IT in Construction

Lecture #10

Building Information Modeling

BIM Planning

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Outline

- Maturity stages and BIM implementation
- BIM Strategy and Roadmap
- BIM Execution Plan (BEP)
- Research projects at the Sharif University of Tech

maturity stages and BIM Implementation

BIM maturity stage

- BIM implementation represents a broad term that describes the process of incorporating digital information of a building (or other facilities) project during its life-cycle.
- The range of BIM incorporation over the project's life-cycle is described as 'maturity stage' of the BIM implementation in a project.
- In general 4 maturity stages from maturity stage 0 to maturity stage 3 are defined for the BIM implementation in a project.

BIM maturity stage

- **BIM maturity stage 0:** Unmanaged computer aided design (CAD) including 2D drawings, and text with paper-based or electronic exchange of information but without common standards and processes. Essentially this is a digital drawing board.
- Basically no BIM!!

BIM maturity stage

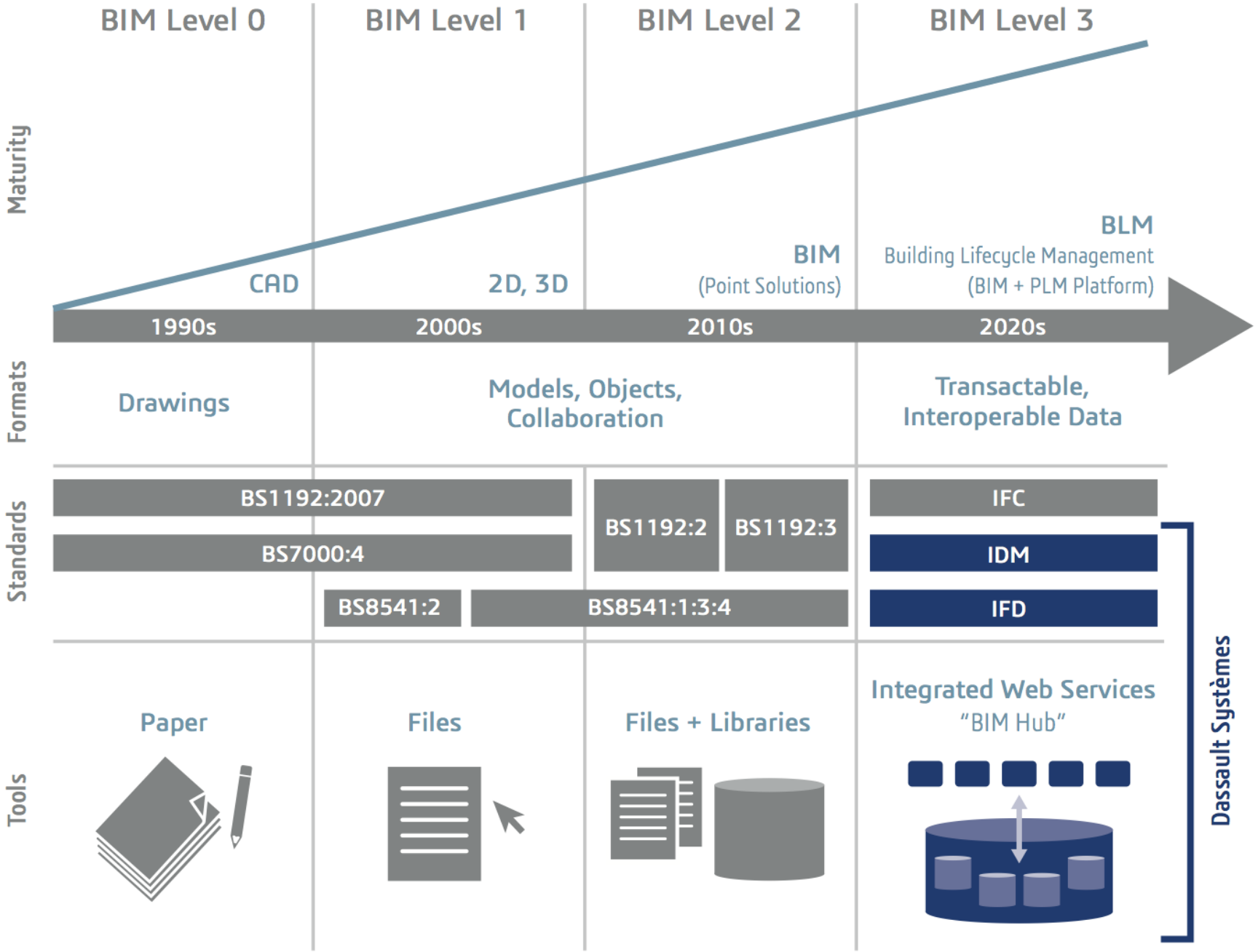
- **BIM maturity stage 1:** Managed CAD, with the increasing introduction of spatial coordination, standardized structures and formats as it moves towards Level 2 BIM. This may include 2D information and 3D information such as visualizations or concept development models. Level 1 can be described as 'Lonely BIM' as models are not shared between project team members.
- In Iran, we mainly stay at this level of the BIM model implementation!

BIM maturity stage

- **BIM maturity stage 2:** Managed 3D environment with data attached, but created in separate discipline-based models. These separate models are assembled to form a merged model, but do not lose their identity or integrity. Data may include construction sequencing (4D) and cost (5D) information. This is sometimes referred to as 'pBIM' (proprietary BIM).
- In Iran, to date I have not faced any BIM implementation at this or higher levels!

BIM maturity stage

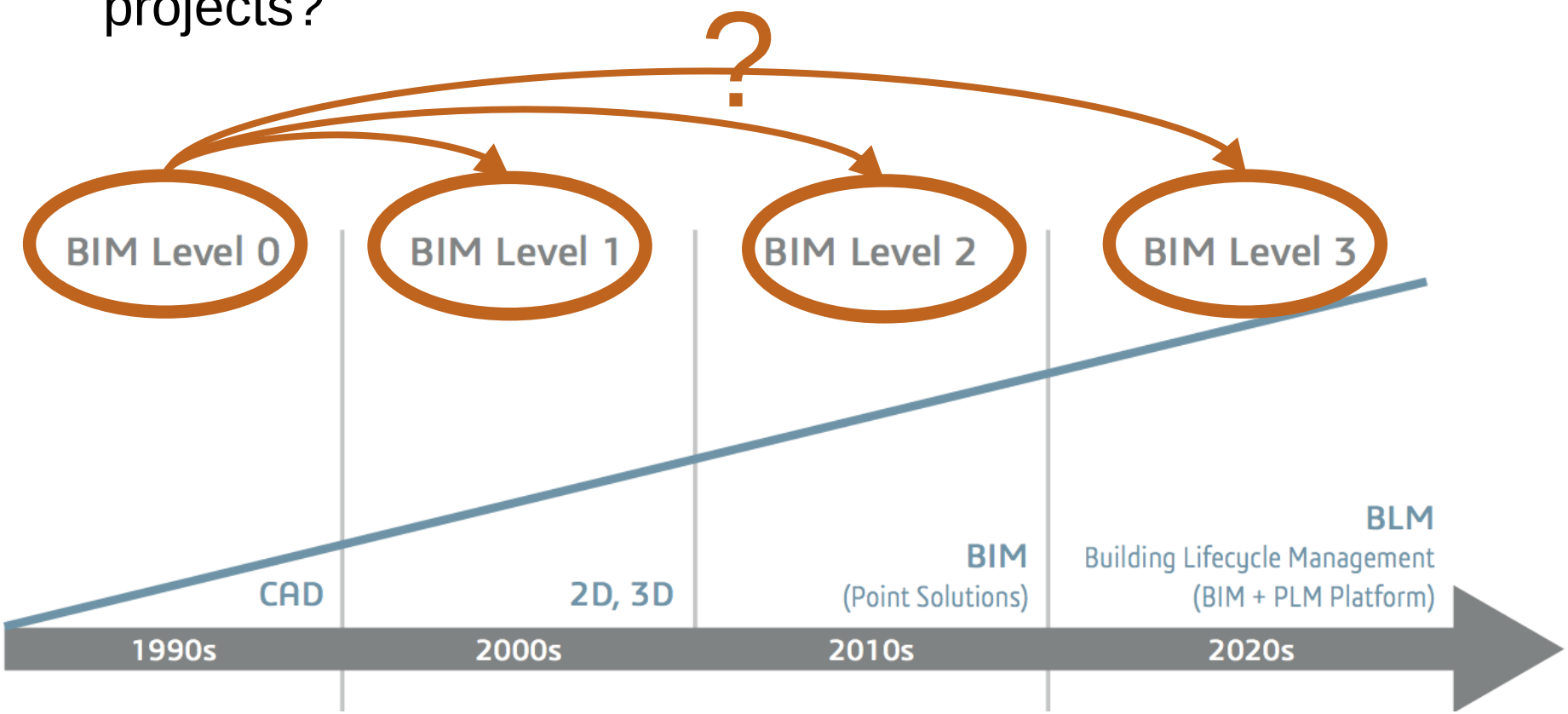
- **BIM maturity stage 3:** A single collaborative, online, project model with construction sequencing (4D), cost (5D) and project lifecycle information (6D). This is sometimes referred to as 'iBIM' (integrated BIM) and is intended to deliver better business outcomes.



The BIM Maturity Model by Mark Bew and Mervyn Richards adapted to reflect BLM's relationship to Level 3.

BIM implementation maturity stage

- Which level of BIM Maturity can be implemented in our projects?



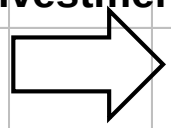
BIM implementation maturity stage

- Which level of BIM Maturity can be implemented in our projects?

  - Is the organization ready for the adopted maturity stage?
  - Normally targeting concurrent Multiple Steps = No Step!
  - Assess your organization's standing before targeting a specific level of BIM maturity implementation!
  - Six different *BIM planning elements* of the organization are evaluated to identify organization's standing.

BIM maturity matrix

Organizational BIM Assessment Profile							
BIM Planning Element		Level of Maturity Score					
		0 Non-Existent	1 Initial	2 Managed	3 Defined	4 Quantitatively Managed	5 Optimizing
Strategy (5 aspects)	The Mission, Vision, Goals, and Objectives, along with management support, BIM Champions, and BIM Planning Committee.						
BIM Uses (2 aspects)	The specific methods of implementing BIM						
Process (2 aspects)	The means by which the BIM uses are accomplished						
Information (3 aspects)	Information Needs refer to Model Level of Development and Facility Data requirements						
Infrastructure (3 aspects)	Technological and physical systems needed for the operation of BIM with the organization.						
Personnel (3 aspects)	Human resources of an organization						



BIM Strategy and Roadmap

BIM Strategy

(Baldwin, 2019)

- BIM capabilities can be utilized the most when organizations start adopting BIM in accordance with their properly developed BIM strategy and roadmap!!
- BIM is an organization's approach to the design, construction, commissioning, ownership, management, operation, maintenance use, demolition and reuse of built assets
- Strategy is a long-term and high level plan of actions aiming to achieve identified organizational goals.
- BIM strategy defines how BIM can contribute to the organization's strategy in different phases of the built assets' lifecycle.

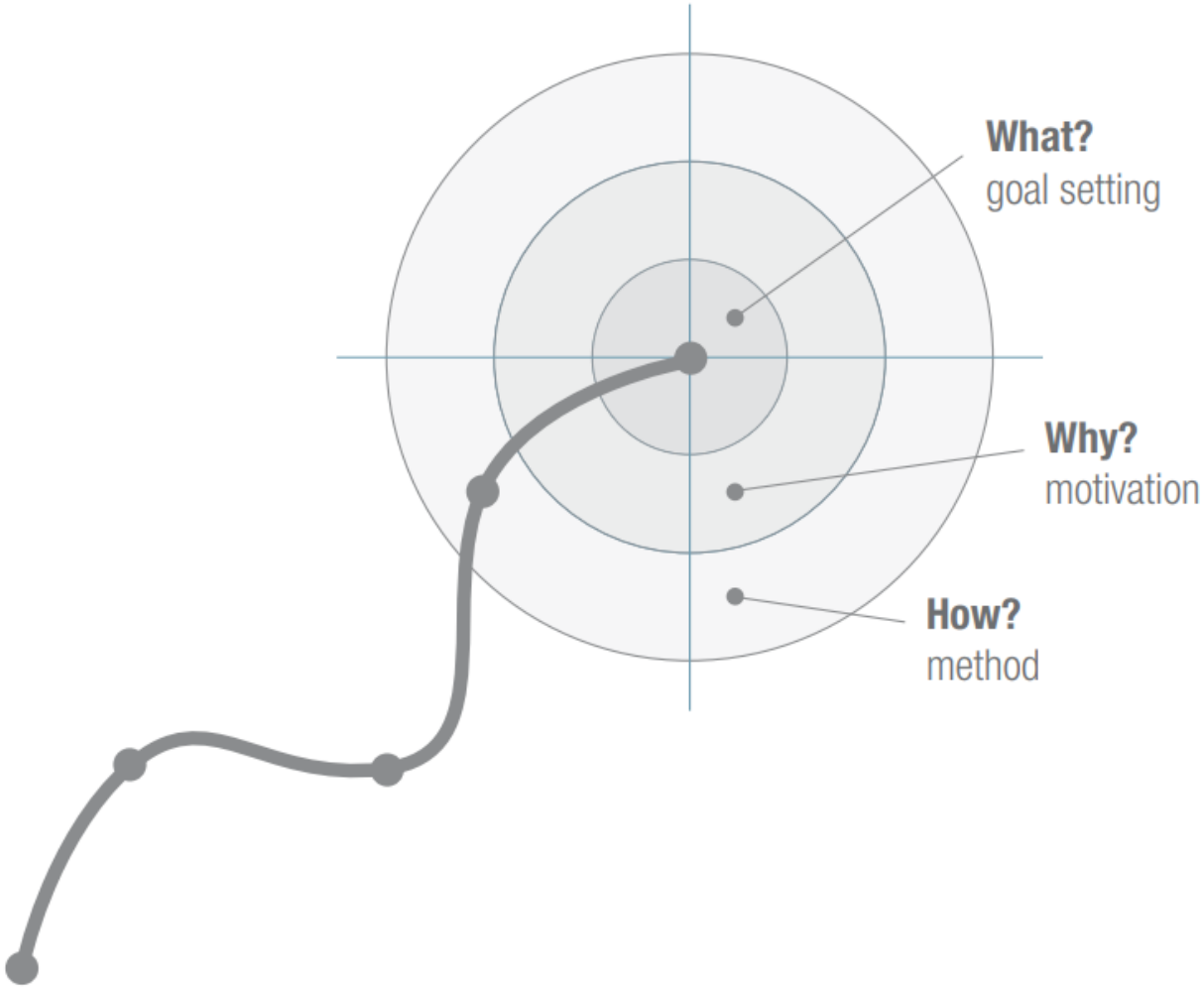
BIM Roadmap

(Baldwin, 2019)

- A BIM roadmap details the organization's plan for meeting short-term and long-term strategic goals.
- A BIM roadmap clearly outlines an organization's goals and objectives and takes a close look at all facets of the firm's BIM strategy.
- A BIM roadmap tells the top management where the firm stands today and what it needs to do to fully leverage required BIM use.
- A BIM roadmap is the firm's guide to integrating its business strategy with technology and project delivery strategies.

BIM Strategy and Roadmap

(Baldwin, 2019)



The BIM Strategy and Roadmap

BIM Strategy and Roadmap Development Steps

(Baldwin, 2019)

1-Collect Requirement	• High level requirements, reason and goals of the organization's main stakeholders for BIM adoption,
2-Readiness assessment	• Evaluate the organization's readiness,
3-Cost/ benefit analysis	• Perform cost/ benefit analysis for the adoption of different BIM capacities in the organization,
4-Finalize strategy	• Finalize BIM strategy and roadmap in coordination with the organization's management team,,
5-Transition plan	• Transition plans for the organization to transition to BIM enabled operations should be designed,

1-Collect Requirement

(Baldwin, 2019)

- It is quite essential to identify main incentive and reason of BIM adoption in the organization,
- The reasons why an organization may adopt BIM vary.
  - **External pressures**, such as public or private mandates or market competition.
  - **Internal considerations**, such as the desire to innovate or simply to improve inefficiencies in current practices.

1-Collect Requirement

(Baldwin, 2019)

- Contact main stakeholders including top management, owners and key individuals to collect the organization's goals, incentives and requirements.
- It is very important that the contacted individuals have good understanding about BIM capabilities and requirements

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Setup training sessions if main stakeholders do not have good understandings regarding the BIM implementation requirements and implications

1-Collect Requirement

- Questions to ask:
  - Why organization is interested in moving toward BIM, with an expecting big change in the organizational processes?
    - Sample responses: High fever of BIM in the country, low performance of the organization and low profit margin, losing the market share, and project owners mandate.
    - The provided response directs the organization's strategy:
      - High fever of BIM in the country → Give high priority to the BIM applications with high promotional and external indications
      - Low performance of the organization and low profit margin → Give high priority to the BIM applications with high cost saving impacts
      - Losing the market share → Identify the market needs and give high priority to the BIM applications to fulfill the market needs

1-Collect Requirement

- Questions to ask (cont'd):
  - What are the main issues and concerns in the organization that they think BIM can address?
    - Sample responses: Poor organizational communications, poor scope control, high reworks, poor design, high procurement expenses, high volume of material waste.
  - How fast they want to adopt BIM in their processes?
    - Many stakeholders can't wait to get to the ultimate BIM organization's maturity level. However, you need to explain the required time frame for the organizational change!
  - How much money and effort they are ready to invest?
    - You need to familiarize stakeholders about the money and effort consequences of their BIM requirements and get their feedback on their money and effort investment possibilities,

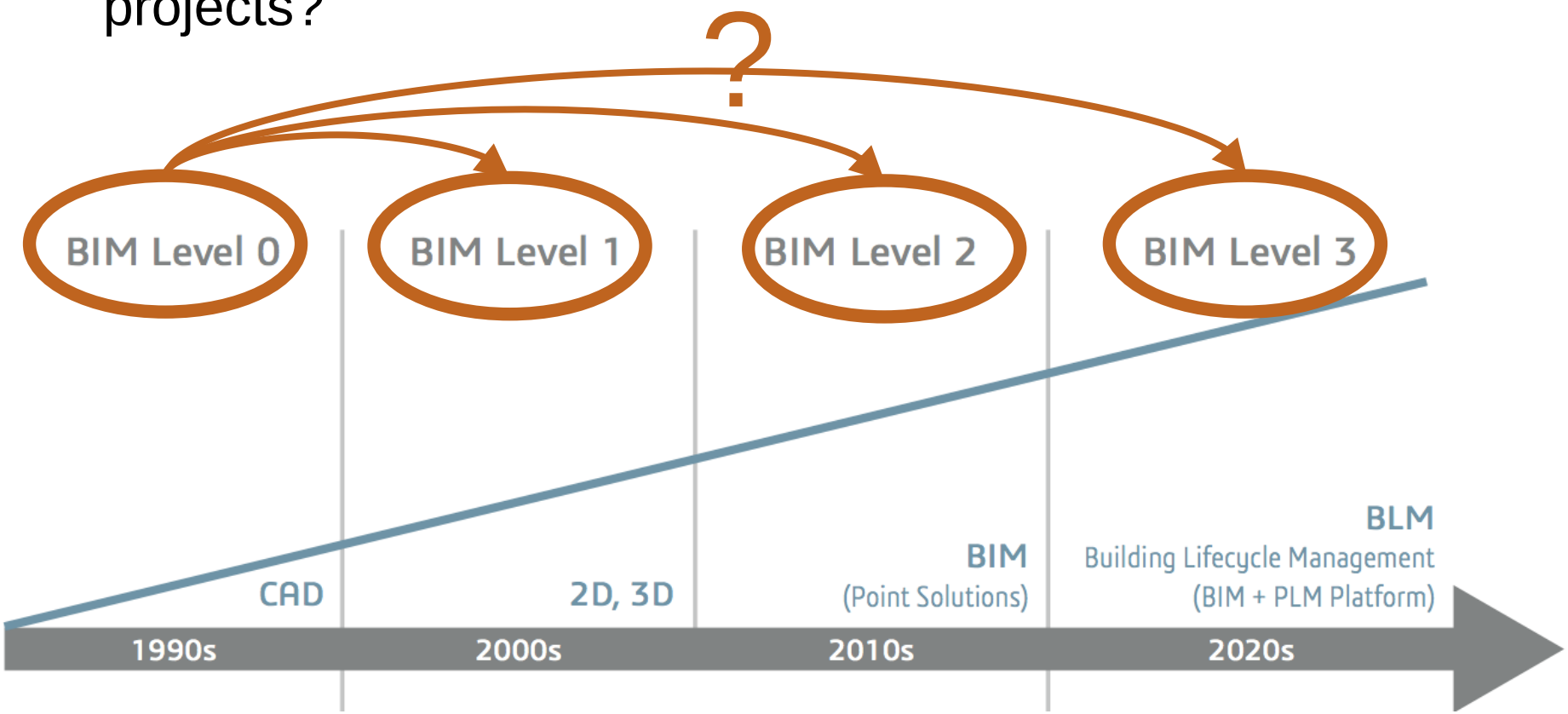
2- Readiness Assessment

(Baldwin, 2019)

- Before prescribing any move toward BIM adoption and developing strategy and roadmap a good understanding about the current situation of the organization should be achieved!

2- Readiness Assessment

- Which level of BIM Maturity can be implemented in our projects?



2- Readiness Assessment

- Is your organization ready for adopting BIM, and in what level of maturity?
  - Is the organization ready for the desired maturity level?
  - Normally targeting concurrent multiple steps = No Step!
  - Assess your organization's standing before targeting a specific level of BIM maturity implementation and start changing the organization!

2- Readiness Assessment

Sample Assessment Method- Maturity Matrix

- Use of BIM maturity matrix is one method used for evaluating the organizational standing,
- This approach is proposed was proposed by Penn State University,
- In this approach six different BIM planning elements of the organization are evaluated using a matrix template,

2- Readiness Assessment

Organizational BIM Assessment Profile							
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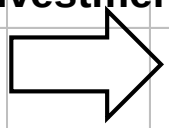
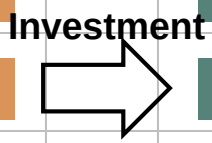


2- Readiness Assessment

Organizational BIM Assessment Profile

BIM Planning Element		Level of Maturity Score						Current Level	Target Level	Total Possible	
		0 Non-Existent	1 Initial	2 Managed	3 Defined	4 Quantitatively Managed	5 Optimizing	3	39	90	Estimate Cost of Change ($)
Strategy (5 aspects)	The Mission, Vision, Goals, and Objectives, along with management support, BIM Champions, and BIM Planning Committee.							0	10	25	?
BIM Uses (2 aspects)	The specific methods of implementing BIM							0	4	10	?
Process (2 aspects)	The means by which the BIM uses are accomplished							0	4	10	?
Information (3 aspects)	Information Needs refer to Model Level of Development and Facility Data requirements							0	6	15	?
Infrastructure (3 aspects)	Technological and physical systems needed for the operation of BIM with the organization.							3	9	15	?
Personnel (3 aspects)	Human resources of an organization							0	6	15	?



3-Cost/ Benefit Analysis

(Baldwin, 2019)

- Which BIM capabilities match the organization's gaps the most?
- How much organizational change is required?
- How much investment is required?
- Identified organization's standing in different planning elements is a main input to this step!
- BIM capabilities with low cost to benefit rations are of the high priority for BIM adoption!

3-Cost/ Benefit Analysis

(Baldwin, 2019)

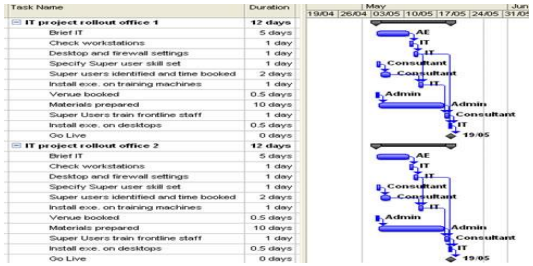
- Incorporation of BIM in the project processes requiring limited number of stakeholders involvement in a limited time normally bears low level of changes and love cost to the organization
- This trend is vise versa for the project processes implemented in a considerable portion of the project with multiple stakeholders involved!
- In this perspective many BIM capabilities used in project planning processes, with a limited duration, normally enforce low level of changes

3-Cost/ Benefit Analysis

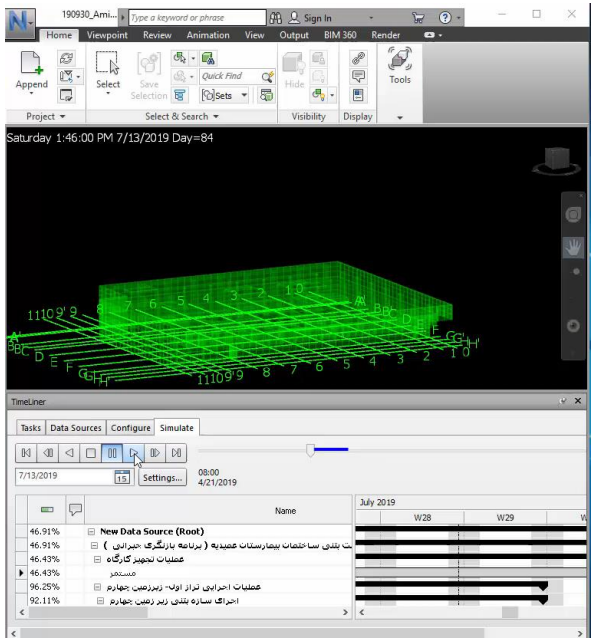
- Example 1: 4D Planning (after preparation of the regular time plan, planning team links the plan to the 3D model and presents to different stakeholders)

BIM Modeling team

Project planning team



BIM Management team

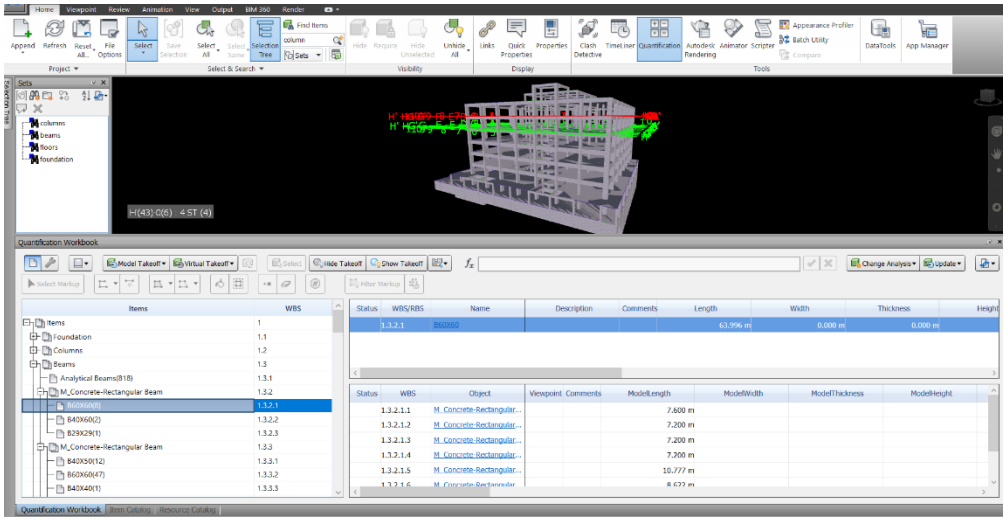


3-Cost/ Benefit Analysis

- Example 2: Quantity takeoff (after finalizing the 3D model and planning team can run the quantity takeoff query and output the material quantities)

BIM Modeling team

BIM Management team



3-Cost/ Benefit Analysis

(Baldwin, 2019)

- In this perspective, many BIM capabilities used in project control processes, with a project wide duration, normally enforce high level of changes and respectively high cost to the organization,

3-Cost/ Benefit Analysis

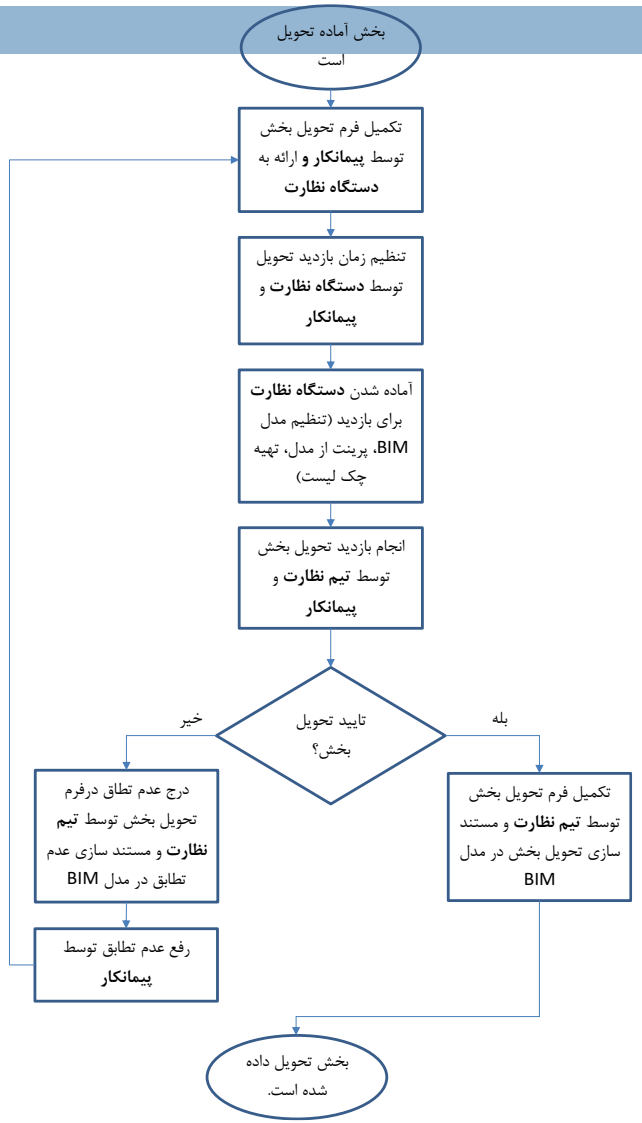
- Example 3: 4D control (it is implemented all over the project duration, requires all project participant to adjust their progress reporting into the new format)

3-Cost/ Benefit Analysis

- Example 4: Scope control (it is implemented all over the project duration after every discipline completes its job and is going to deliver its part!)

3-Cost/ Benefit Analysis

رنگ	شرح
	مقطعی که زمان شروع اجرای آن نرسیده و اجرا نشده است
	مقطعی که زمان شروع اجرای آن رسیده اما شروع نشده است
	مقطعی که اجرای آن شروع شده و بدون تاخیر در حال انجام است
	مقطعی که اجرای آن شروع شده و با تاخیر در حال انجام است
	مقطعی که اجرای آن بدون تاخیر به اتمام رسیده است
	مقطعی که اجرای آن با تاخیر به اتمام رسیده است
	مقطعی که بدون تاخیر تحویل گرفته شده است
	مقطعی که با تاخیر تحویل گرفته شده است
	مقطعی که بدون تاخیر در حال دوباره کاری است
	مقطعی که با تاخیر درحال دوباره کاری است



4-Finalize Strategy

(Baldwin, 2019)

- Prepare various short-term and long-term BIM implementation scenarios which meet main stakeholder requirements,
- Short-term and long-term BIM implementation scenarios should complement each other. An incremental approach to the BIM application adoption needs to be followed!
- Short-term BIM implementation scenarios usually are formed as combinations of the identified low-cost and easily implementable BIM capabilities,

4-Finalize Strategy

(Baldwin, 2019)

- Long-term BIM implementation scenarios are formed as combinations of more complex BIM capabilities requiring relatively high cost and long time for the organizational preparation,
- Prepared scenarios, their implementation requirements and cost/ benefit analysis are presented to the organization's decision makers to compare and select BIM implementation scenarios which fulfills their requirements the most,

4-Finalize Strategy

(Baldwin, 2019)

- Selected scenario by the organization decision makers is going to be documented and formally reported as the organization's BIM strategy and roadmap.
- The strategy document may also be used as a communication and marketing tool.

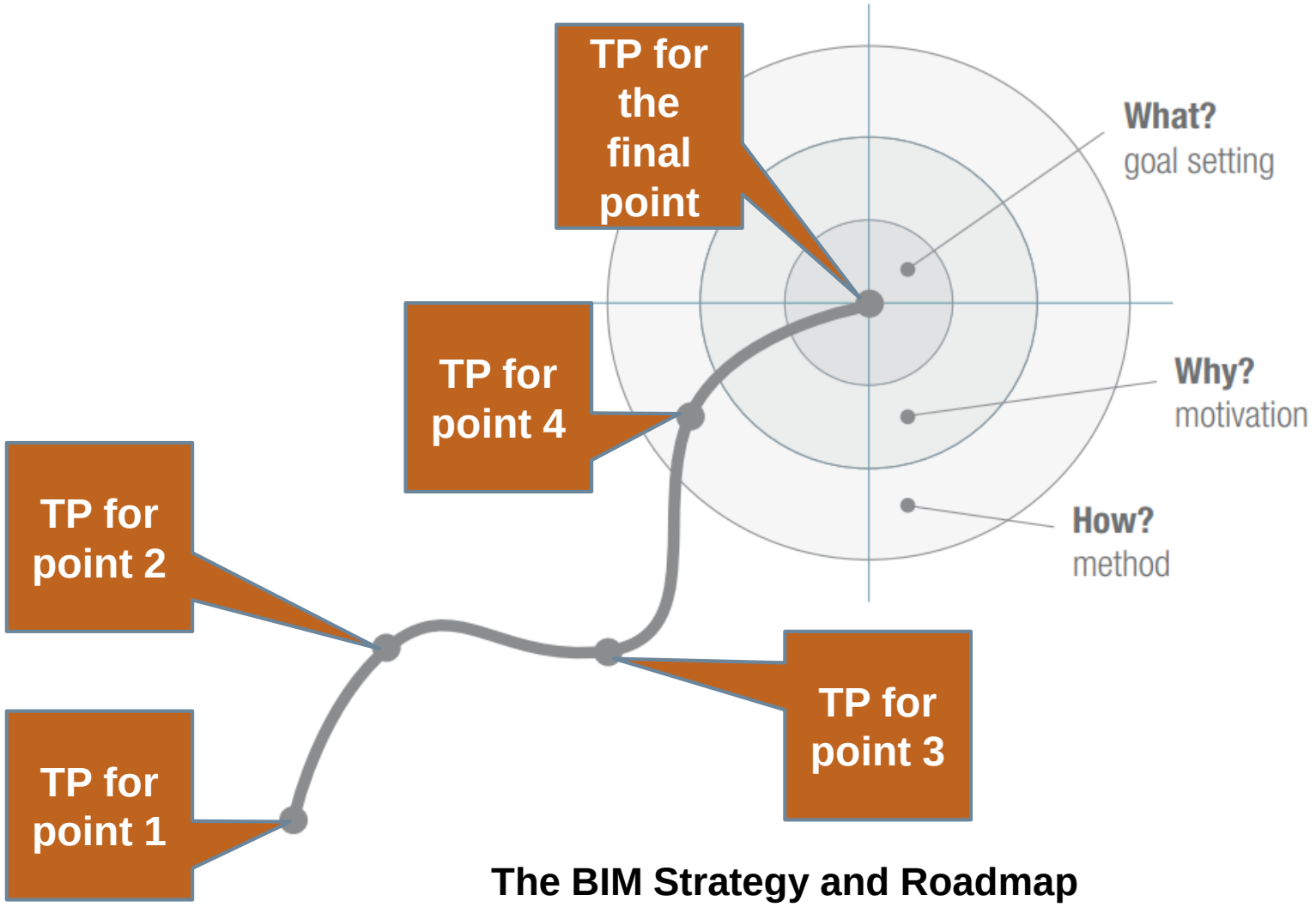
5-Transition Plan

(Baldwin, 2019)

- When BIM strategy and roadmap is finalized, transition plan (TP) for the organization for transition to different BIM enabled setups should be designed,
- In the roadmap, the organization might have designed multiple middle BIM implementation points prior to the final BIM implementation setup. Therefore, the organization needs detailed transition plans for each middle and final BIM implementation point,
- A high level or master transition plan needs to be designed for the entire roadmap. However, the transition plan needs to be detailed for the immediate point on the roadmap

5-Transition Plan

(Baldwin, 2019)



The BIM Strategy and Roadmap

5-Transition Plan

(Baldwin, 2019)

- Transition plan at each point should include the organizations' change in different aspects:
  - Organizational culture and structure
  - Processes
  - Information needs
  - Personnel training
  - Hardware and software infrastructure
  - Legal consideration

BIM Execution Plan (BEP)

Background

(Baldwin, 2019)

- Reaching every point of the organization's roadmap means that the organization is ready to adopt certain level of BIM maturity with the specified BIM capabilities in its projects,
- Implementing the adopted BIM maturity in each organization's project, however, requires a customized BIM execution plan (BEP) developed for the project,
- A project's BEP captures specific condition of the project for implementing the specified BIM capabilities,
- BEP defines how project's information is created, exchanged and delivered to the specified project participants.
- BEP document is a comprehensive document to help the construction project team incorporate identified BIM capabilities in their project management processes,
- Properly built BEP helps keep the project management team on track and saves the team hours of time by focusing on the important details.

Background

- One of the earliest, and certainly the most authoritative sources to describe BIM Execution Plan was the *Pennsylvania State University (PSU) BIM Project Execution Planning Guide*, originally published in 2009 and revised in 2011. There are many variations and templates on BIM Execution Plan that have since been developed around the world. However, the Penn State guide is still the most instructive and accessible document available.

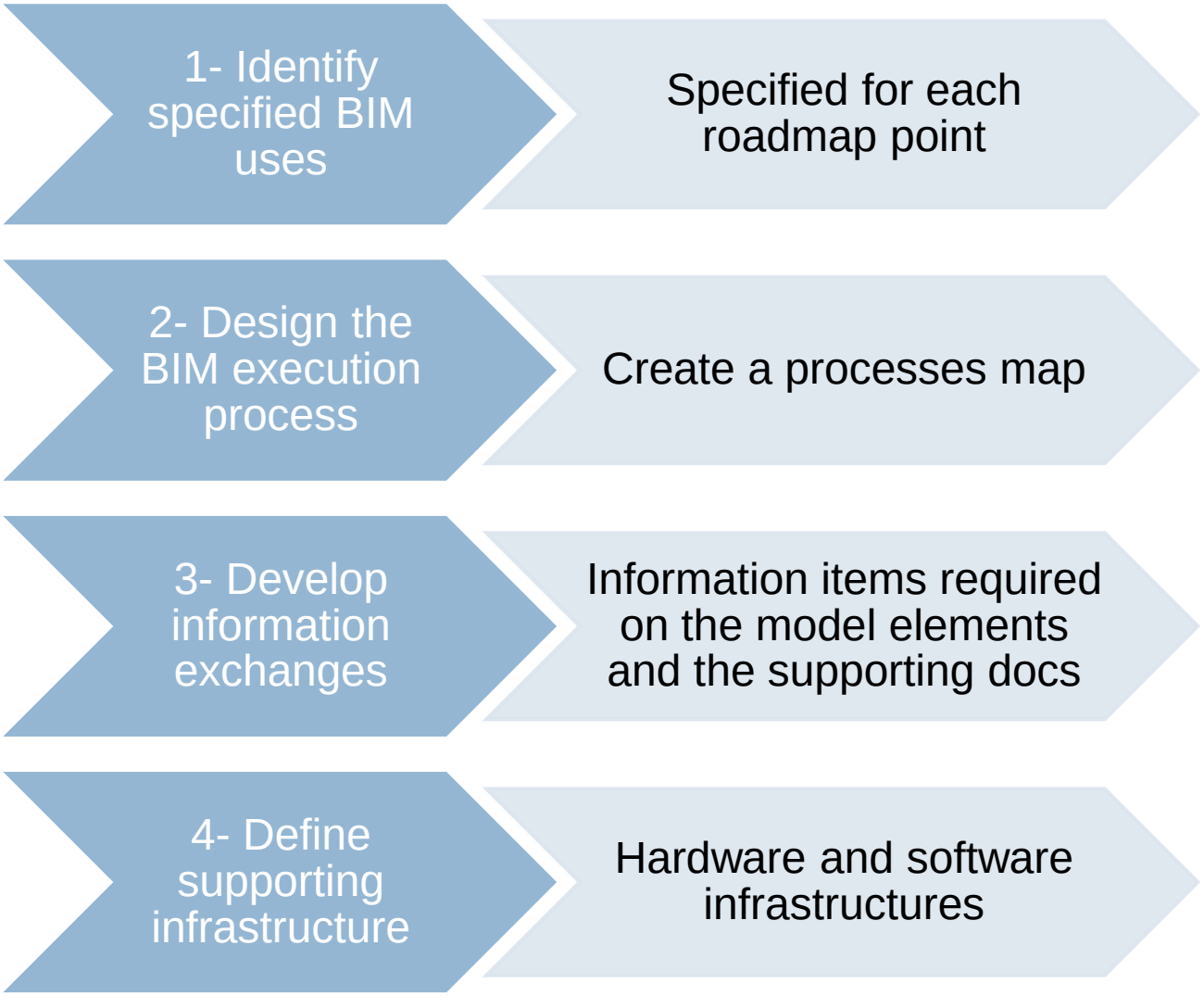
Background


BIM
operate.construct.design.plan.
PROJECT EXECUTION PLANNING GUIDE
VERSION 2.0
DRAFT - APRIL 16, 2010
http://www.engr.psu.edu/bim/PxP
A buildingSMART alliance™ Project
Sponsored by The Charles Pankow Foundation, The Construction Industry Institute, The Pennsylvania State University Office of Physical Plant, and The Partnership for Achieving Construction Excellence
Developed by the Computer Integrated Construction Research Program at The Pennsylvania State University
CHARLES PANKOW FOUNDATION
Building Innovation through Research
Construction Industry Institute
PENNSTATE Office of Physical Plant OPP
PACE The Partnership for Achieving Construction Excellence
The Computer Integrated Construction Research Program
Penn State Department of Architectural Engineering

BEP Development Steps

- The Penn State BIM Project Execution Planning Guide sets out a straightforward four-step process for defining project delivery:

BEP Development Steps



Different BEP Documents

- Initial BEP or Employers' Information Requirements (EIR): What are the owner's mandates for the BIM implementation?
- BEP for consulting engineers: How are consulting engineers accommodating the owner's mandates?
- BEP for contractors: How are contractors accommodating the owner's mandates?

References

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Thank you!

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