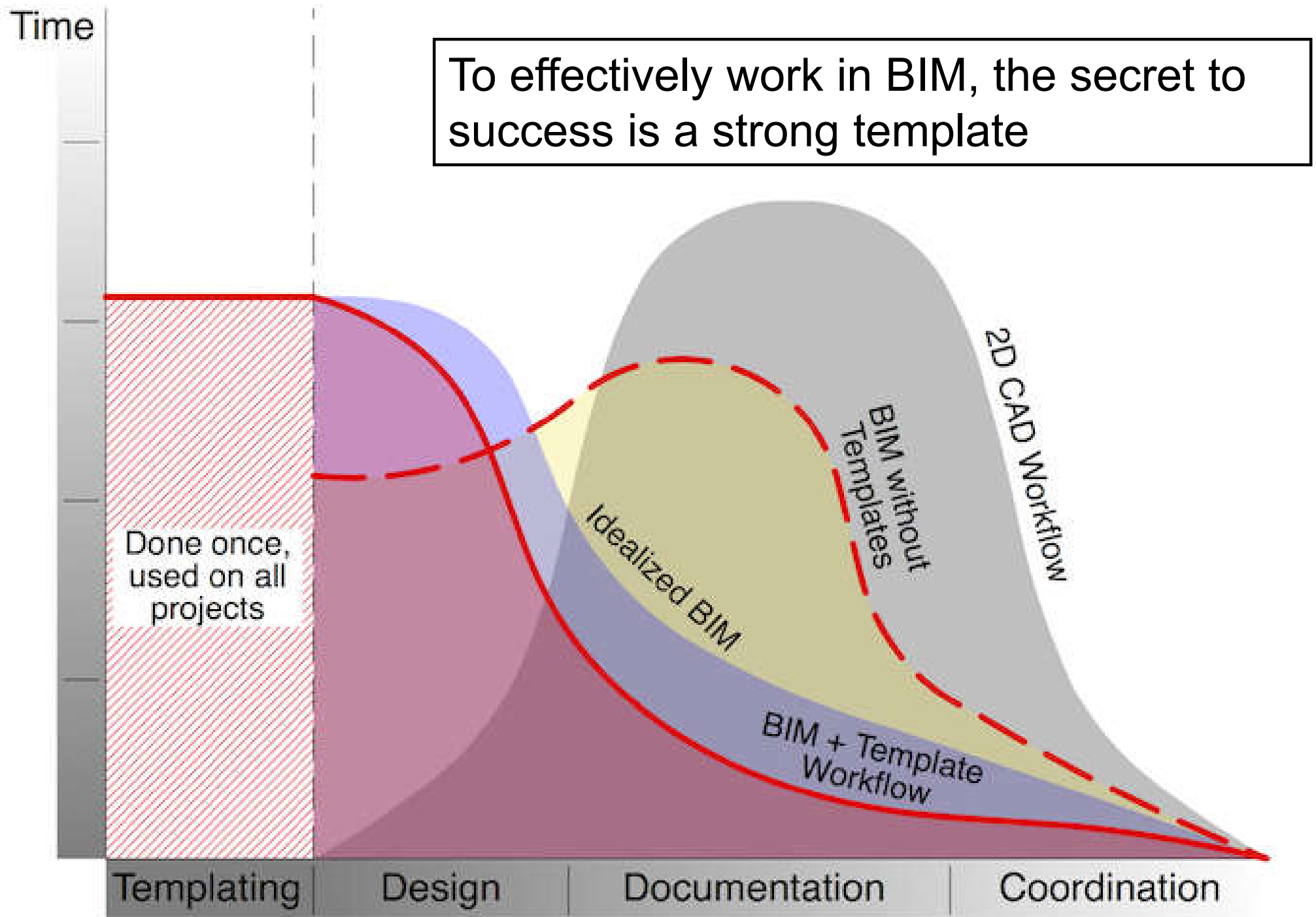
# BIM process can shift efforts to reduce problems

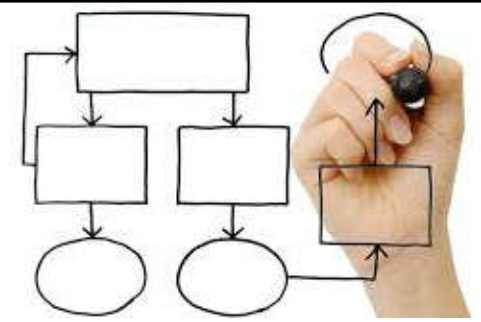


# Workflow of BIM and 2D CAD



# Actual workflow of BIM with and without templates

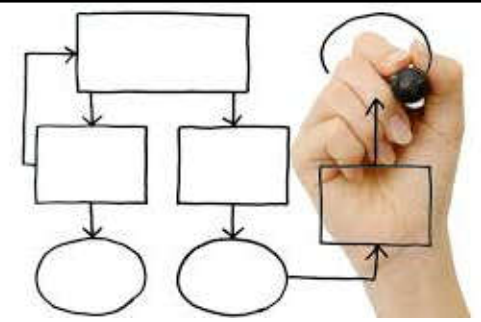




# BIM work flow

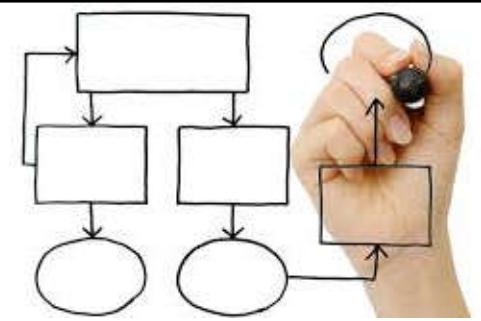
- Behaviour change towards collaboration
  - Co-ordination
    - Avoid gaps and overlap in team members work
  - Co-operation
    - Obtain mutual benefit by sharing work
  - Collaboration
    - Achieve results which could not be accomplished alone
- Integrated multi-disciplinary collaborative solutions for the construction industry





# BIM work flow

- Key points
  - Get senior management involved to ensure leadership support
  - Dedicate someone to the effort – BIM Champion
  - Prepare a BIM plan – keep it simple and specific
- Learning curve
  - There is an initial cost and loss of productivity while obtaining the necessary resources as firms go through the initial learning curve (6-18 months)



# BIM work flow

- The Periodic Table of BIM
  - <https://www.thenbs.com/periodic-table-of-bim>
  - Guide to ensure a successful BIM implementation



Strategy



Foundations



Collaboration



Process



People



Technology



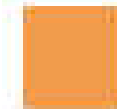
Standards



Enabling Tools



Resources



Digital Plan of Work

# The Periodic Table of BIM

The Periodic Table of BIM															
1 Bs BIM Strategy												2 Su Surveys and Reports			
3 Fr Framework	4 Cu Culture and behaviour											5 Bt BIM Toolkit	6 Lod Level of detail	7 Loi Level of Information	8 Vi Videos
9 Co Common methods	10 Po Process	11 As Assesment and need	12 Eir Employers info requirements	13 Cm Communication	14 In Investment	15 Sf Software	16 Cd Capital delivery phase	17 Cl Collaborative business relationships	18 Li Library objects	19 Cs Classification	20 An Analysis tools	21 Ev Events			
22 Pr Procurement route	23 Fo Forms of procurement	24 Ex Execution	25 Bep BIM execution plan	26 So Soft skills	27 Ch Change process	28 Ha Hardware	29 Op Operational phase	30 Pt Protocol	31 Pe Prequalification questionnaires	32 Cafm Computer-Aided Facilities Management	33 Ct Cost tools	34 Fu Forums and user groups			
35 Ca Capability and capacity	36 Di Digital tools	37 De Delivery	38 Midp Master information delivery plan	39 Cp Cooperation	40 Sh Share success	41 Tr Training	42 Fm Facilities management	43 Qu Quality management systems	44 Bsdd buildingSMART data dictionary	45 Pg Programme tools	46 Ad Administration tools	47 Sc Social media			
	48 St Standardisation and Interoperability	49 Ma Maintenance and use	50 Cde Common data environment	51 Ci Champion	52 Av Availability	53 Fi File storage	54 Dg Digital security	55 Ds Design managment systems	56 Ifc Industry foundation classes	57 Au Authoring tools	58 Mo Model viewers and checkers	59 Bl Blog posts			
		60 Dpow Digital Plan of Work	61 If Information exchange	62 Sp Support	63 En Engage	64 Ir Infrastructure	65 Br Briefing	66 Am Asset management	67 Idm Information delivery manual	68 Sp Specification tools	69 Fl File sharing and collaboration	70 Bo Books			

## Digital Plan of Work stages

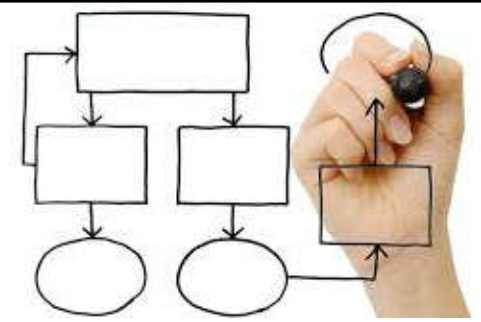
71 <b>Sr</b> Strategy	72 <b>Bi</b> Brief	73 <b>Df</b> Definition	74 <b>Dn</b> Design	75 <b>Bu</b> Build and commission	76 <b>Hn</b> Handover and closeout	77 <b>Oe</b> Operation	78 <b>Ed</b> End of life
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Find support on your BIM journey at [theNBS.com/BIM](https://www.thenbs.com/BIM)

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(Source: The Periodic Table of BIM <https://www.thenbs.com/periodic-table-of-bim>)



# BIM work flow

- Step-by-step guide to using BIM on projects
  - [https://www.designingbuildings.co.uk/wiki/Step-by-step\\_guide\\_to\\_using\\_BIM\\_on\\_projects](https://www.designingbuildings.co.uk/wiki/Step-by-step_guide_to_using_BIM_on_projects)
    - To identify the decisions that will need to be made throughout the life of a built asset and the information deliverables required at each stage of the project to support those decisions
    - Information deliverables include model files, documents and structured data files containing information about the facility, floors, spaces, systems and components (*digital replica* of the built asset)



# Step-by-step guide to using BIM on projects: following the RIBA plan of work stages

## **Stage 0: Strategic definition**

- 0a: Business justification
- 0b: Strategic brief

## **Stage 1: Preparation and brief**

- 1a: Appraisals
- 1b: Brief and information requirements
- 1c: Supplier appointments

## **Stage 2: Concept design**

## **Stage 3: Developed design**

## **Stage 4: Technical design**

## **Stage 5: Construction**

## **Stage 6: Handover and close out**

## **Stage 7: In use**

\* The end of each stage is marked by an employer's decision point at which the employer needs specific information to help them decide whether the project has developed satisfactorily and whether it should continue to the next stage.

\*\* RIBA = Royal Institute of British Architects

## Step-by-step instructions showing how to plan a project in compliance with BIM

- Structure the project and the data
- Create the building model
- Assign parameters and attributes; attach additional information
- Export the BIM model and give it to all those involved
- Check the model data and the components
- Revise and adjust the model; external planning partners add their data
- Import the external data into the project
- Compare the models and their components
- Add the changes to the original model
- Export the updated BIM model again and give it to all those involved
- .....

# Collaboration in the Office

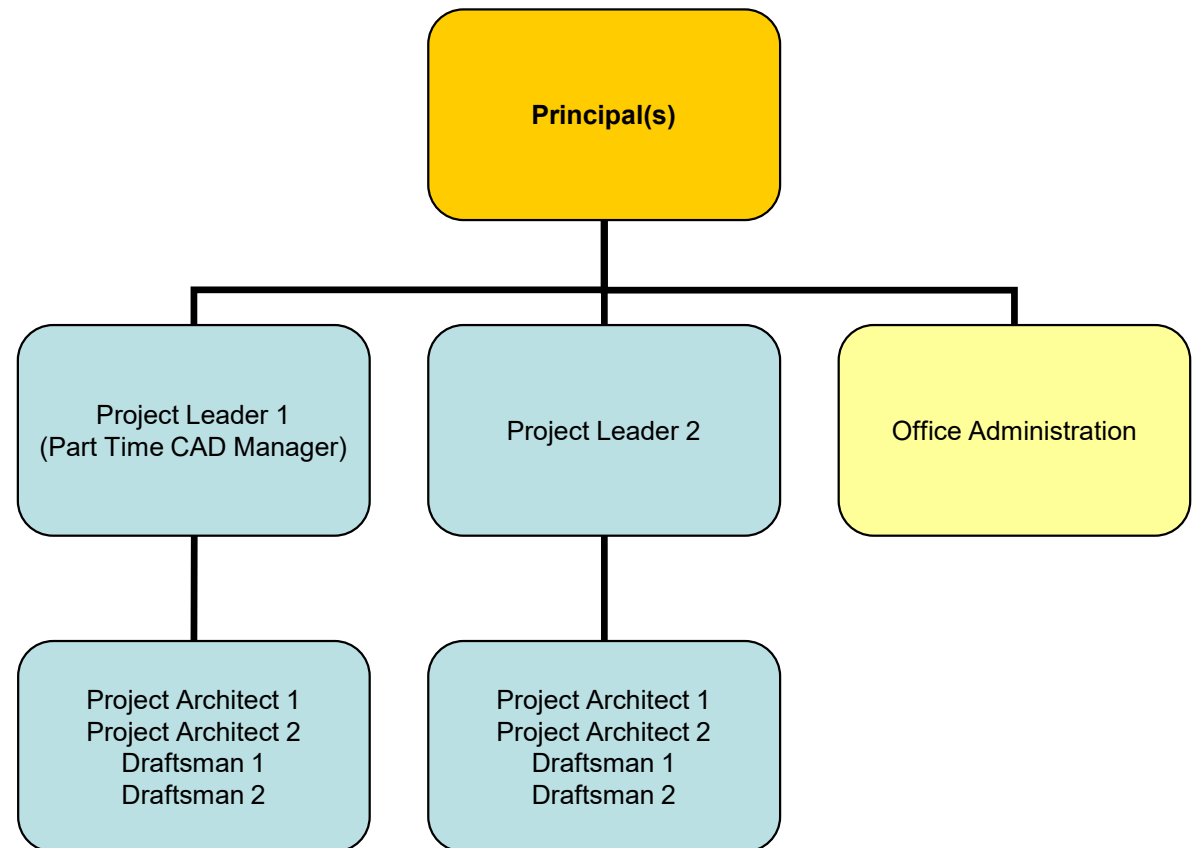
- Sharing and coordinating the work between the project team members is one of the most important tasks of the project leader and the CAD manager.
- 
- Project sharing method should be adequate for the project team size and the office organization.
- Advanced BIM programs provide effective solutions for this problem.



# Office Organization: Small Office

## Organization:

- Two independent project teams
- Two projects run at the same time
- One project team contains 4-5 people
- Small to medium scale projects
- No full time CAD manager



## Problems:

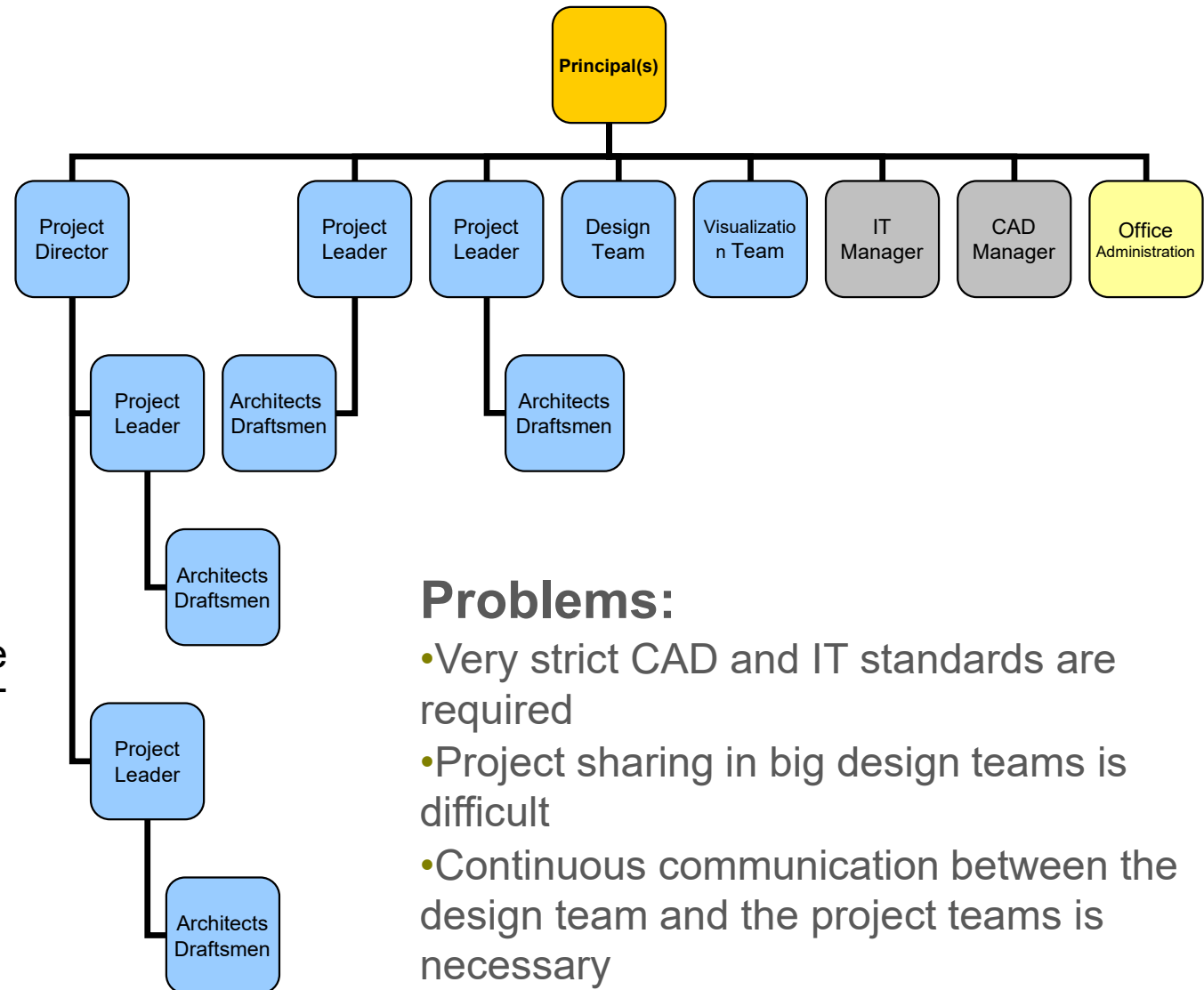
- No dedicated person to establish and maintain office CAD and IT standards
- Lack of professional design and visualization teams



# Office Organization: Large Office

## Organization:

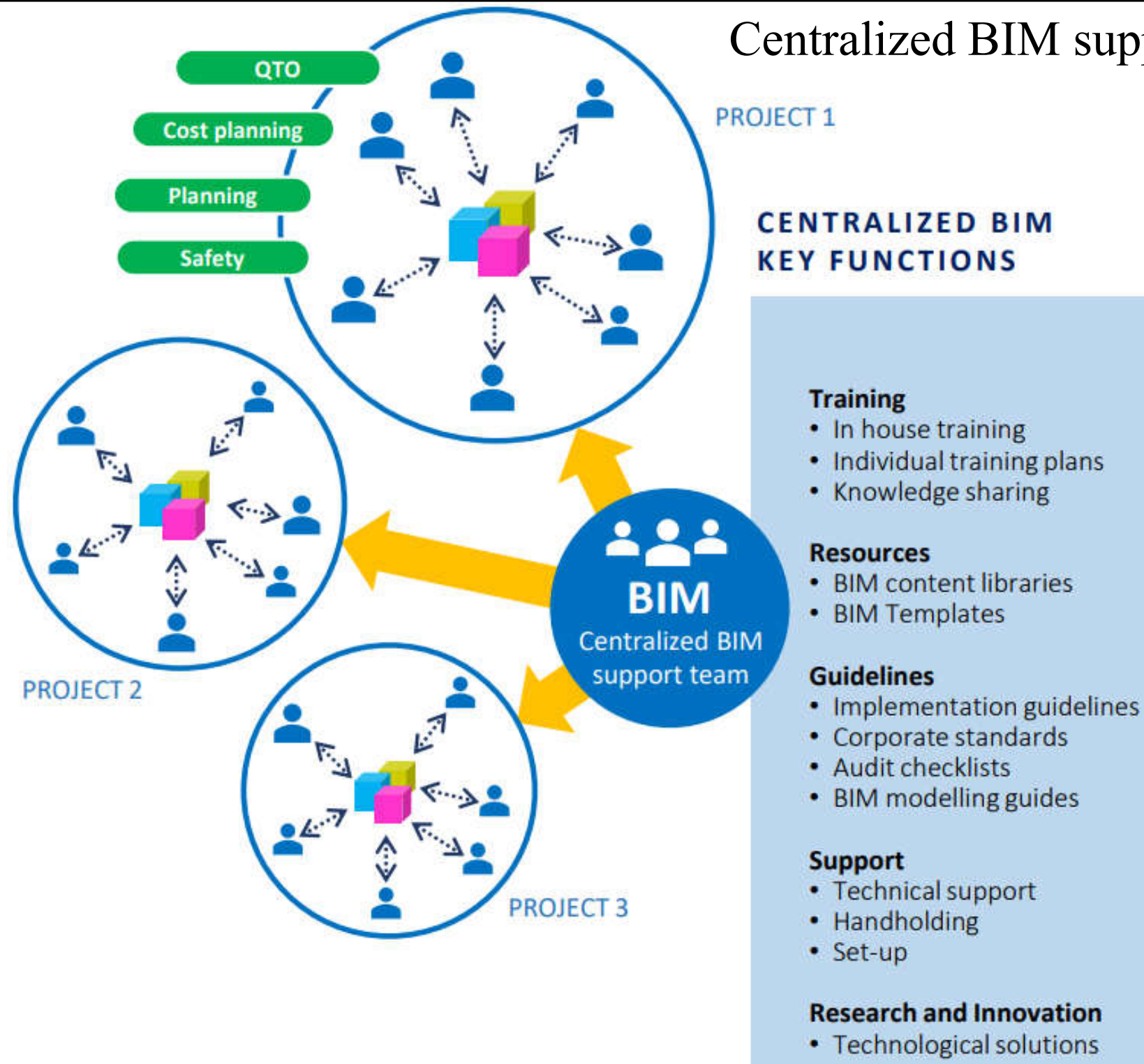
- 4 project Teams
- Three projects run parallel (one big project)
- Two project teams are working on a big project under the supervision of a project director
- One project team contains 5-10 people
- Full time CAD and IT managers
- Independent design and Visualization Team supports the project architects



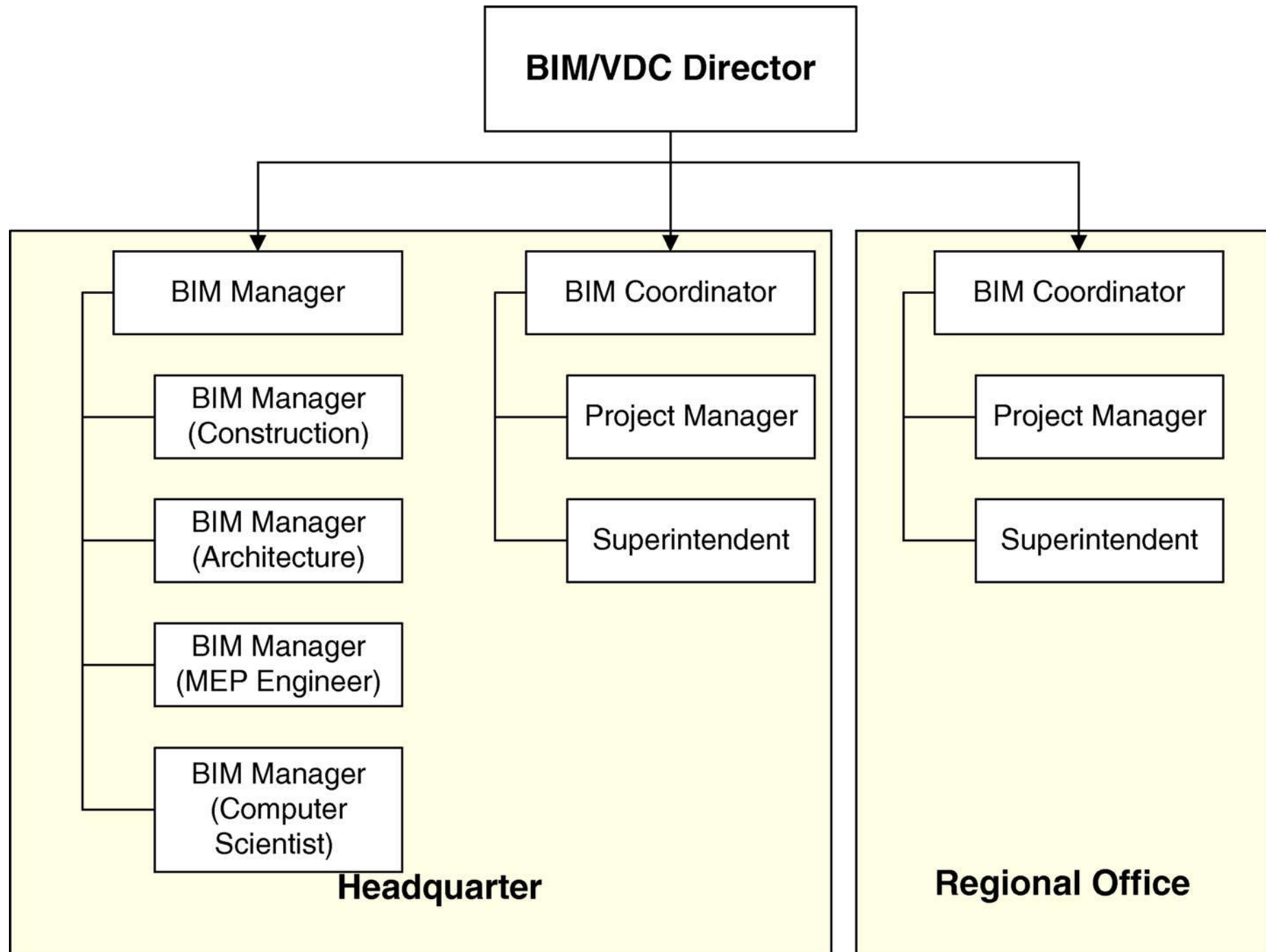
## Problems:

- Very strict CAD and IT standards are required
- Project sharing in big design teams is difficult
- Continuous communication between the design team and the project teams is necessary

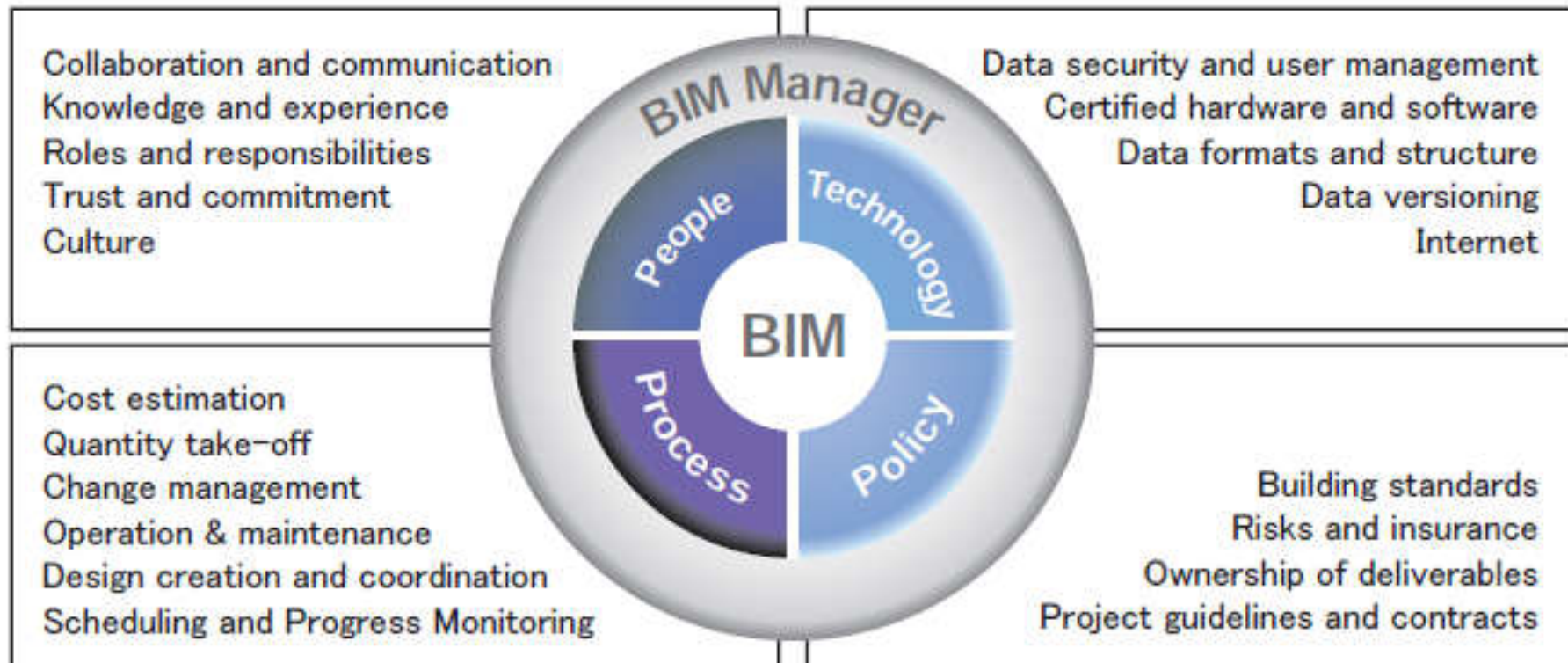
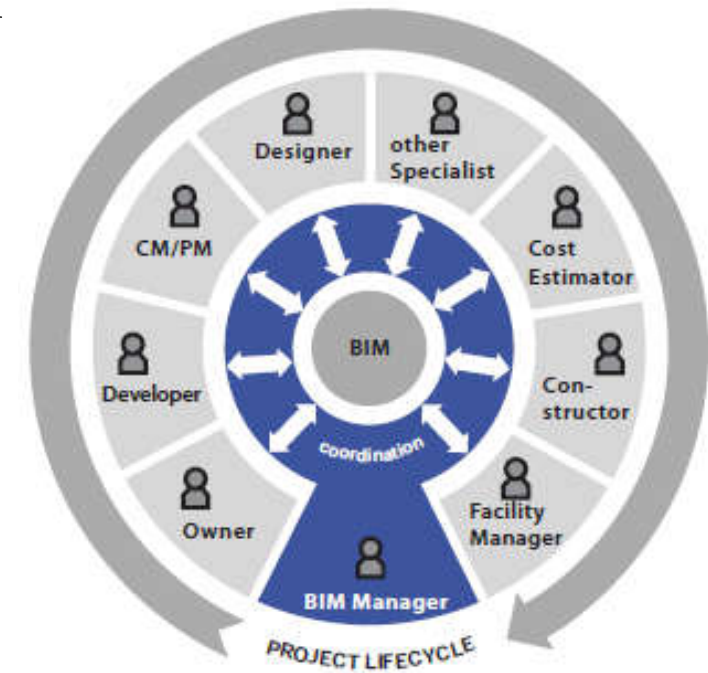
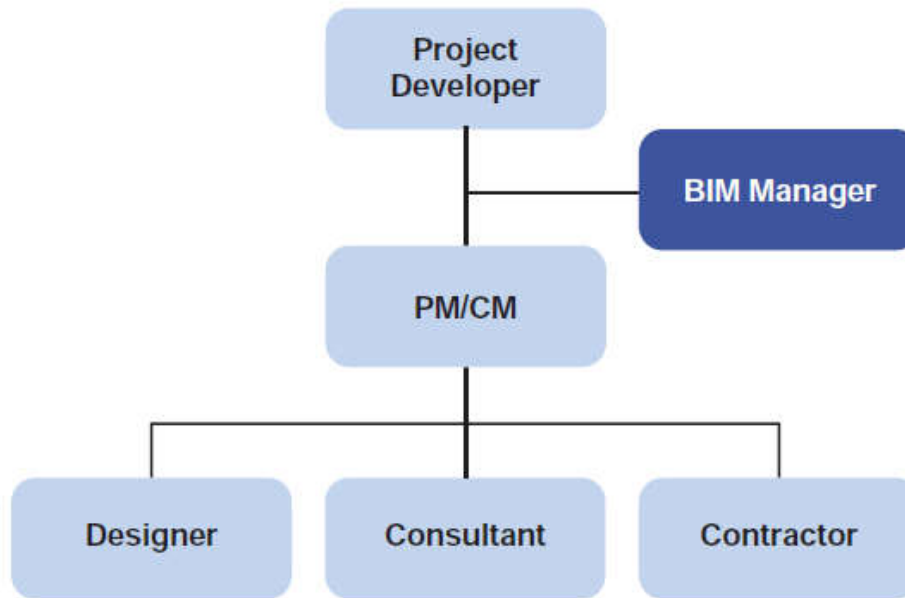
# Centralized BIM support team



# An example of organization structure of a BIM company/department



# The BIM Manager

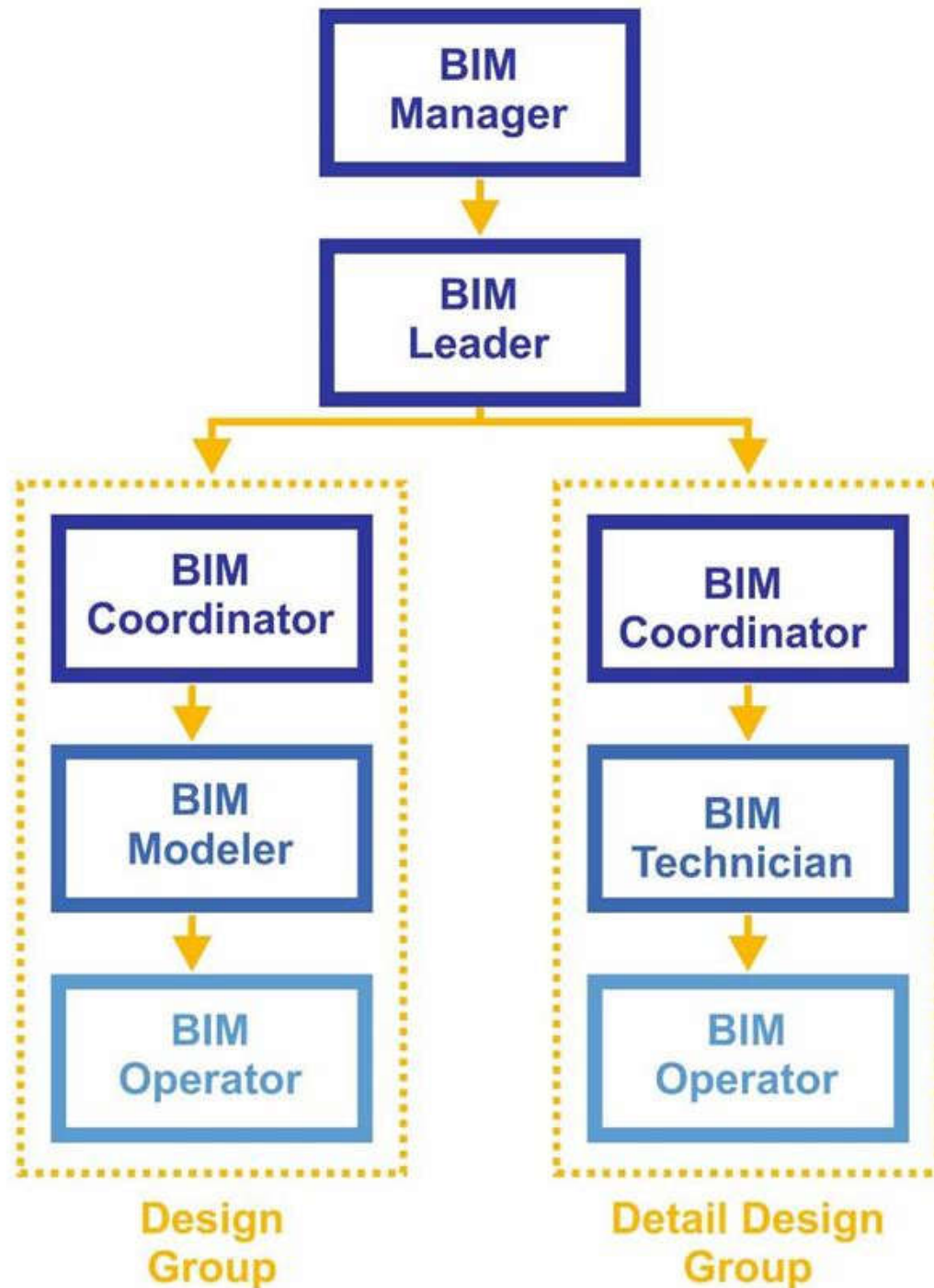




## Typical tasks of a BIM Manager

- Receive and manage multiple subcontractor models
- Coordinate all BIM Logistics (contracts, emails, file sharing, etc.)
- Create, maintain and analyze federated model mainly for coordination purposes
- Review and document design and coordination conflicts
- Run and analyze clash detection on federated model
- Prepare and distribute clash reports to facilitate the coordination process
- Schedule and facilitate coordination meetings along with project manager and/or superintendent
- Write meeting minutes
- Site inspection and liaising with trade contractors
- Meet with designers/owners as required to facilitate review of models as needed
- Compile contract BIM close out documentation

# BIM role classification



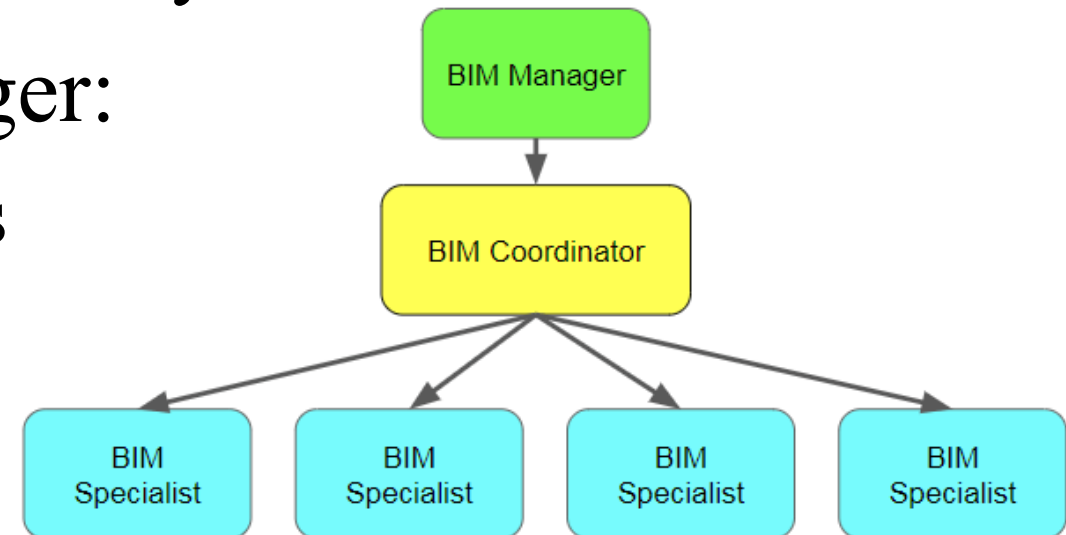
## 4 key areas of BIM management:

- Model & drawing management
- Information management
- Design & construction management
- Stakeholder management

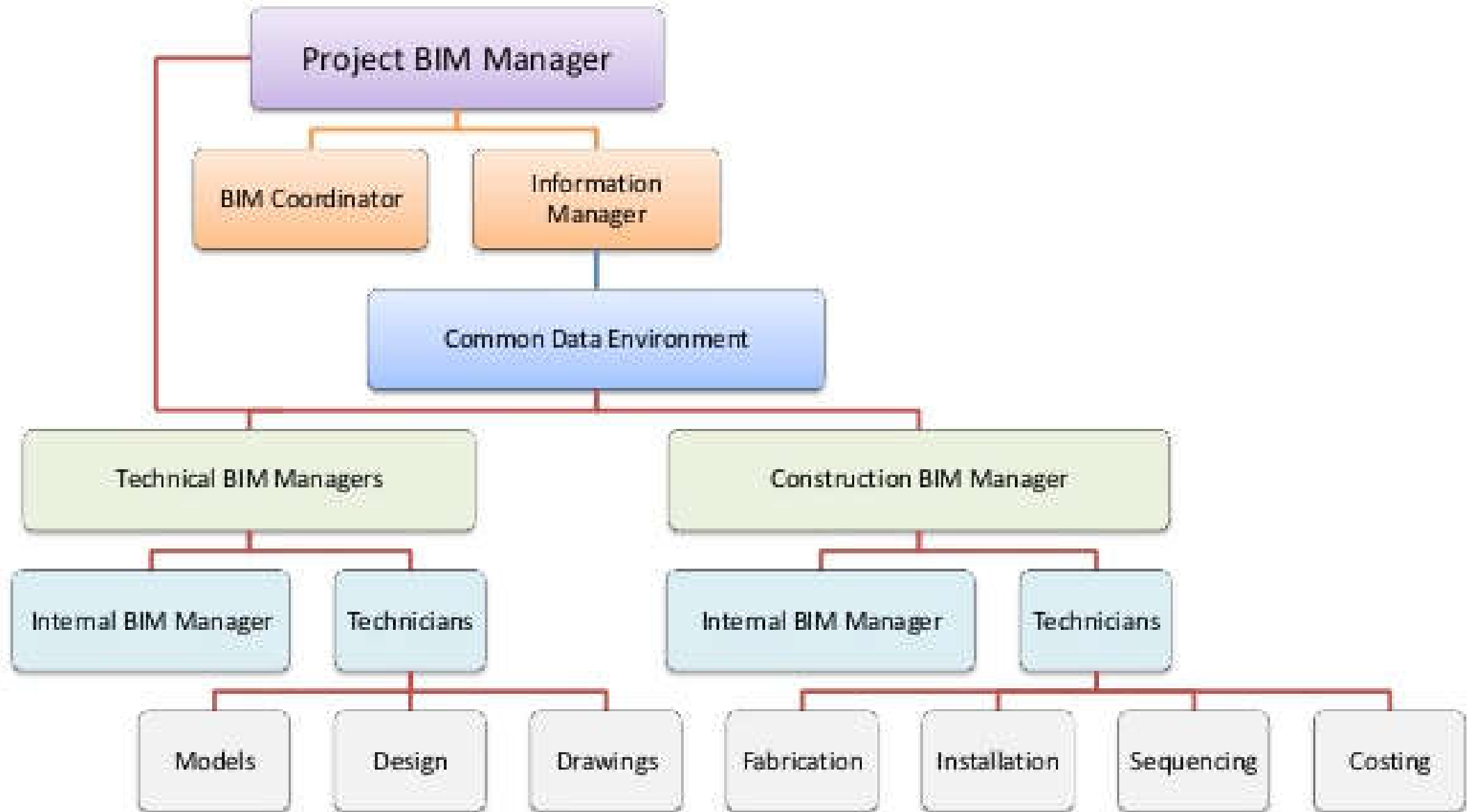


# Office organization

- Effective BIM management
  - It's everyone's responsibility
- 6 types of BIM Manager:
  - Project BIM Managers
  - BIM Coordinators
  - Information Manager
  - Technical BIM Manager
  - Construction BIM Manager
  - Internal BIM Managers (within an organization)



# BIM management structure



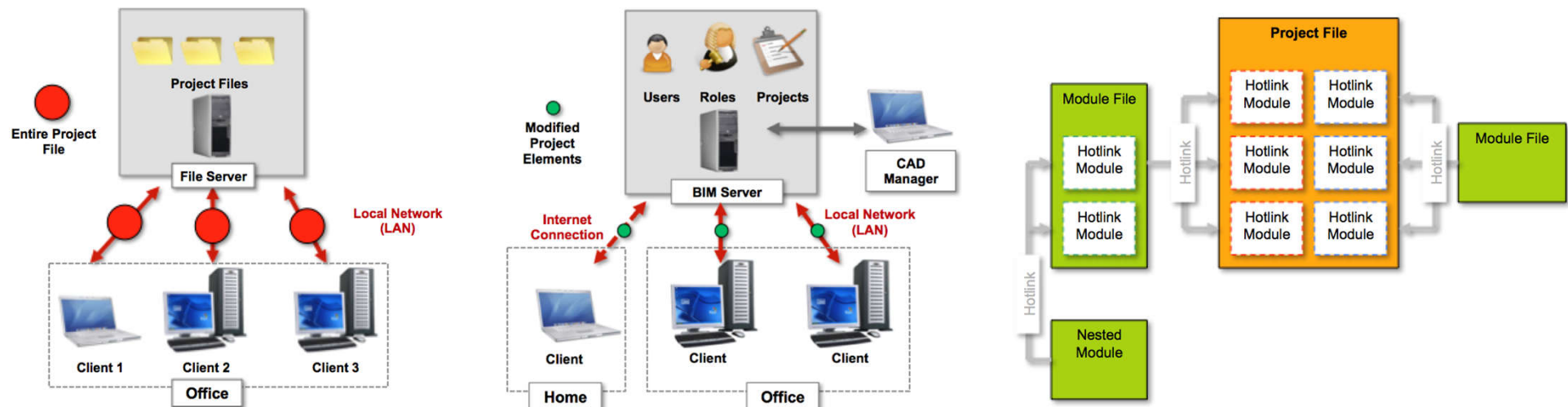


# Internal Collaboration-BIM

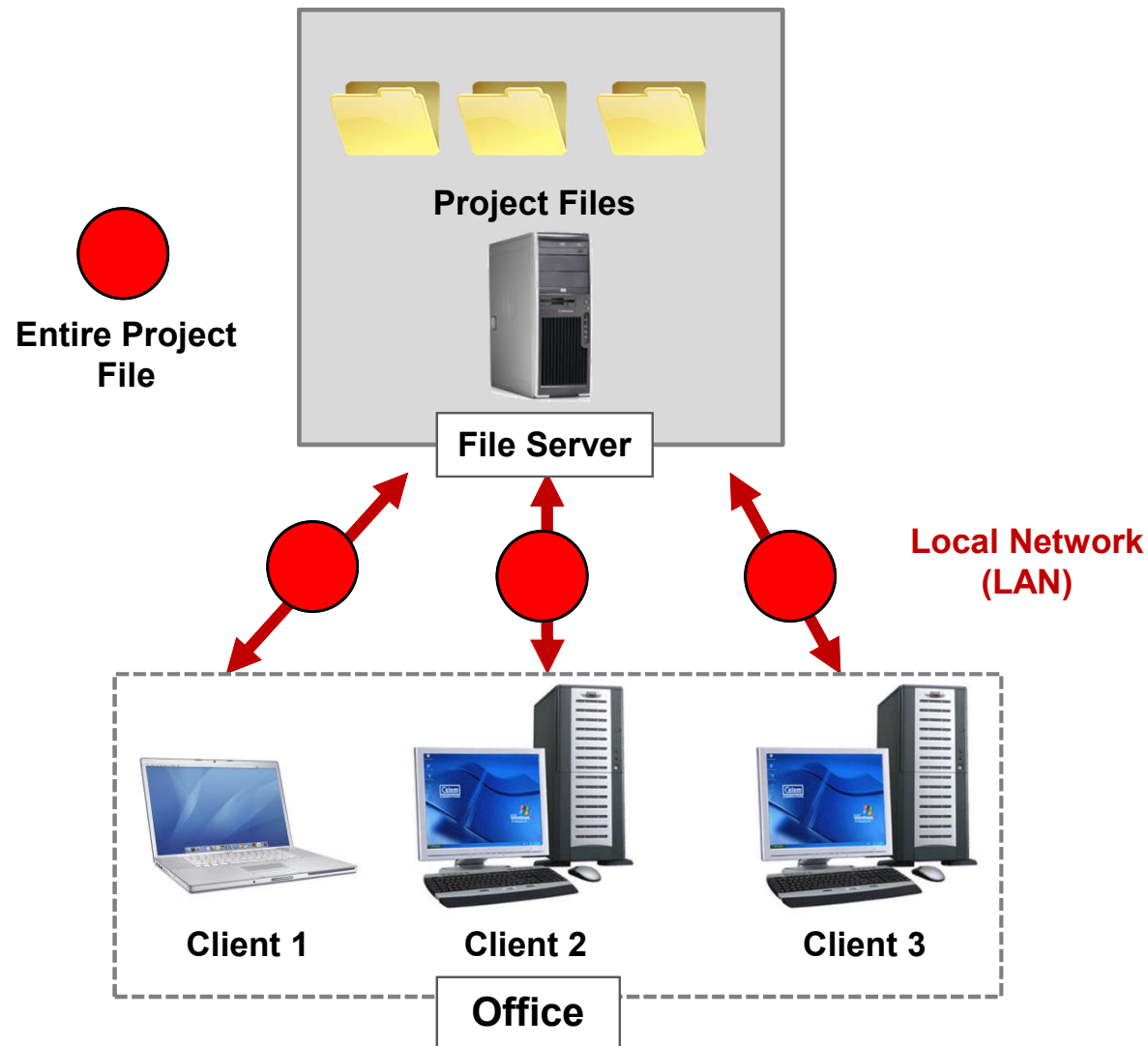
BIM applications allow the sharing of the project data between the project team members.

The most common project sharing methods are:

- File server based teamwork solutions
- Client-server based teamwork solutions
- Hotlinked file methods

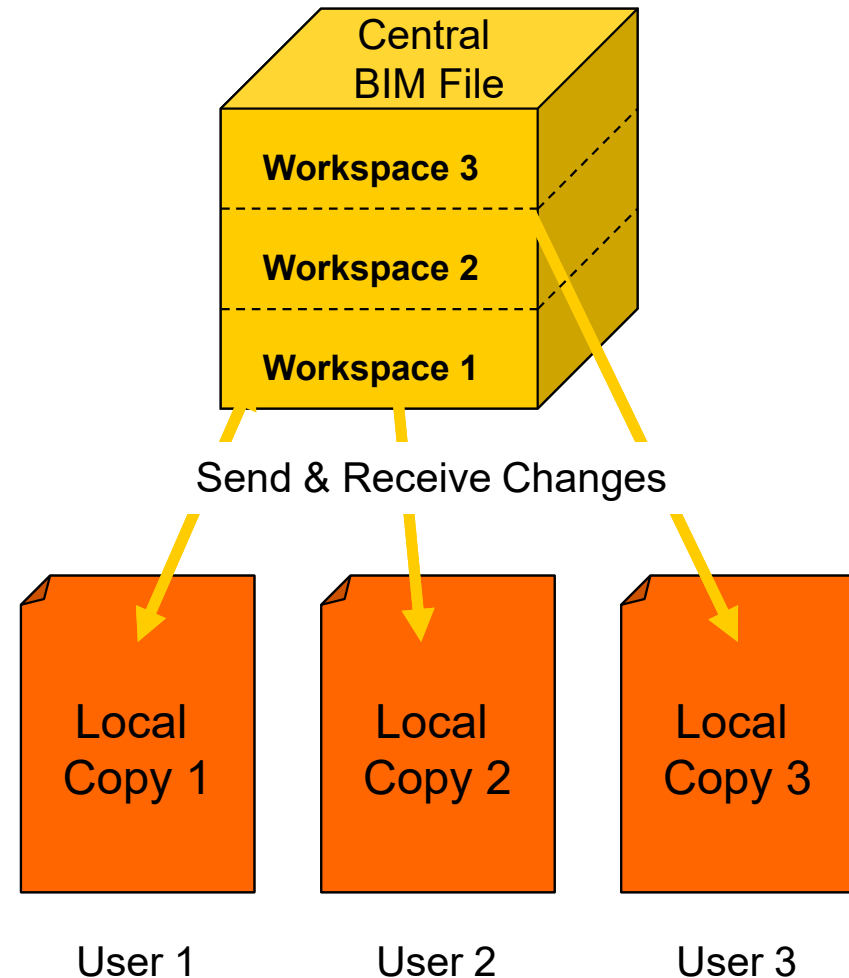


# File Server Based Teamwork Solutions



# File Server Based Teamwork Concept

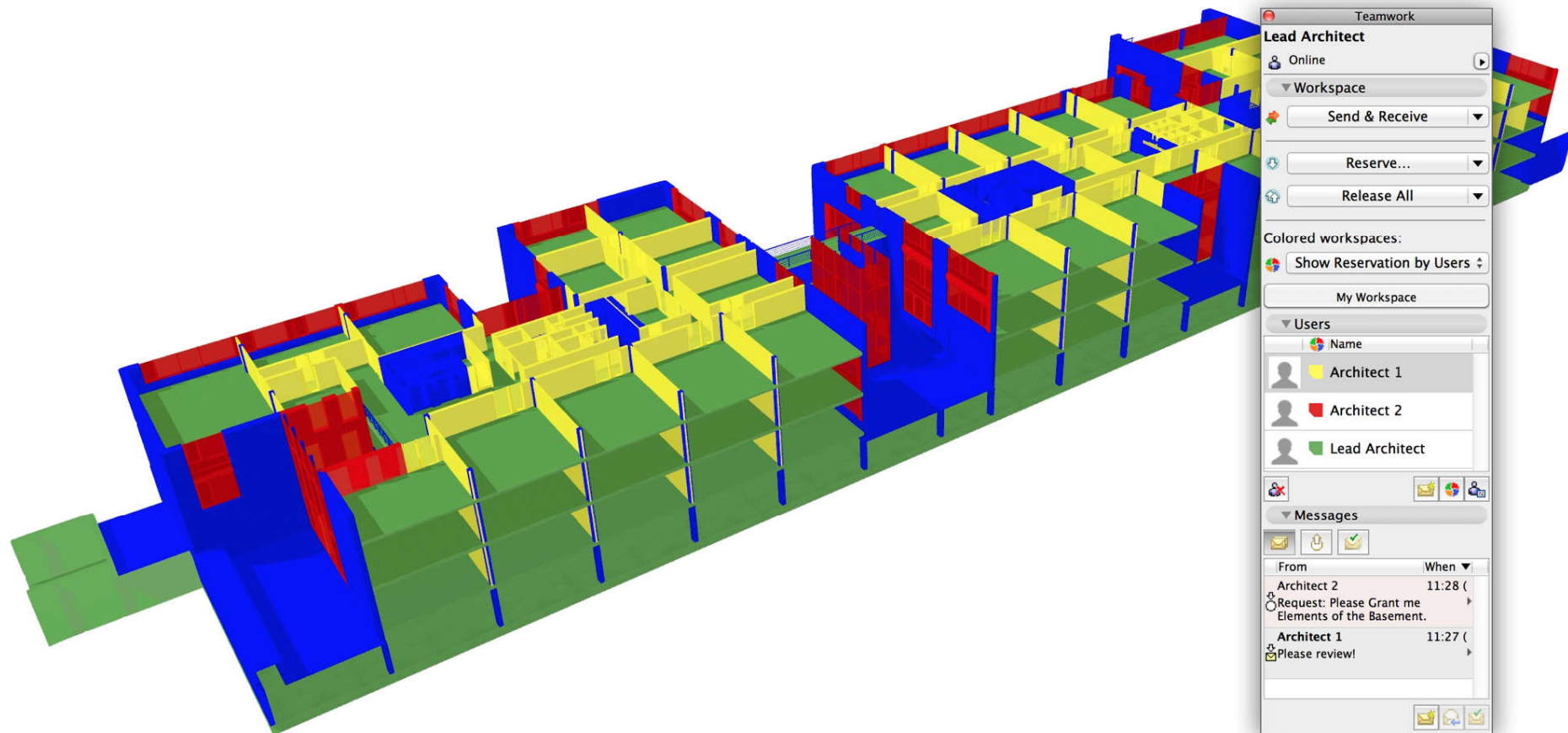
- File server based teamwork solutions are based on the same concept:
  - Central file contains the complete virtual building database
  - Team members work on local copies
  - Team members have dedicated workspaces
  - Team members send and receive changes regularly



# Workspace Definition

Workspaces can be reserved by different methods:

- By Selection (e.g. Stories, sections, elevations, drawings, marquee areas)
- By Criteria (e.g. Layers, element types)



# Send & Receive Changes

Users must regularly send and receive changes to keep the central BIM file and the local copies up to date.

- Changes made by any team member are sent to the shared Team Project by choosing **Send & Receive Changes** command, or (optionally) when signing out.
- Changes sent to the Team Project do not appear automatically in other Teammates' copies. In order to see changes made by another Teammate, they have to **Receive Changes**.



# Evaluation of File Server TeamWork Solutions

- **Benefits:**

- Effective

- Team members can work simultaneously on the same project

- Organized

- Team members have dedicated roles and rights. Overlapping workspaces are not allowed, thus users can't modify or delete accidentally the other's work

- Transparent

- Team members can check the actual status of the project at any time

- Controllable

- Team leaders can revise the changes made by the project team

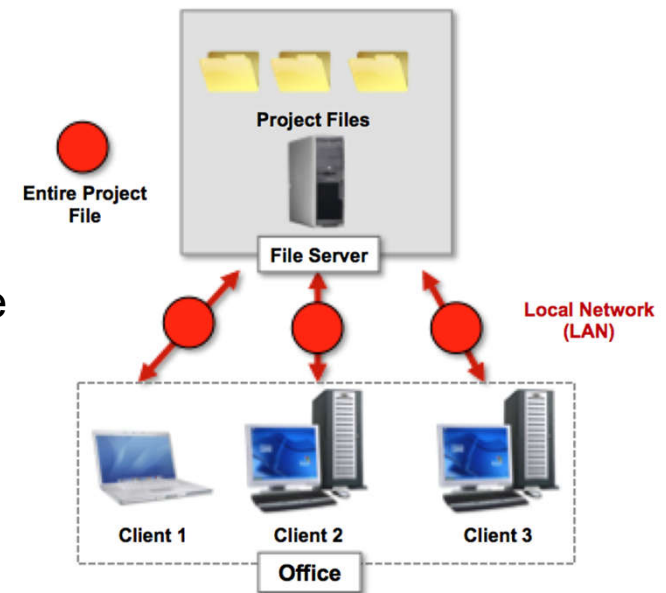
- **Limitations:**

- Team members can't send or receive changes simultaneously

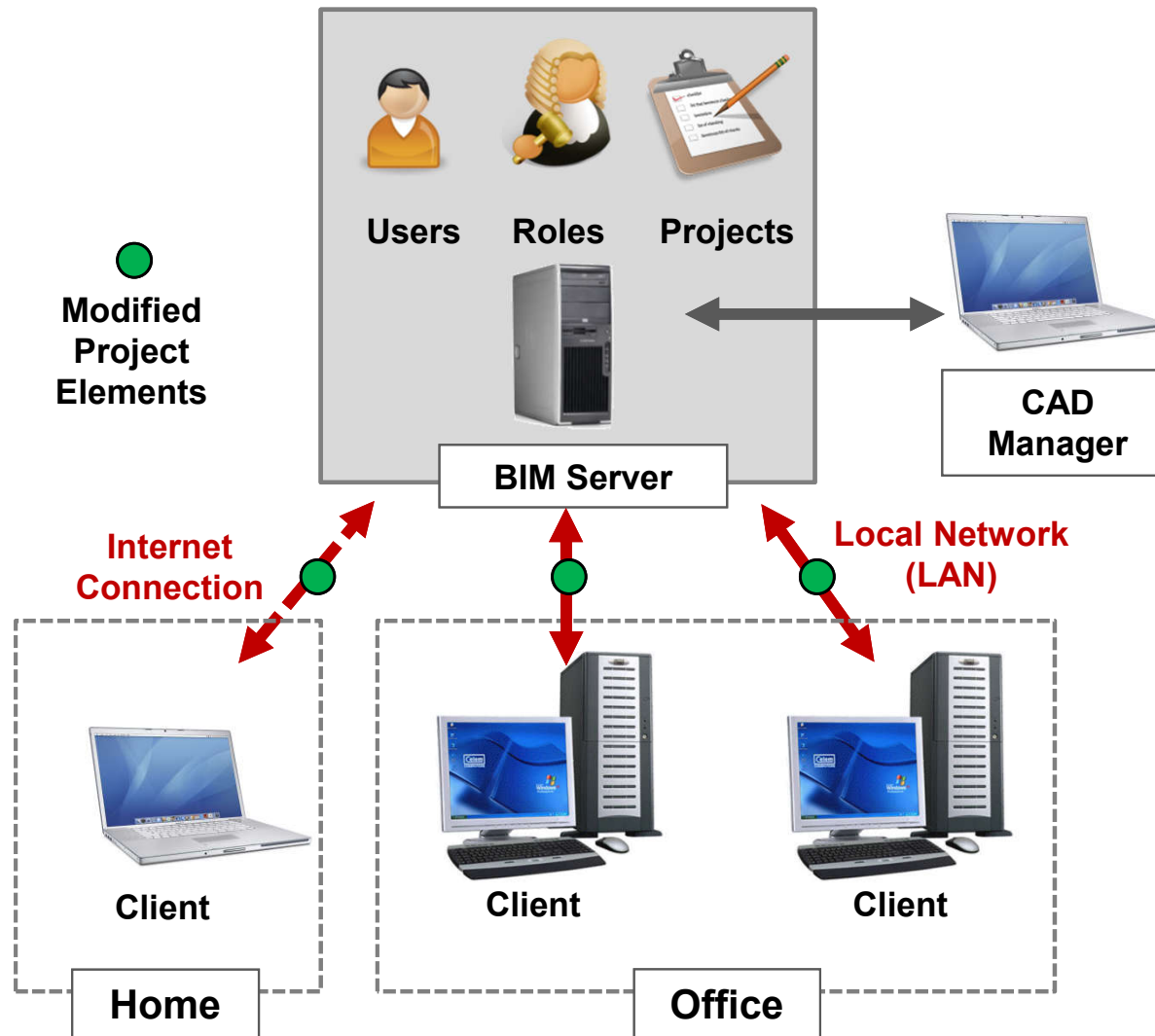
- Sending and receiving changes can be slow with large projects

- Offices in remote locations can't access the project via regular Internet connection

- There is no intelligent application on the server to manage users, projects and user roles



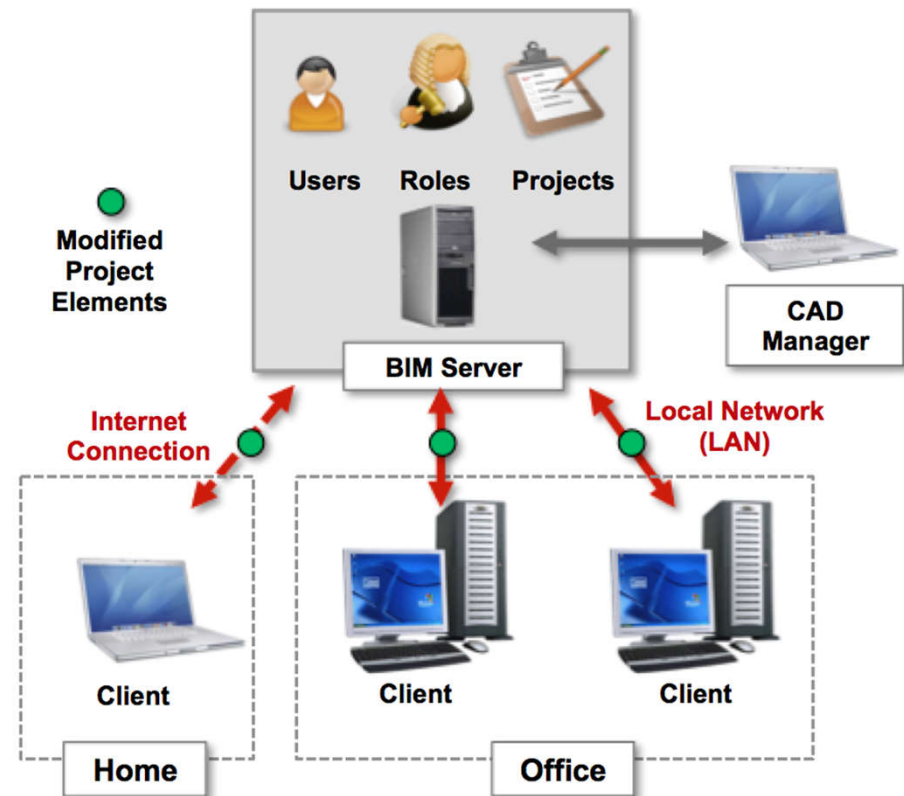
# Client-Server Based Collaboration Solution



# Evaluation of Client-Server TeamWork Solution

## Benefits:

- **Effective**  
Team members can work simultaneously on the same project
- **Organized**  
Team members have dedicated roles and rights. No overlapping workspaces
- **Transparent**  
Team members can check the actual status of the project at any time
- **Easy**  
Easy to adopt collaboration techniques
- **Fast**  
Only project changes are sent over the network
- **Flexible**  
On demand element reservation
- **Data Safety**  
Intelligent data filtering on the server
- **Offline Work**  
Users can work in their workspace in offline mode

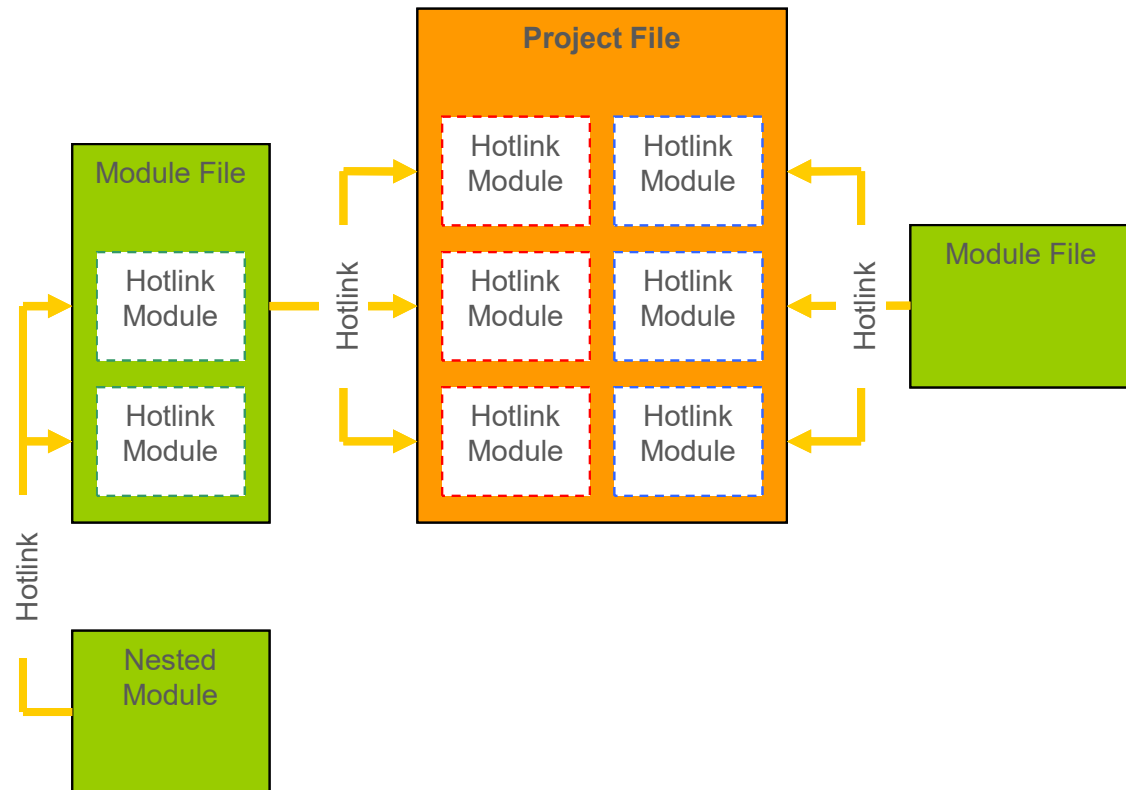


## Limitations:

- Users have to be online to utilize all features
- TeamWork in itself can't divide large projects into smaller parts

# The Hotlinked Files Concept

- Using **hotlinked files** allows you to insert the contents of external files (sources or modules) into the currently open master project file (host file)
- Whenever the content of a source/module file is changed, the modifications automatically appear in all instances of the hotlinked modules placed in the host file
- Typical hotlink solutions are the hotlinked modules in ARCHICAD and external references (xRefs) in AutoCAD



# Evaluation of the Hotlinked File Method

- **Benefits:**

- Hotlinks can be used effectively to manage repetitive elements in a project (e.g. rooms in a hotel)
- Hotlinked files can also refer to other hotlinks. That is called a nested module.
- Hotlinks can be used to subdivide a larger building into smaller, easier-to-handle logical parts

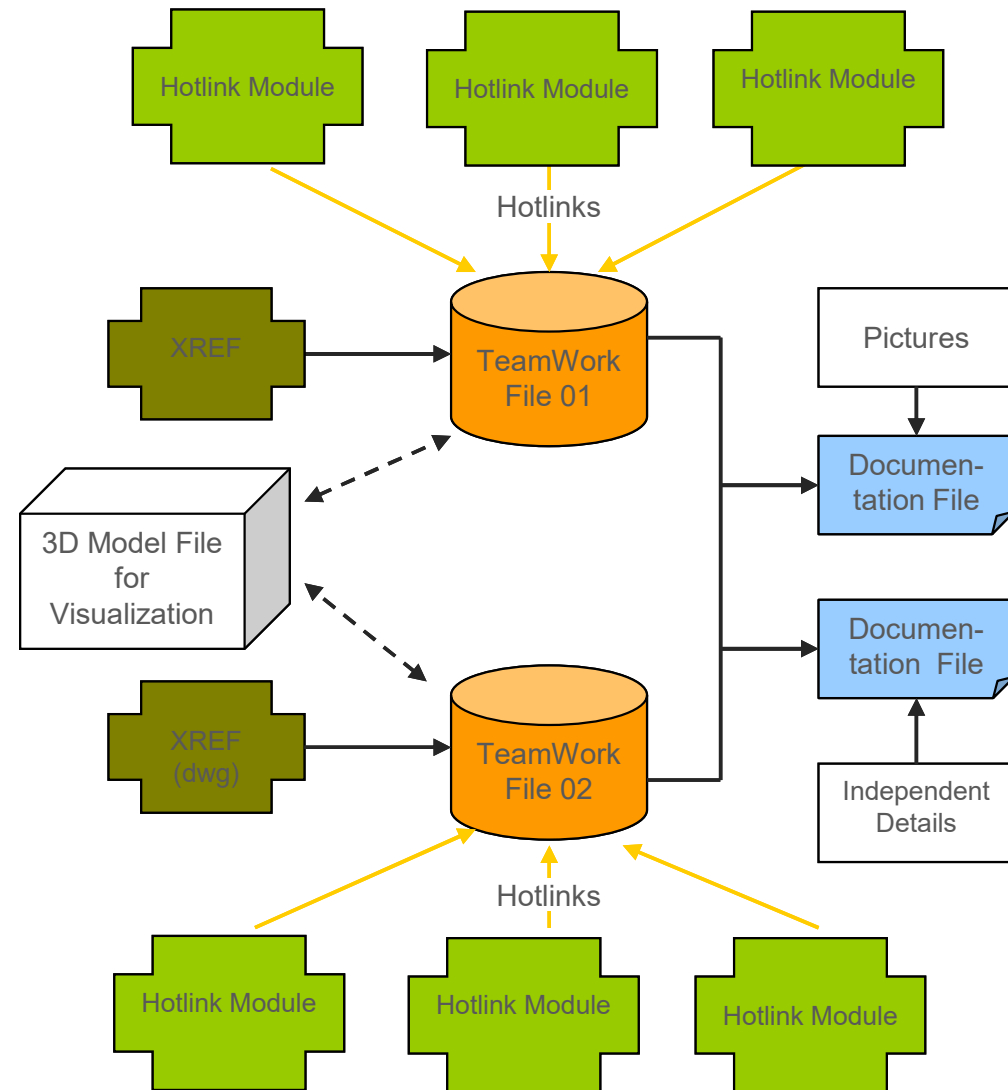
- **Limitations:**

- Owner of the host file doesn't have automatic control over the content of the hotlinked files
- Changes of the hotlinked file can cause conflicts in the host project
- Moving or deleting the hotlinked file will break the link in the host file

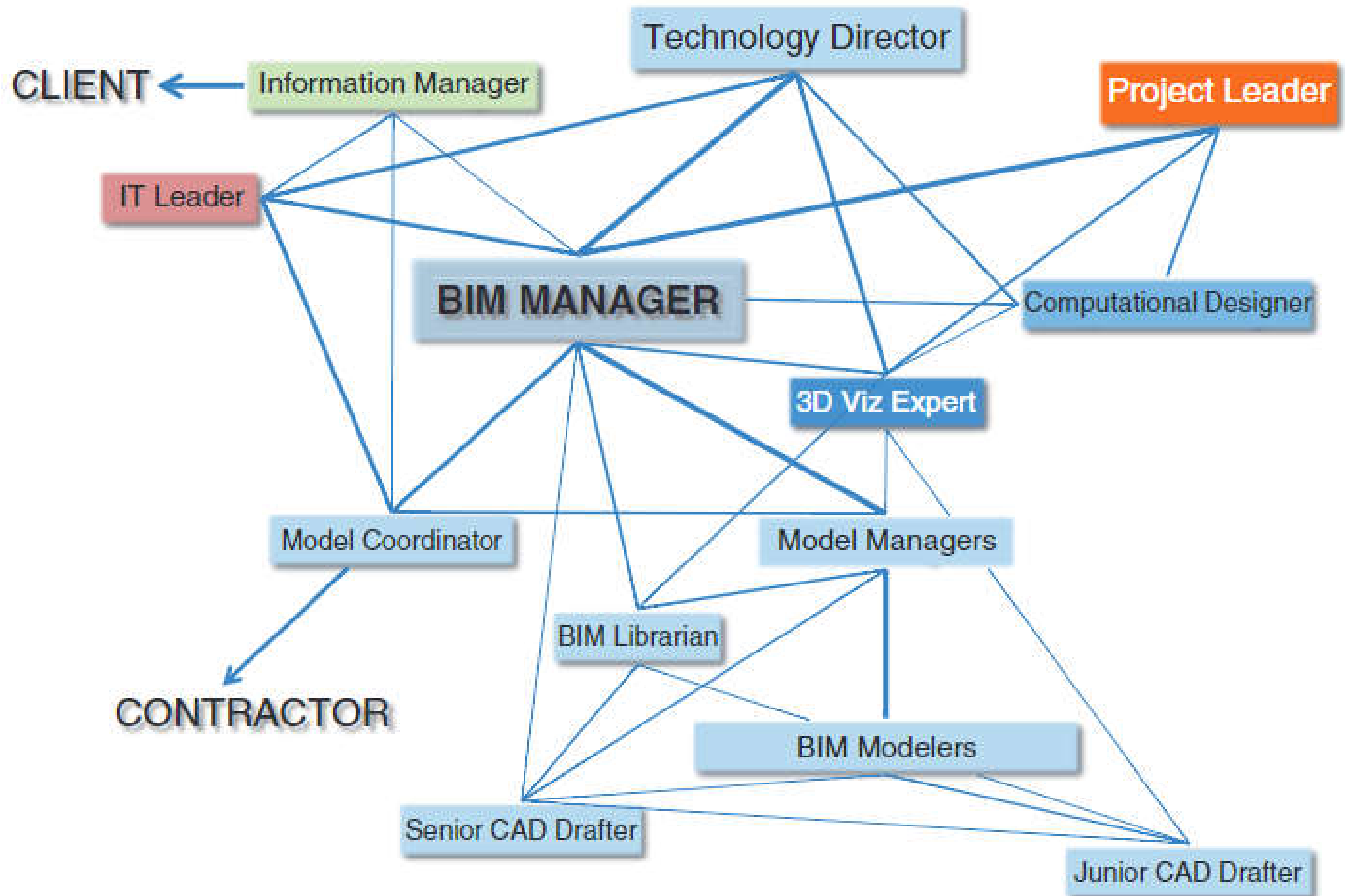


# Complex Projects

- In case of big or complex projects a custom collaboration solution is needed that is adequate for the office organization and the type of the project.
- Combination of Teamwork files, with hotlinked modules and external references can be effective even in case of very complicated projects.



# Possible role distribution surrounding BIM in a large design firm





# BIM project execution

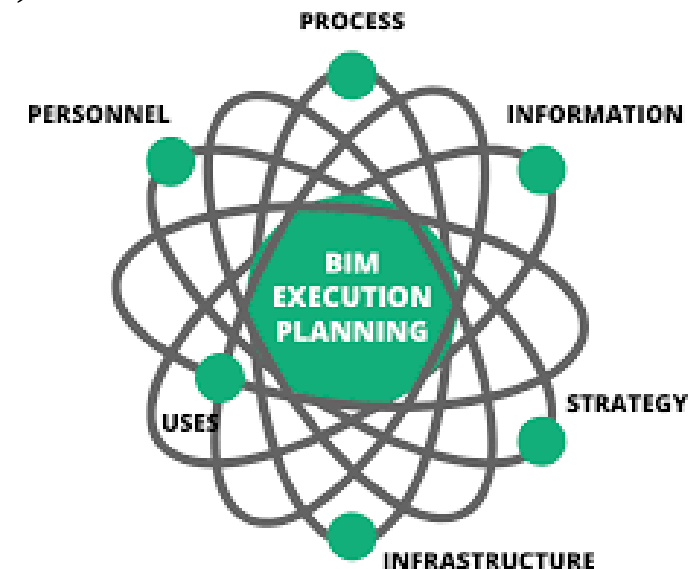
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- BIM has to be configured for each project specifically
  - Definition of roles
  - Which data to be stored
  - Communication strategy
- The actual BIM configuration is dependent on requirements of stakeholders, participating companies, and project specific requirements



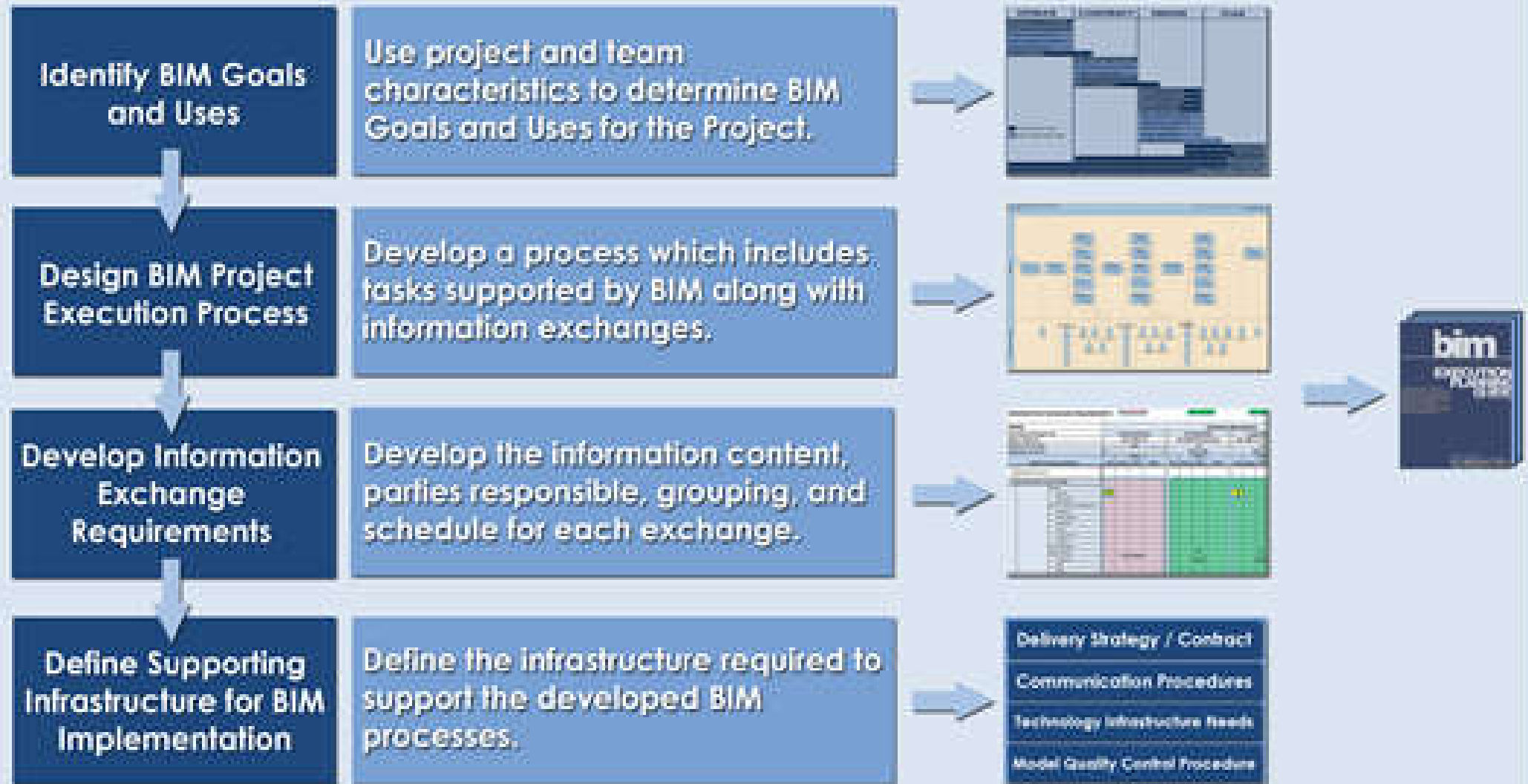
# BIM project execution

- Typical guidelines for BIM projects:
  - Development and use of the models
  - Information management
  - BIM Execution Plan (BEP or BxP)
  - BIM protocols
    - Coordination and conflicts
    - Model ownership & requirements
    - File formats, responsibilities
    - Cost estimating, scheduling
  - Level of development (LOD)



# BIM project execution planning procedure

## BIM Project Execution Planning Procedure







# BIM project execution

- Benefits of BIM Execution Plan (BEP)
  - Set clear goals & objectives across organization & teams
  - Increase accountability and productivity
  - Standardize your communication methods
  - Define roles and responsibilities
  - Bind all parties early in the RFP (request for proposal) process
  - Control project costs, schedule, scope & quality

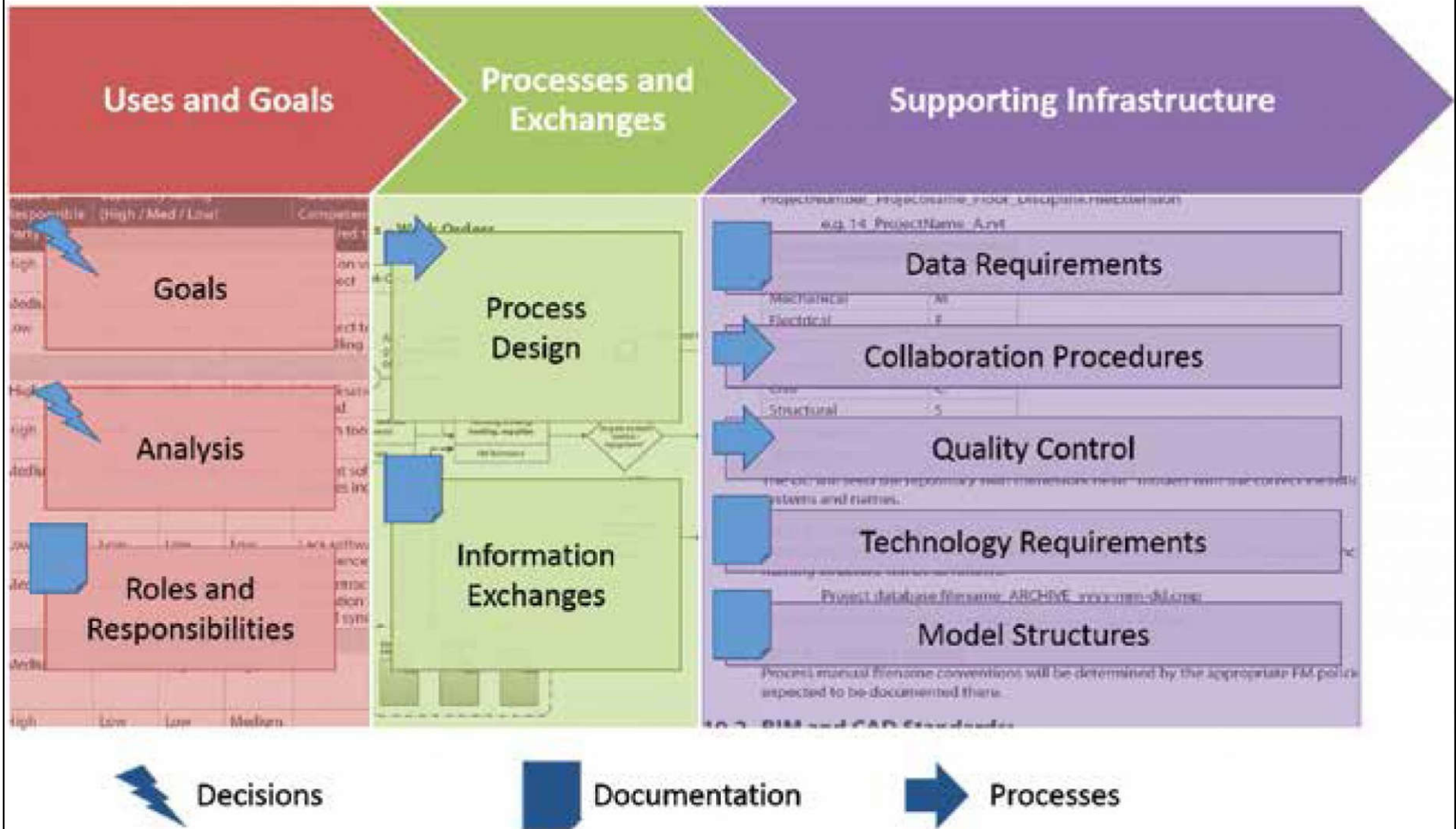


# BIM project execution

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- Major issues of the BIM Execution Plan:
  - Project participants
  - Models to be used & content
  - Contract & record documents
  - Areas of the project
  - Schedule (delivery and updates)
  - Protocols for submission
  - Coordinate system & dimension accuracy
  - File format, naming, structure, software to be used

# BIM project execution plan (PxP) process and structure





# BIM project execution

- Pre-contract BIM Execution Plan
  - It is prepared by prospective suppliers, setting out their proposed approach, capability, capacity and competence to meet the Employer's Information Requirements (EIR)
- Post-contract BIM Execution Plan
  - Once the contract has been awarded, the successful supplier then submits a post-contract BEP confirming the supply chain's capabilities and providing a Master Information Delivery Plan (MIDP). The MIDP is the primary plan setting out when project information is to be prepared, by whom, using what protocols and procedures

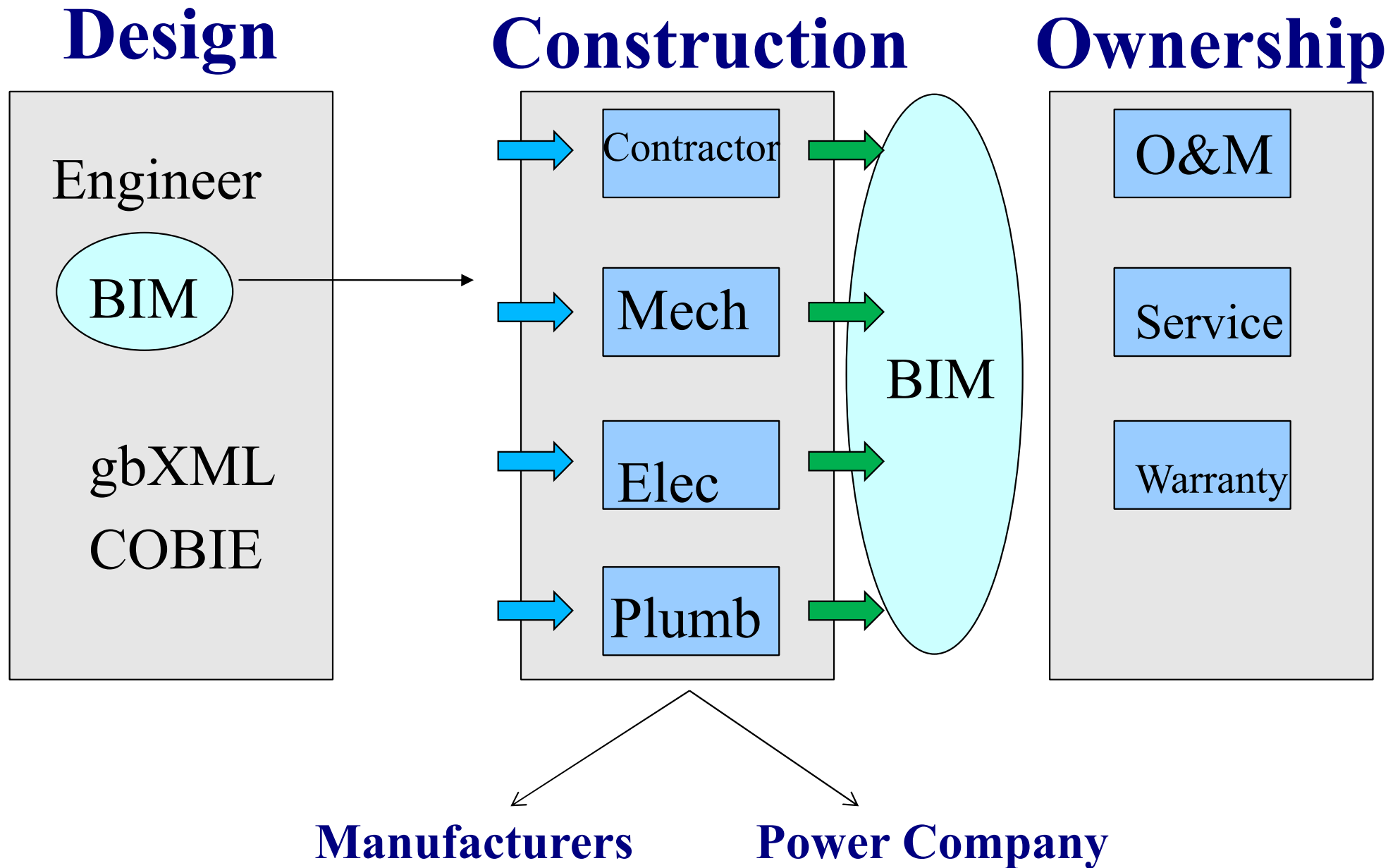


# BIM project execution

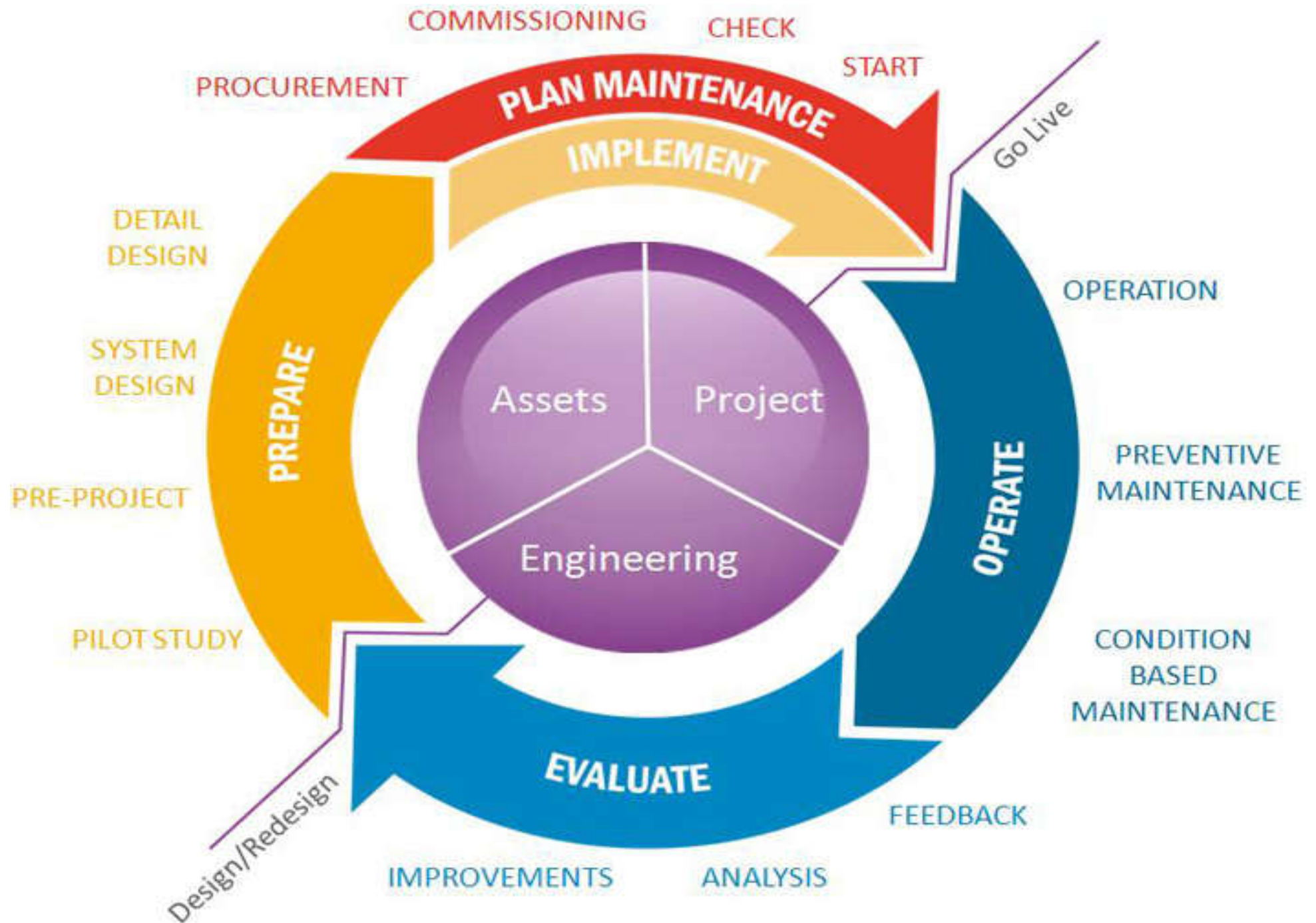
- BIM project execution plan templates
  - [https://www.bca.gov.sg/BIM/others/BIM\\_Execution\\_Plan.doc](https://www.bca.gov.sg/BIM/others/BIM_Execution_Plan.doc)
  - [https://bim.wikispaces.com/file/view/BIM\\_PxP\\_Template\\_Made\\_Easier.docx](https://bim.wikispaces.com/file/view/BIM_PxP_Template_Made_Easier.docx)
  - [http://classes.engr.oregonstate.edu/cce/winter2017/cce203/BIM\\_ProjectExecutionPlanningGuide.pdf](http://classes.engr.oregonstate.edu/cce/winter2017/cce203/BIM_ProjectExecutionPlanningGuide.pdf)
- BIM project execution plan example
  - [http://bimexperts.com.br/wp-content/uploads/2015/12/Solve\\_PxP.pdf](http://bimexperts.com.br/wp-content/uploads/2015/12/Solve_PxP.pdf)



# Basic flow of BIM data



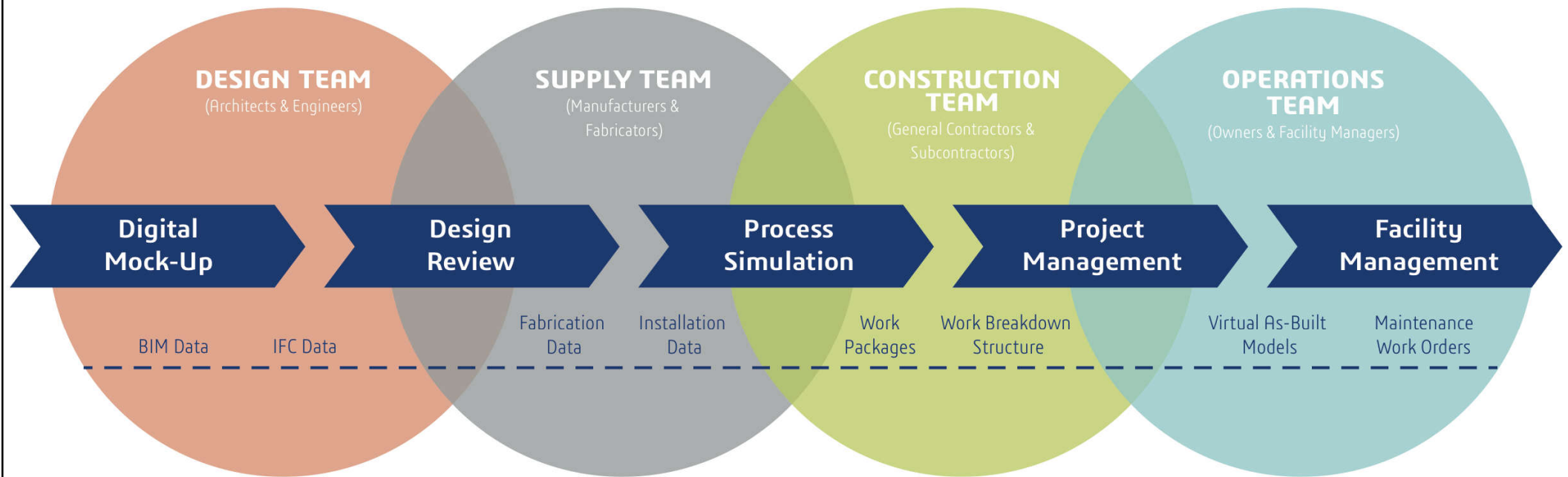
# Using BIM for all phases



# Building lifecycle management (BLM) approach

## Extended Collaboration Model for Design, Construction & Operations

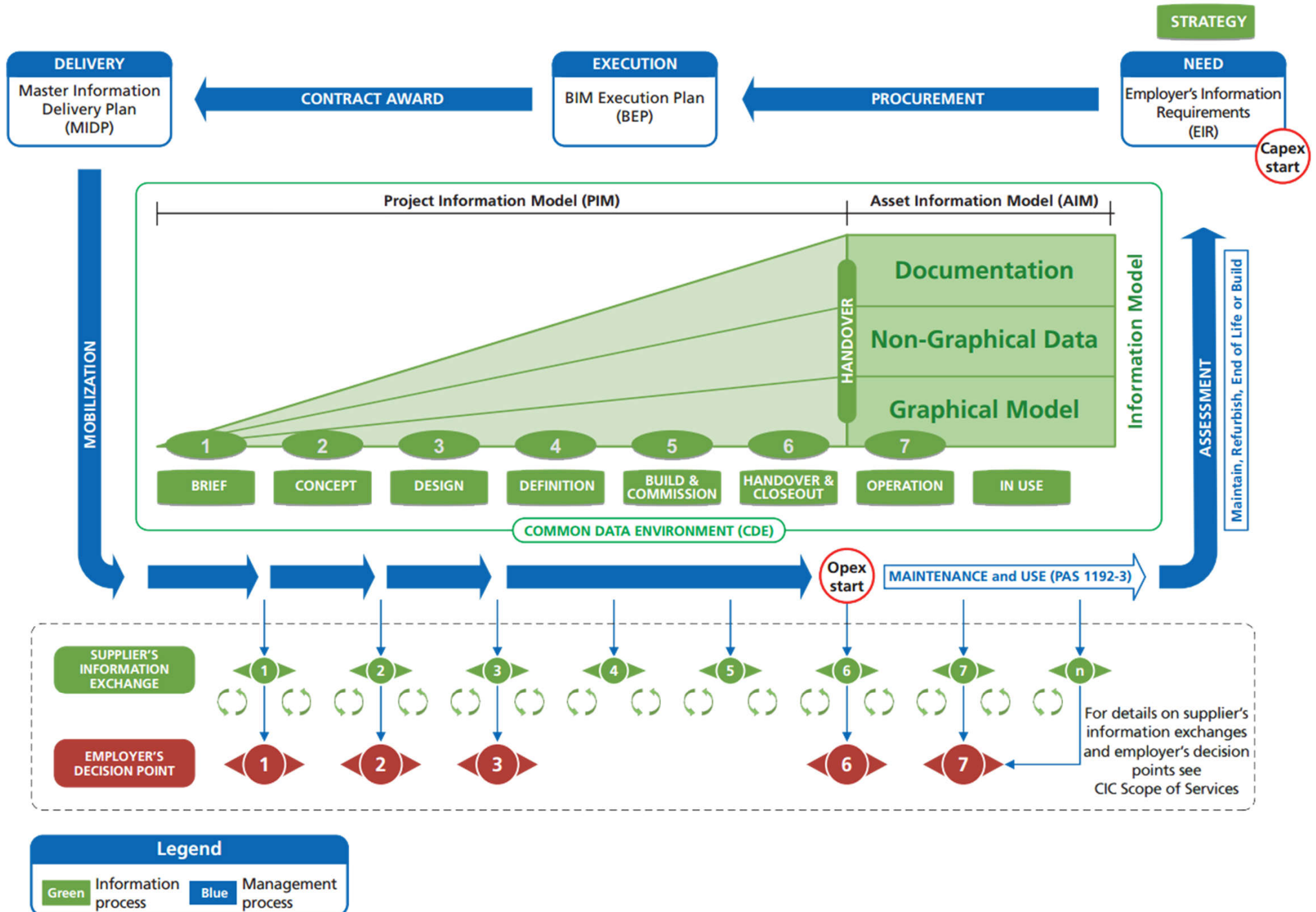
BIM Level 3 Benefits Are Realized throughout the Building Lifecycle



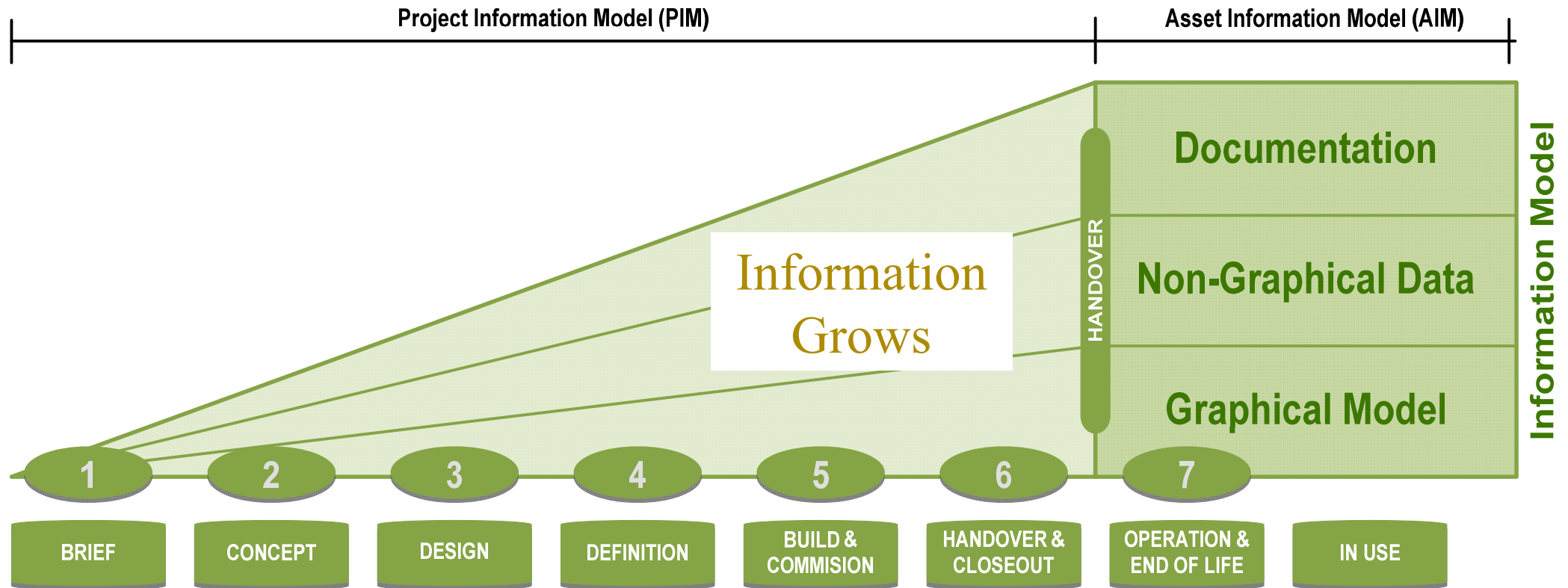
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(Source: <https://thebimhub.com/2015/11/02/think-a-zero-rfi-goal-is-impossible-consider-these/>)

# The information delivery cycle of BIM



# Project information model (PIM) and asset information model (AIM)



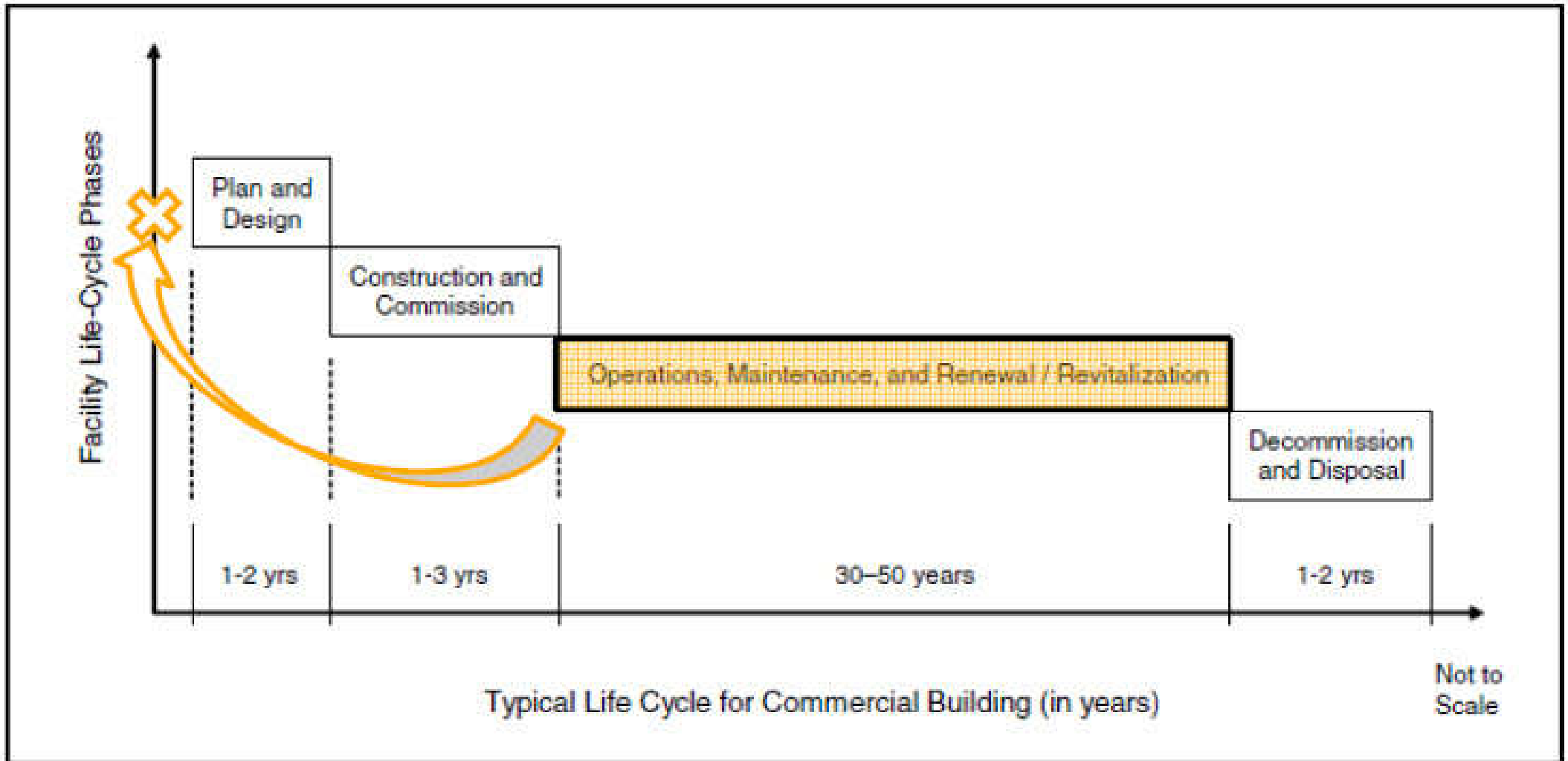
Business value creation potential of BIM for  
asset and facility management:  
create, manage and use asset lifecycle data  
and information to produce an 'asset  
information model' (AIM)



(Video: The NBS BIM Workflow (3:31) [https://youtu.be/TQ\\_Zgc8aQzE](https://youtu.be/TQ_Zgc8aQzE))

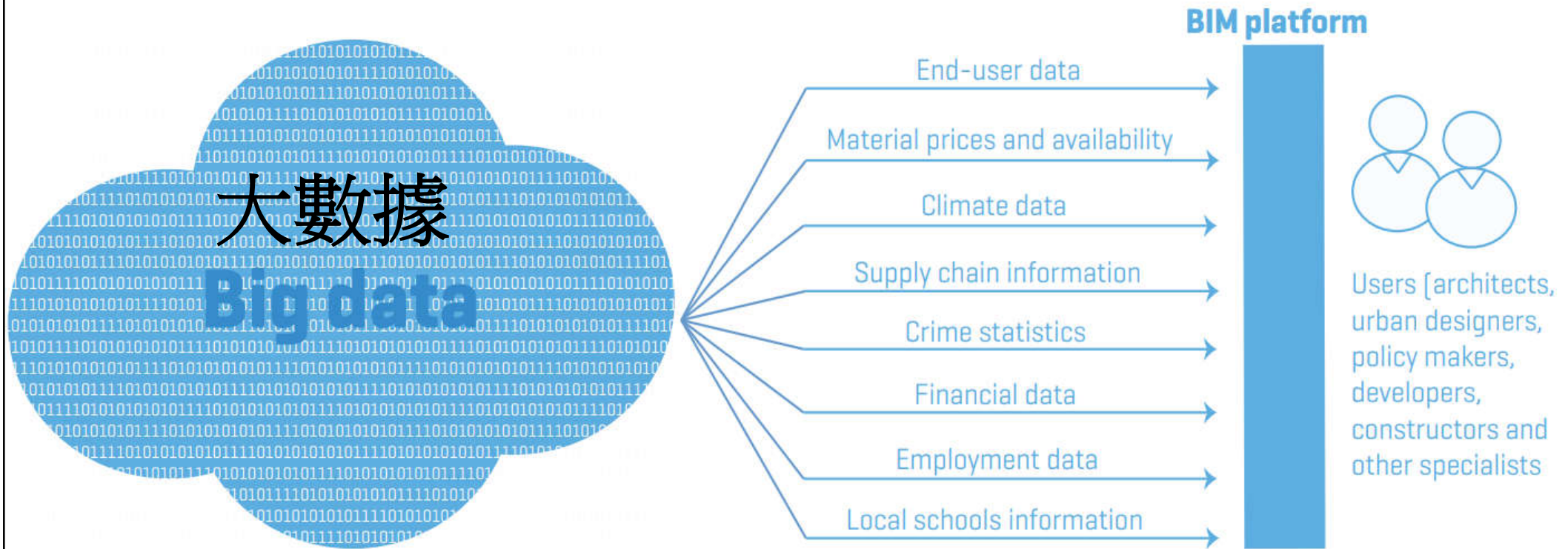


# Typical life cycle of commercial building



The early creation and progressive delivery of the functional and physical asset data and information required by the asset operator and maintainer will successfully drive sustainable business value creation and substantial cost savings, across the entire 20 to 50 year built asset lifecycle.

# Big data-supported BIM platform



Big data provides unprecedented insight and improved decision-making. This technology can be tapped to enhance the design, construction, operation and maintenance of our built environment.

A BIM platform can be linked to a large volume of data that can enhance the decision-making power of the stakeholders in a team. A project can benefit from real-time information sources such as supply chain data, commodity pricing data, marketing data, sensor data, point-cloud data, crime statistics, employment data and so on.

If BIM does not deeply  
alter your core DNA  
and profoundly change  
your psyche then you  
will not understand  
BIM at all.