Innovation in Infrastructure Projects with "BIM"

-Learning from the experience of CALS/EC-
(Learning from the failure of CALS /EC?)

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6th March, 2015 in Jakarta

What we have learned from MRT-J project.

- Serious **schedule delay** has been caused by **unpredictable condition change** in construction process. (Strength of Water-pipe, Redirection of Lifeline)
- As a result of schedule delay, contractors are facing the serious **risk of the productivity reduction**. Owner side also has critical situation.
- **Frontloading** is effective to decrease the risk of design change, which could be followed by the **improvement of the productivity**.
- **Virtual construction in design process** must be the powerful method to precisely predict what would happen in the construction process.

What we have learned from MRT-J project.(2)

- **Virtual construction in design process** could be done by using **Building Information Modelling** technology.
- But, to do that, information and knowledge on construction phase or fabrication phase should be available in design stage. (**Information sharing**)
- In Japan, MLIT had been taking the leadership in the **CALS/EC** project which was just partially successful.
- We have to **learn from "the failure of CALS/EC"** to get the fruit from BIM introduction to infrastructure projects.

Definition of BIM

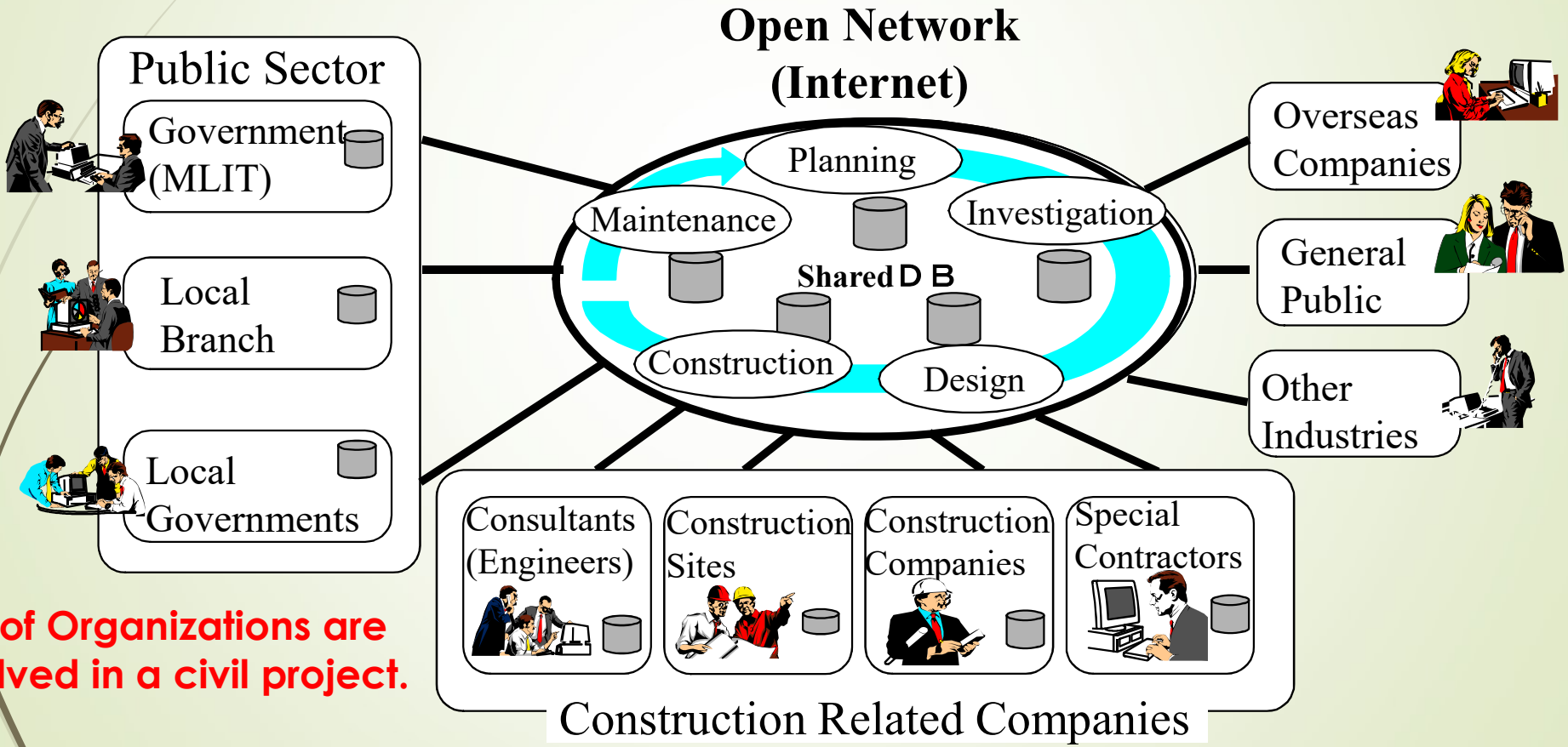
BIM is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. (from the commencement of its life)

(from the website of National BIM standard-United States.)

Image of CALS/EC (Ideal Concept)

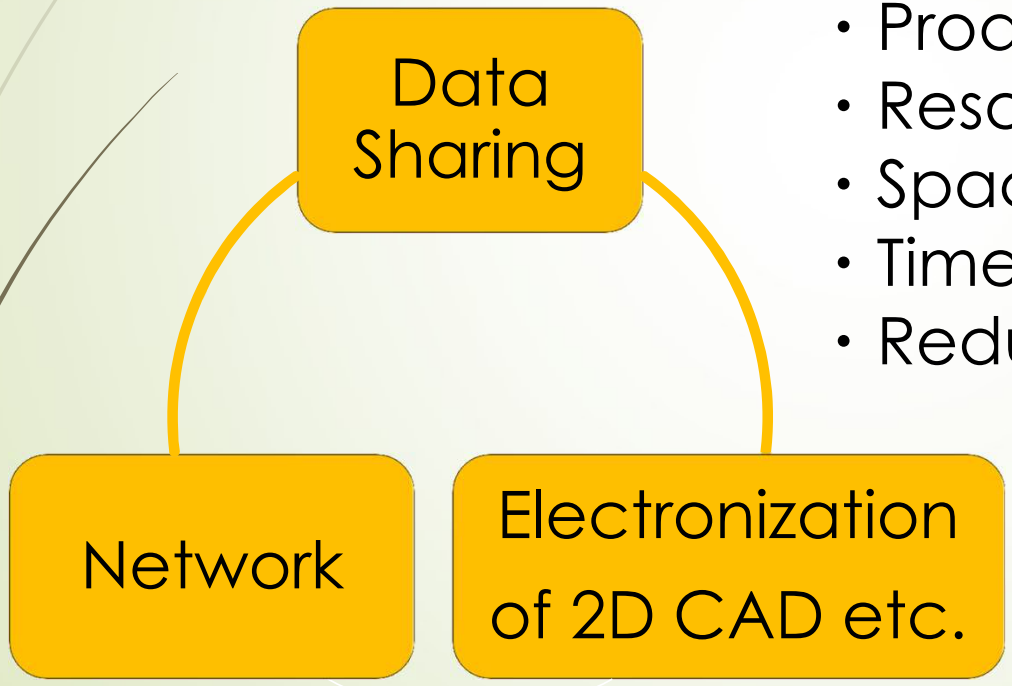
Continuous Acquisition and Lifecycle Support and Electronic Commerce

Innovation with Electronic data, Internet, Data sharing in the lifecycle



Lots of Organizations are involved in a civil project.

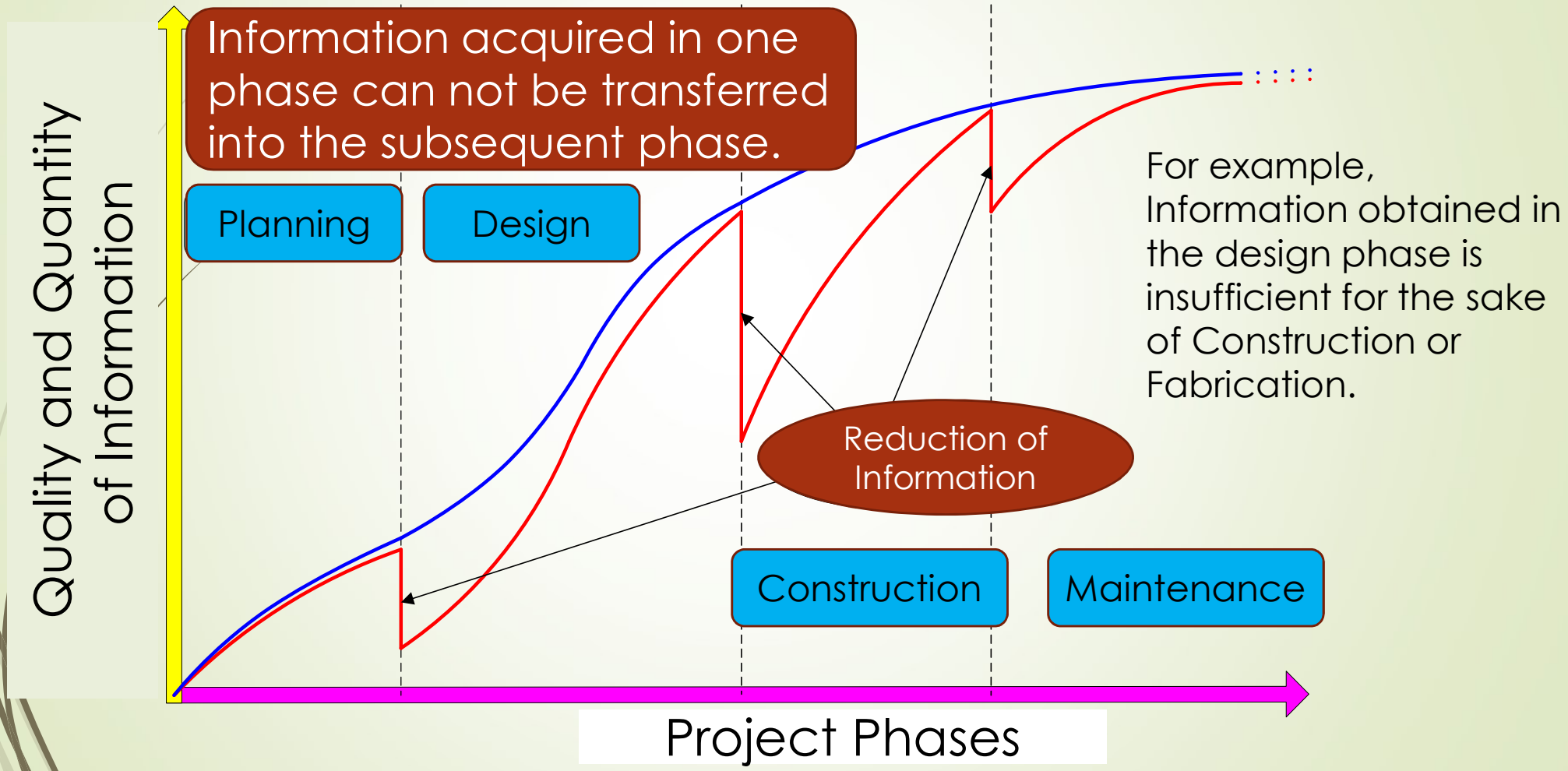
CALS/EC(Continuous Acquisition and Life-cycle Support / Electronic Commerce)



[Merits expected from the basic vision]

- Productivity Improvement.
- Resource Saving (Paperless)
- Space Saving
- Time Reduction for Data Search
- Reduction of Transportation Cost

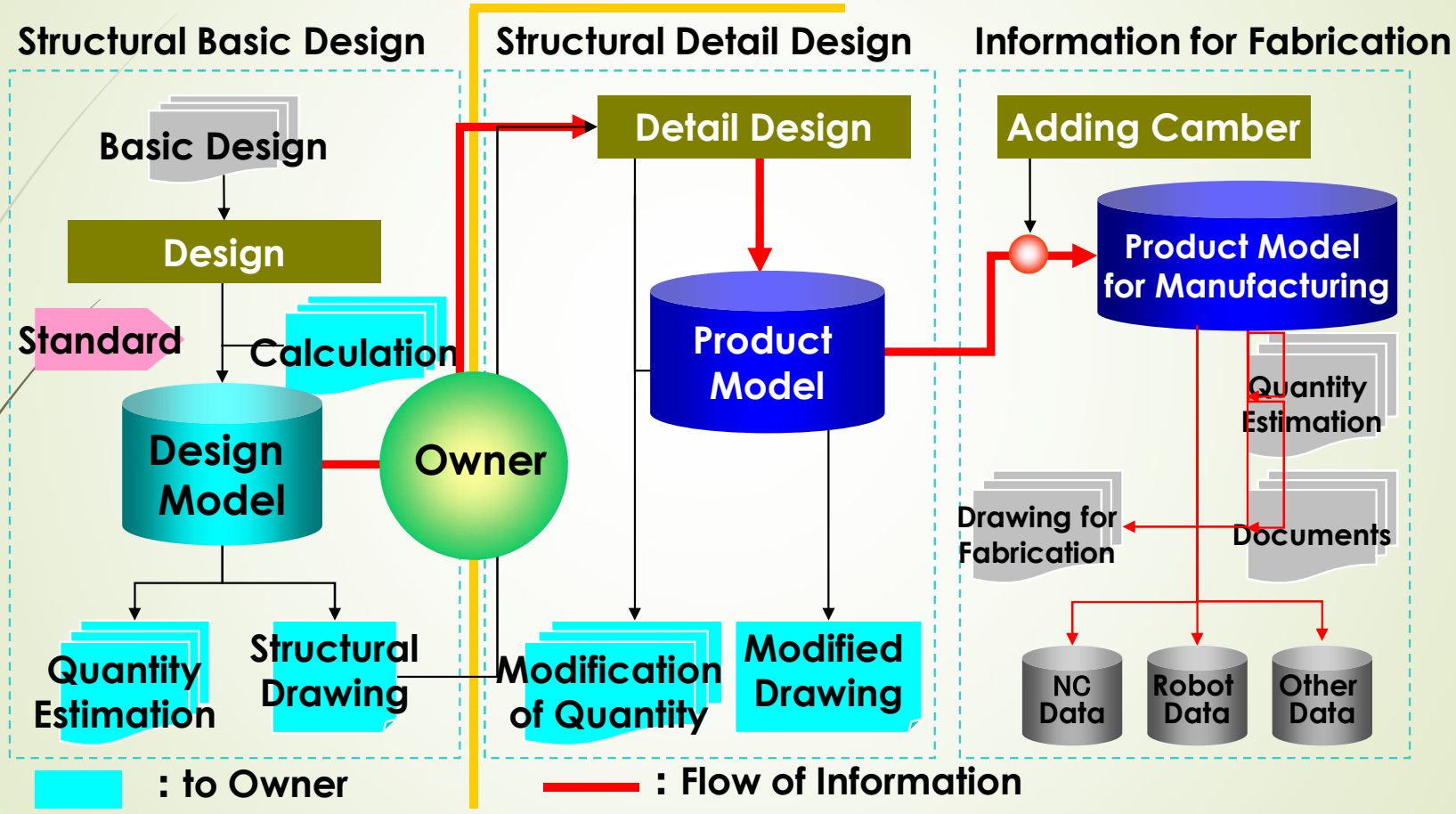
Decrease in Information Gap between each phase



Three Types of CALS/EC Utilization based on Separate Contract.

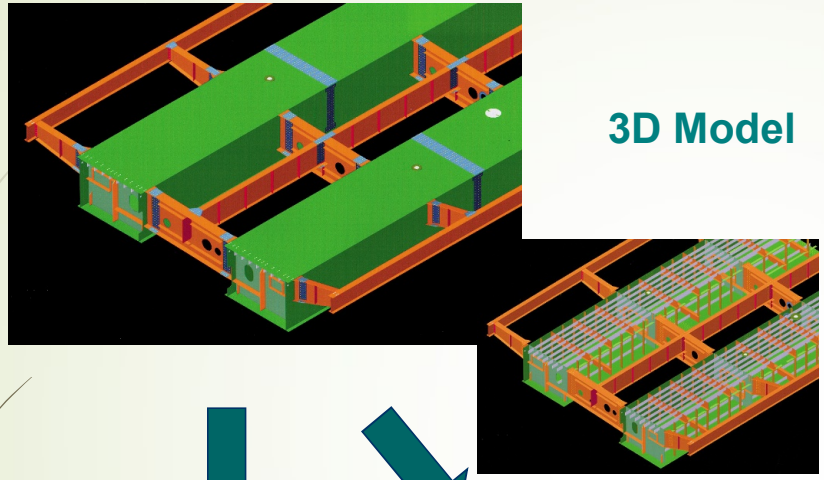
Type	Merits	Issues
Design-to-Construction Limited design work	**Consultant** can concentrate to the task essentially needed in the subsequent phase.	**Consultant** can not accept reduction of business opportunity.
Design-to-Construction Frontloading	**Contractor** do not encounter unpredictable condition change after commencement of the work.	**Contract** do not allow share information in design process.
Construction Phase	Productivity improvement with **cooperative activities** among owner, contractor, and engineer	**Project-by-project utilization** of software for information sharing
Maintenance Phase	**Cost reduction and adequate decision making** with information acquisition	Owners did not **identify Information needed** for long-term maintenance.

Flow of Design proposed by Japan Bridge (Fabricators') Association

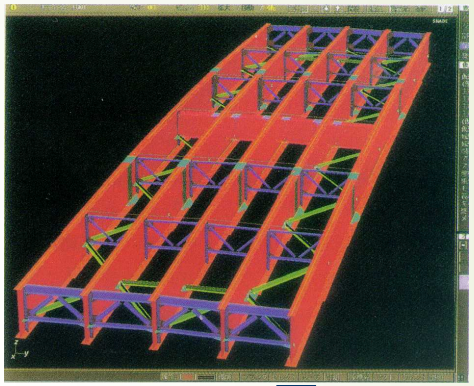


Limited design work by consultant

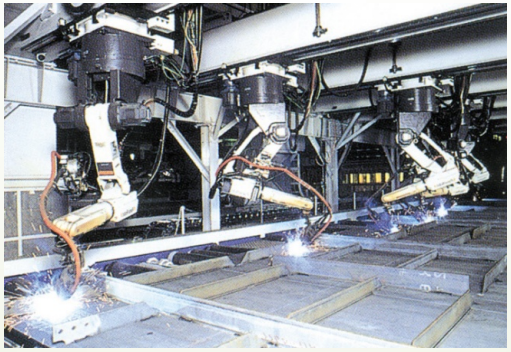
Utilization of 3D Model during Fabrication Phase



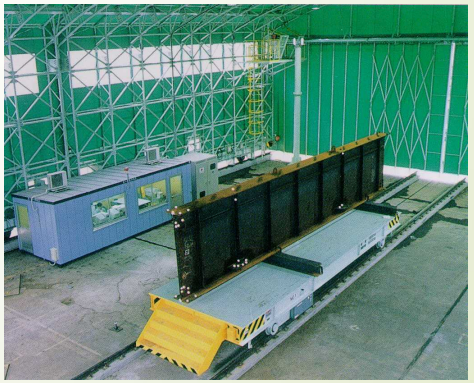
3D Model



Automated Plate Cutting



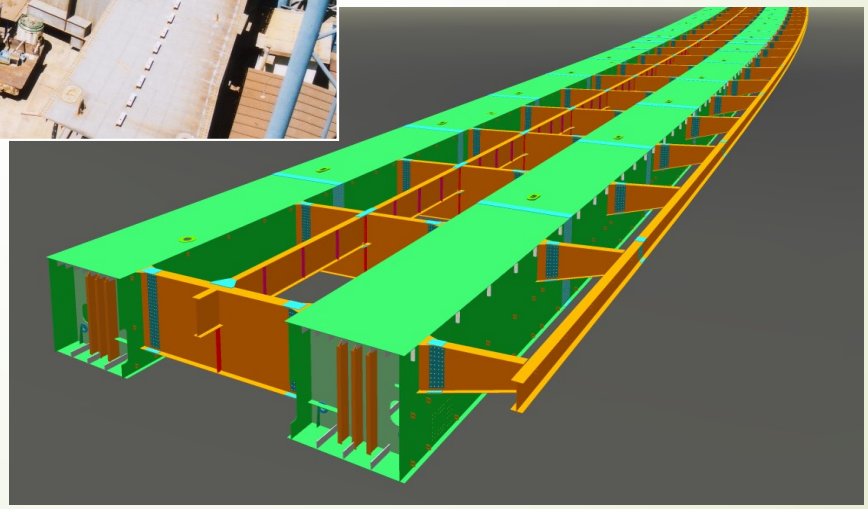
Usage of Robot



Omission of Tentative Assembly

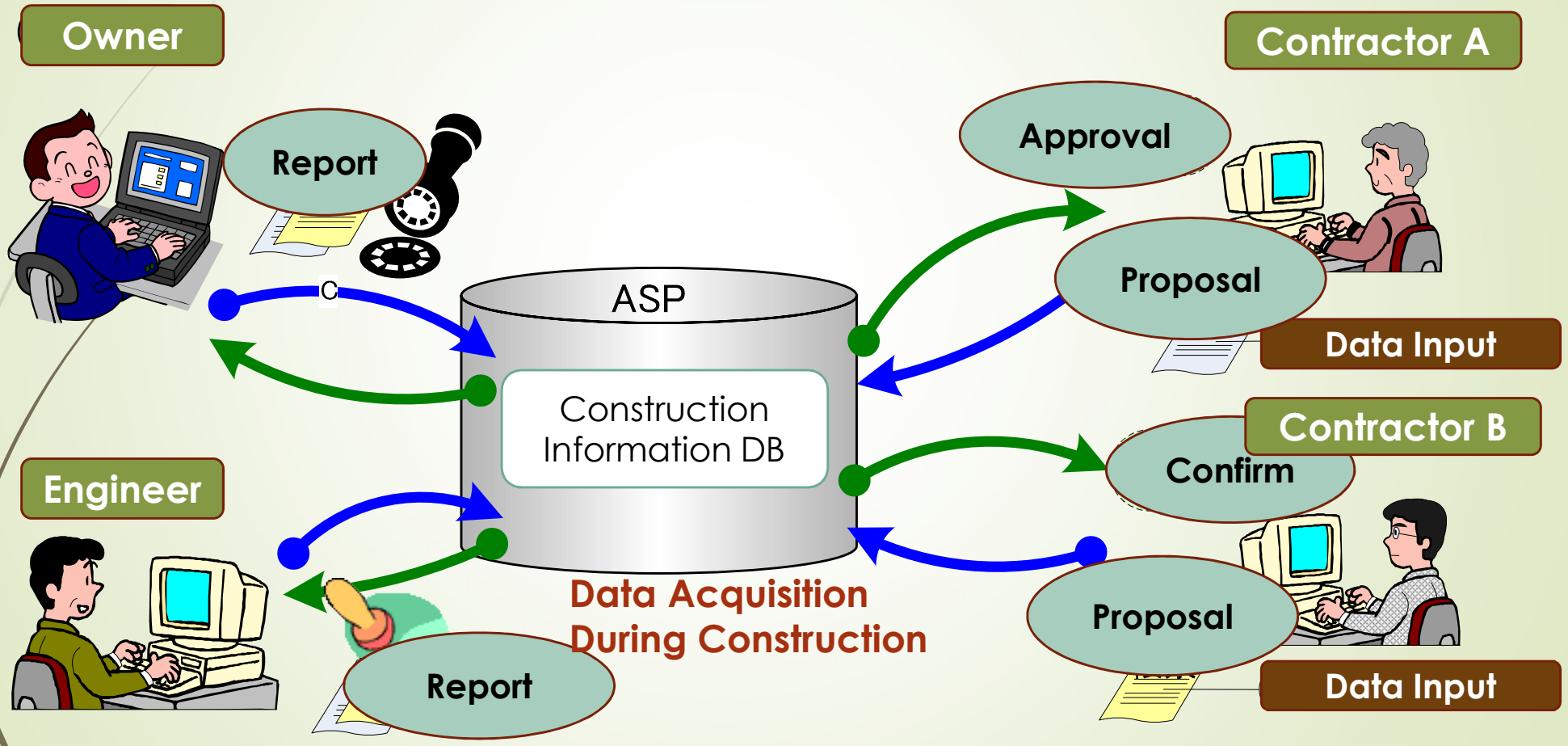
Omission of Tentative Assembly with 3D Model

Omission of
Tentative Assembly



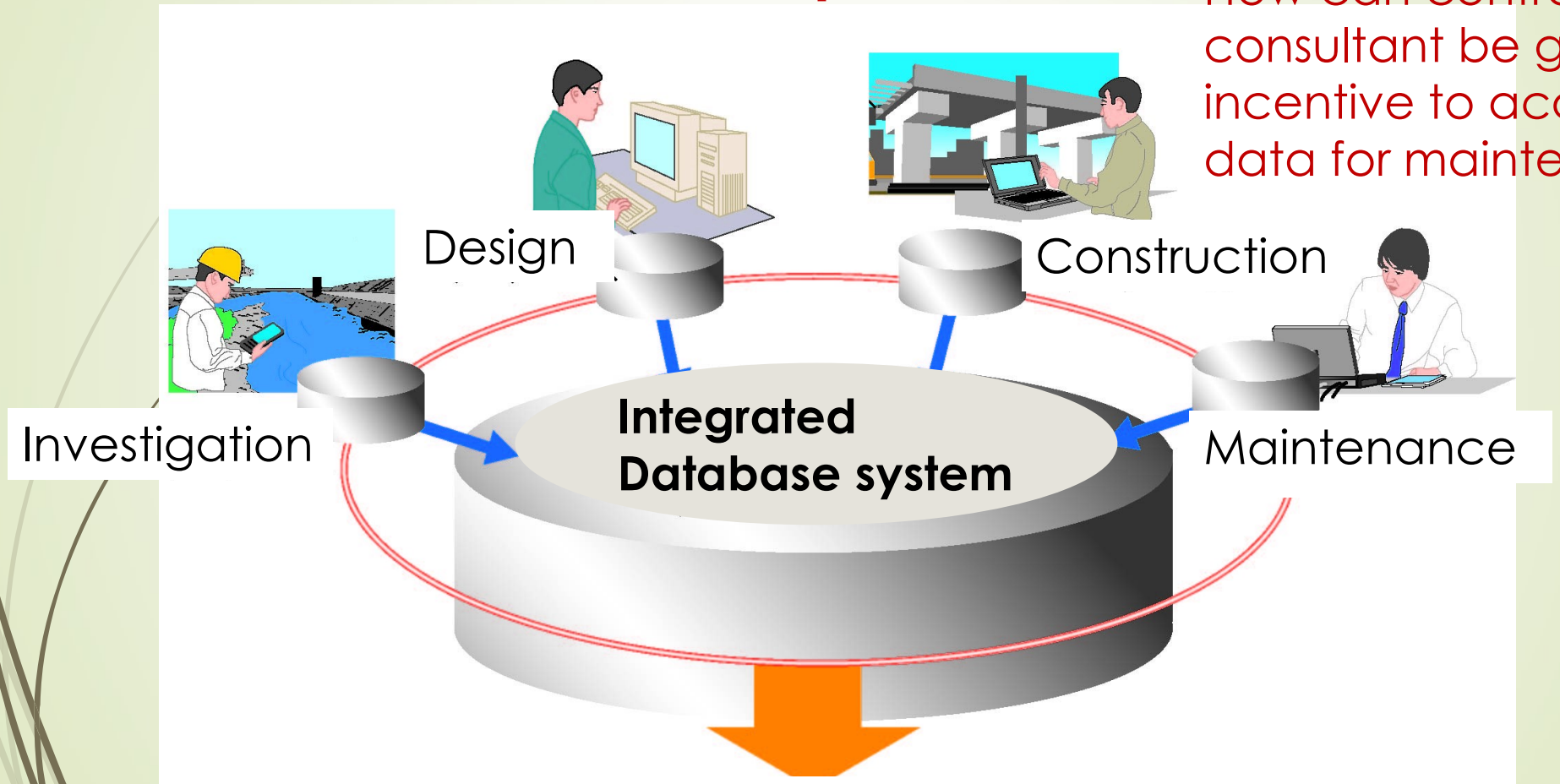
Virtual Fabrication with 3D Product Model

Electronic Data Utilization during Construction



Cost reduction and adequate decision with information acquisition

How can contractor or consultant be given incentive to acquire data for maintenance?



Strategic Maintenance with Long-term Vison

Has CALS/EC Succeeded or Failed?

Activity	Success or Failure	Cause of Failure
Electronic Bidding	Success	**Transparency and Equality of Bidding Chance** (Applicable for other countries)
Knowledge sharing between Design and Construction	Failure?	**2D CAD Standardization** is insufficient. Consultants have **insufficient knowledge** on fabrication or construction execution.
Data sharing during Construction Execution Among Organizations	Partial Success	**Compatibility** of each different ASP software is insufficient.
Electronic Delivery	Partial Success	**Additional delivery of paper documents** may be required together with E-documents.
Usage of Delivered Data	Failure?	Acquired data is stored in each **closed system**
Data Acquisition for Maintenance	Failure?	Required Information has not been identified.

Cause of Failure

- An idea of information sharing is precedent, and then **nobody did not grasp sufficiently merits of knowledge sharing** for each organization.
- Though the **compatibility of the standard format for 2D drawing** was insufficient, the use of the format was forced.
- In case of separate contract, **consultant can't share information with contractors**. Each player did not want to change the role in projects , which would lead to business reduction.

We have to learn from this experience of CALS/EC.

Definition of BIM

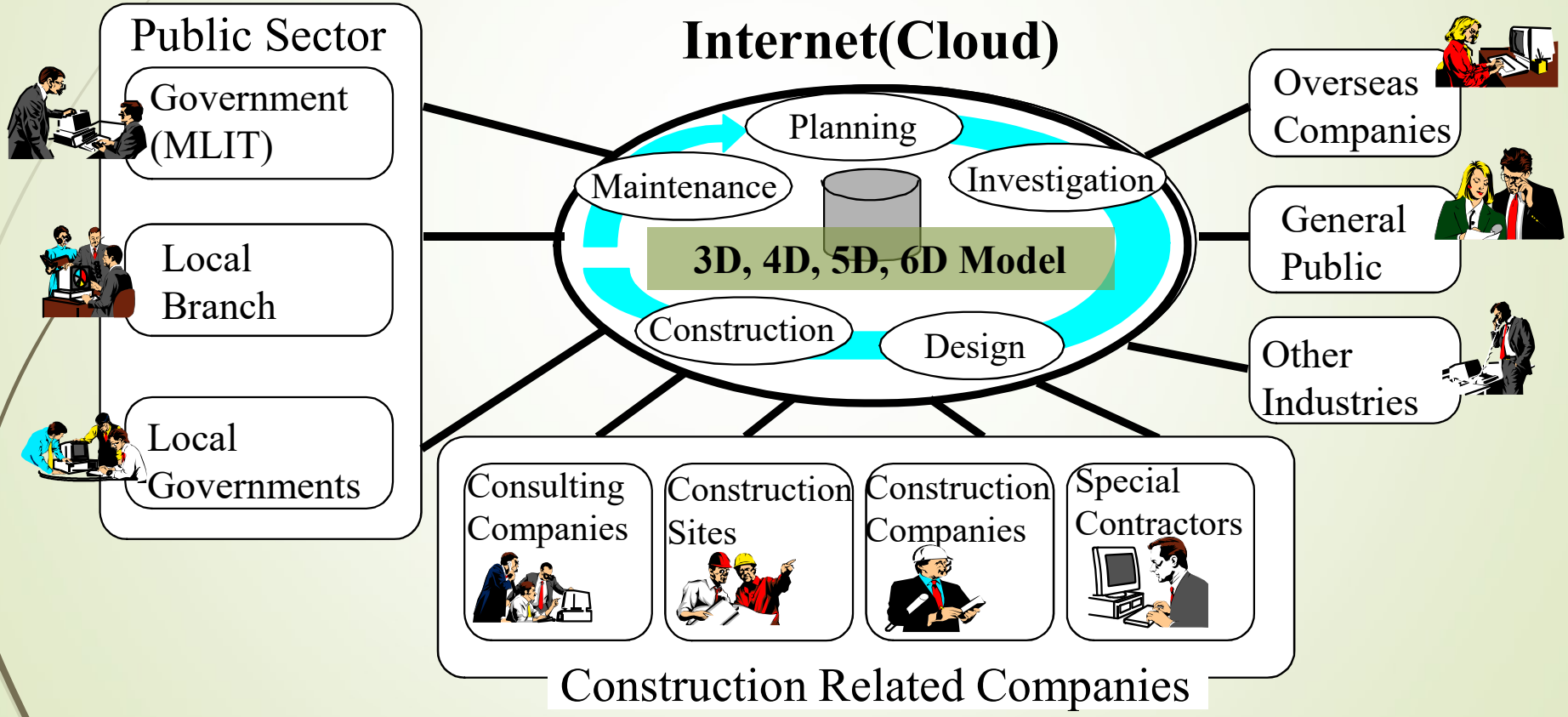
BIM is a digital representation of physical and functional characteristics of a facility. As such it serves as a shared knowledge resource for information about a facility forming a reliable basis for decisions during its lifecycle from inception onward. (from the commencement of its life)

(from the website of National BIM standard-United States.)

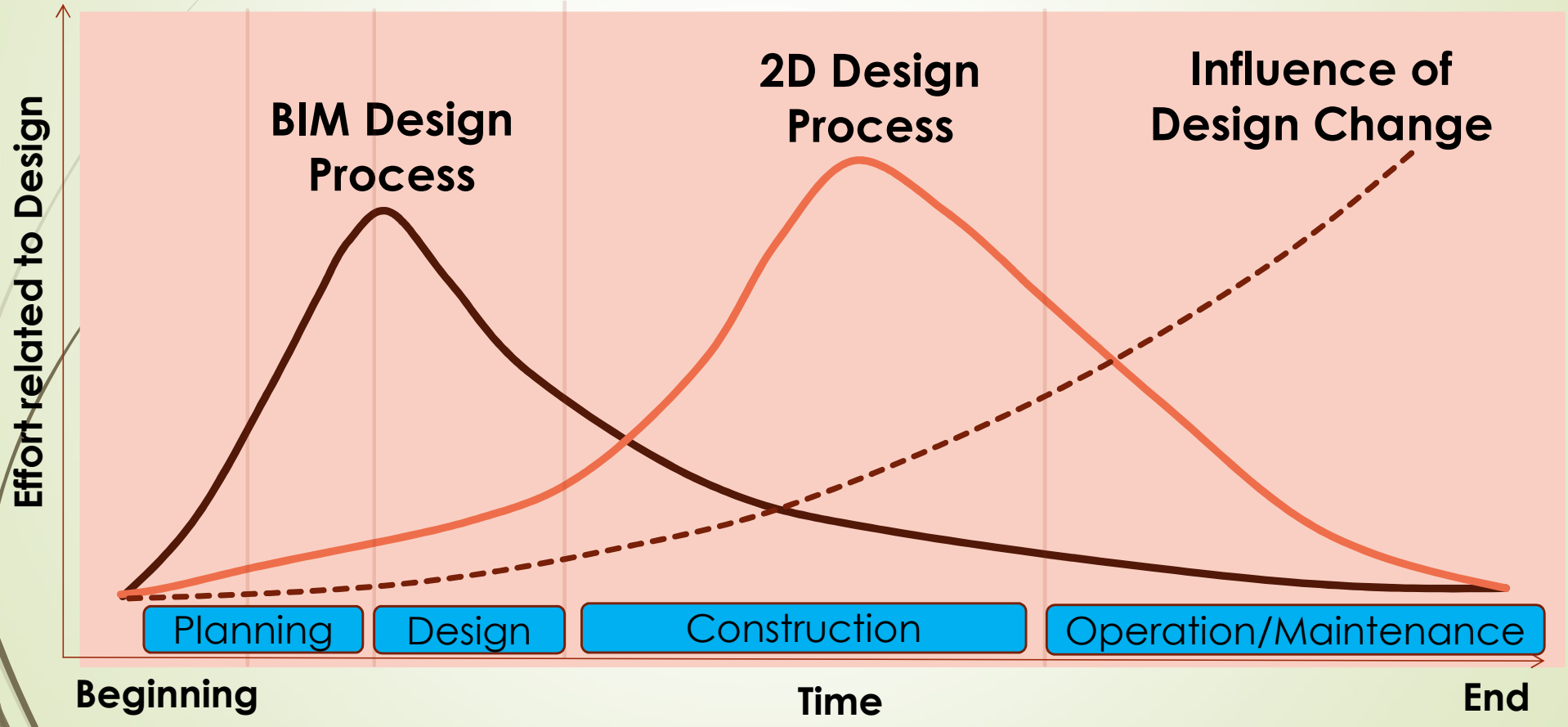
What is BIM?

Building Information Modelling

Innovation with 3D, 4D(+Scheduling), 5D(+Cost), 6D(all aspects) Modelling

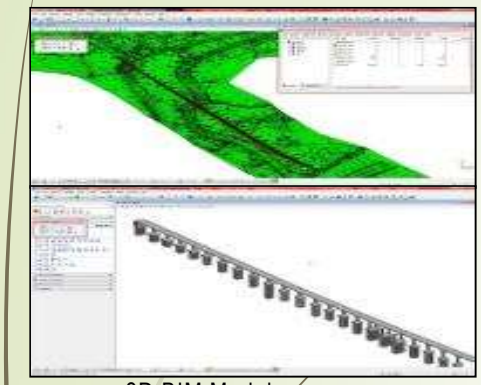


Efficiency of the whole construction project with BIM Technology(Frontloading)



Introduction of Virtual Construction System

- Constituent of Virtual Construction System



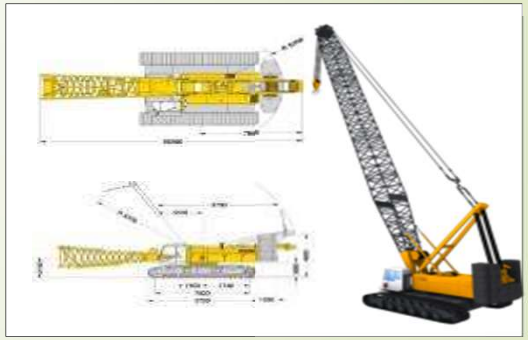
3D BIM Model

Estimated Field Process Schedule

CCTV

Avatar Safety Management

Equipment Library



Equipment Management

Introduction of Virtual Construction System

Virtual Construction (2011 – before Real construction)	Real Construction (2012)
	

Introduction of BIM in Japan

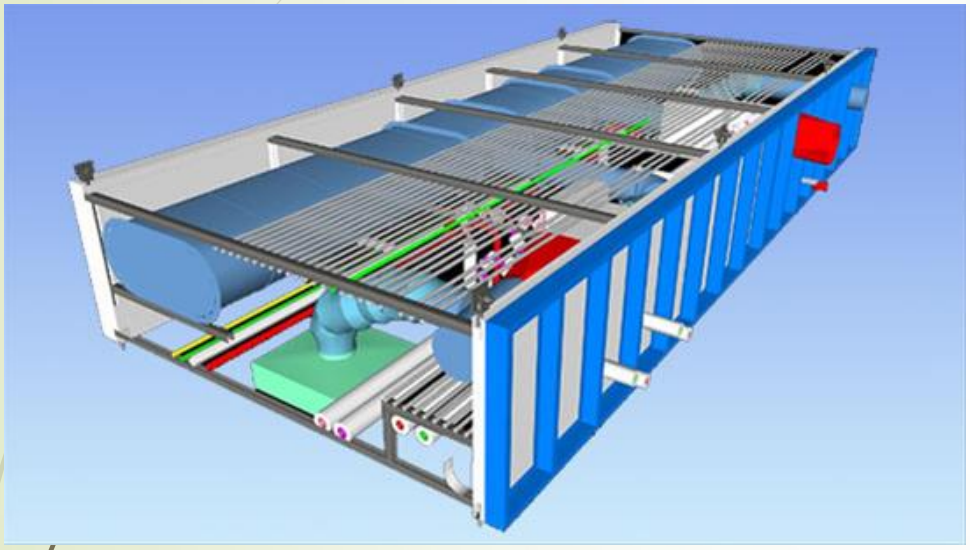
- March2009, Declaration of BIM Introduction for Infra Projects in Japan
- March 2010, Start of BIM Projects in Governmental Facility Building
- March 2014, BIM Guideline Published by MLIT
- 2016, Operation Start of BIM Guideline in Leading Projects by MLIT

Introduction of BIM in Other Countries

UK	2016: Obligation to utilize BIM in Infrastructure Projects
Finland	2007: Requirement of Submitting IFC Data
Denmark	2007: Requirement of Submitting IFC Data
Singapore	2002: Complete Computerization of Building Certification
United States	2007: Requirement of Submitting IFC Data

note：IFC：Standard Data Model to Share BIM Data (Industry Foundation Classes)

In the Case of SKANSKA in Finland



- 1996, SKANSKA started to use BIM
- Finland SKANSKA : BIM was used in More than 200 Projects.
- **“ The basic policy is to solve problems at a stage of BIM model making and then to construct on site.”**

(From Website of SKANSKA)

In the Case of SKANSKA in Finland

- BIM significantly enhances the project team's ability to collaborate and use other innovative tools, from prefabrication to virtual models in the field.
- The design can be easily understood and reviewed for better accuracy and completeness.
- Alternatives can be visualized and evaluated in terms of cost and other project parameters.
- The models can represent the completed project and be integrated with all of the operation and maintenance material required of the project and delivered to the owners as part of their facility management strategy.

(From Website of SKANSKA)

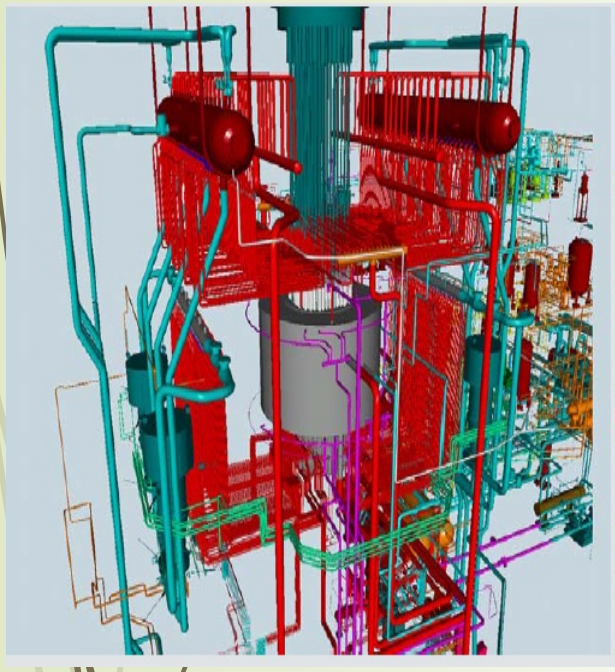
Three Types of BIM Utilization based on Separate Contract.

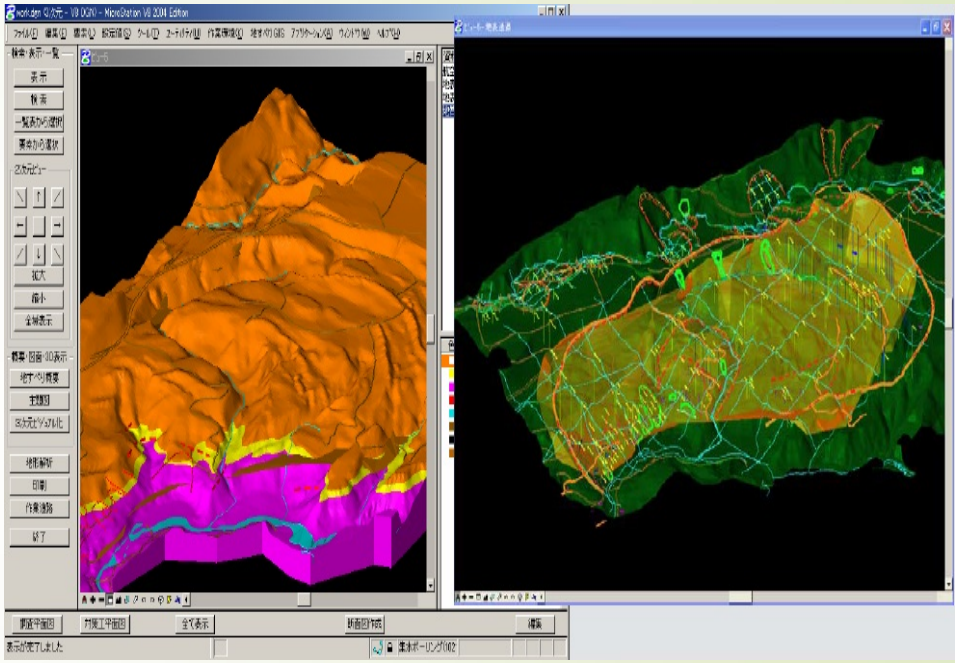
Type	Merits	Issues
Construction Phase	**Productivity Improvement by Contractor** Contractors could do anything based on their own decision.	**(Issue related to Technology is not Critical.)**
Design-to-Construction Phase	**Risk reduction of Change in Construction Condition** Virtual Construction during Design Phase is essential for productivity improvement.	**How to Contract?** In the case of separate contract, Data sharing is restricted. How to implement IPD for public works?
Maintenance Phase	**Cost Reduction during Maintenance** Duration of maintenance is about 50years to 100years.	**Merit of Contractor and Consultant is insufficient.** Information needed for long-term maintenance should be identified.

Merits and Issues of Data Sharing between Design and Construction(Fabrication)

Organization	Merits	Issues to overcome
Owner	**Improvement of Productivity** Productivity of Project Improves, and Benefit/Cost Ratios Increases.	**Contract Improvement** New Contract Method such as Integrated Project Delivery should be implemented.
Contractor	**Risk Reduction by Design Change** Decrease in Uncertainty Leads to Risk Reduction by Design Change in Construction Phase.	**Knowledge Sharing with Consultant** Knowledge on Construction should be shared with Consultant and Owner.
Consultant	**Higher Dependency on Design Quality** Success of Project depend on the quality of design more than before.	**Improvement of Design Ability** Knowledge on Construction or Fabrication Phase should be acquired and used wisely in Design Phase.

Is technology still the issue?





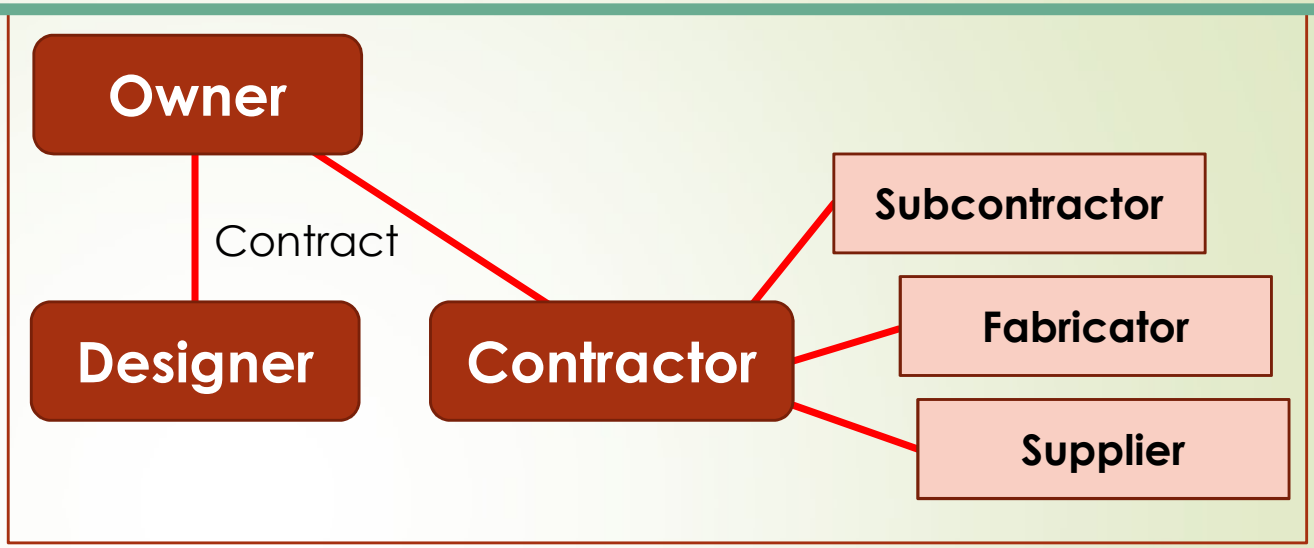
- In August 2008, AUTODESK and BENTLEY announced an agreement to expand interoperability between their portfolios of architectural, engineering, and construction (AEC) software.
- 3D CAD Share of these two companies is about 80% in Japan.
- IFC(Standard Data Model to Share BIM Data) is available.

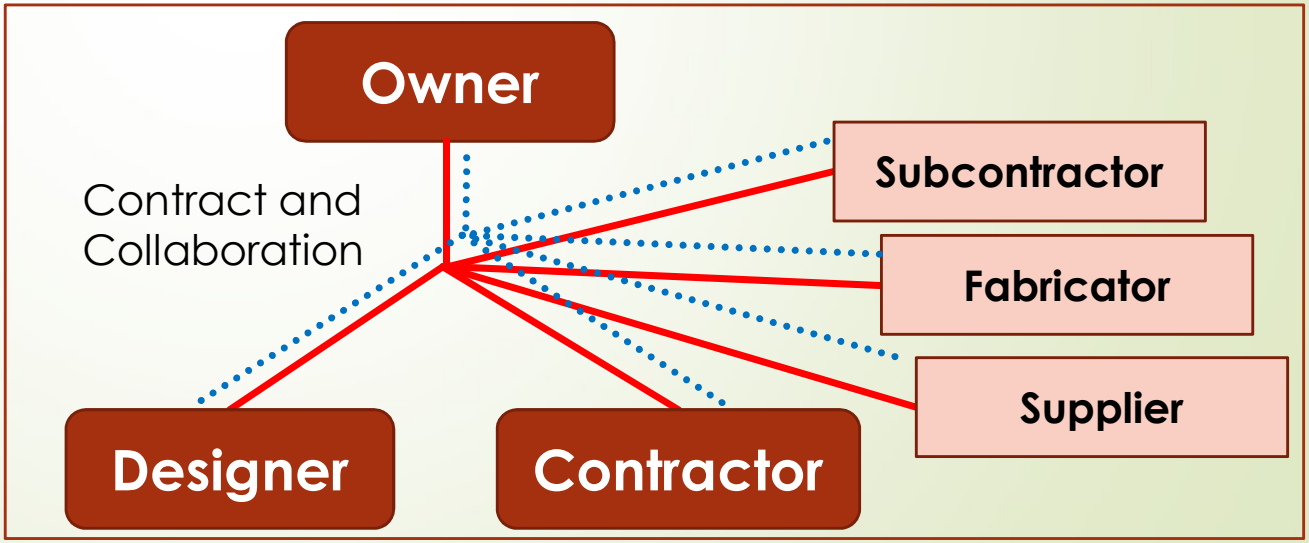
How to Overcome Contract Related Issue?

Integrated Project Delivery (IPD)

A project delivery method that **integrates people, systems, business structures and practices** into a process that collaboratively harnesses the talents and insights of all participants to **reduce waste and optimize efficiency** through **all phases of design, fabrication and construction**.

Defined by The American Institute of Architects (AIA)





IPD

- Information flow
- Contract
- Right to access
- Role of BIM manager
- BS1192 regulation for work flow

Options of Contract for BIM Utilization.

Type	Issues	How to Overcome?
Separate Contract	Data sharing should be restricted based on Contract.	Consultants are to be more capable of utilizing information related to Construction and Fabrication.
Design-Build Contract	Just Technological (not Critical)	Top executives of Contractors should be positive (not conservative).
Integrated Project Delivery	Difficulty to collaborate beyond the range of Contract	Public sectors should be more positive to change the social system. ()Issue on the roles of Contractor, Consultants and Owners.
PPP	Dependence on public sector's decision	Public Service Comparator

I hope BIM will realize the situation stated by the definition in the near future.

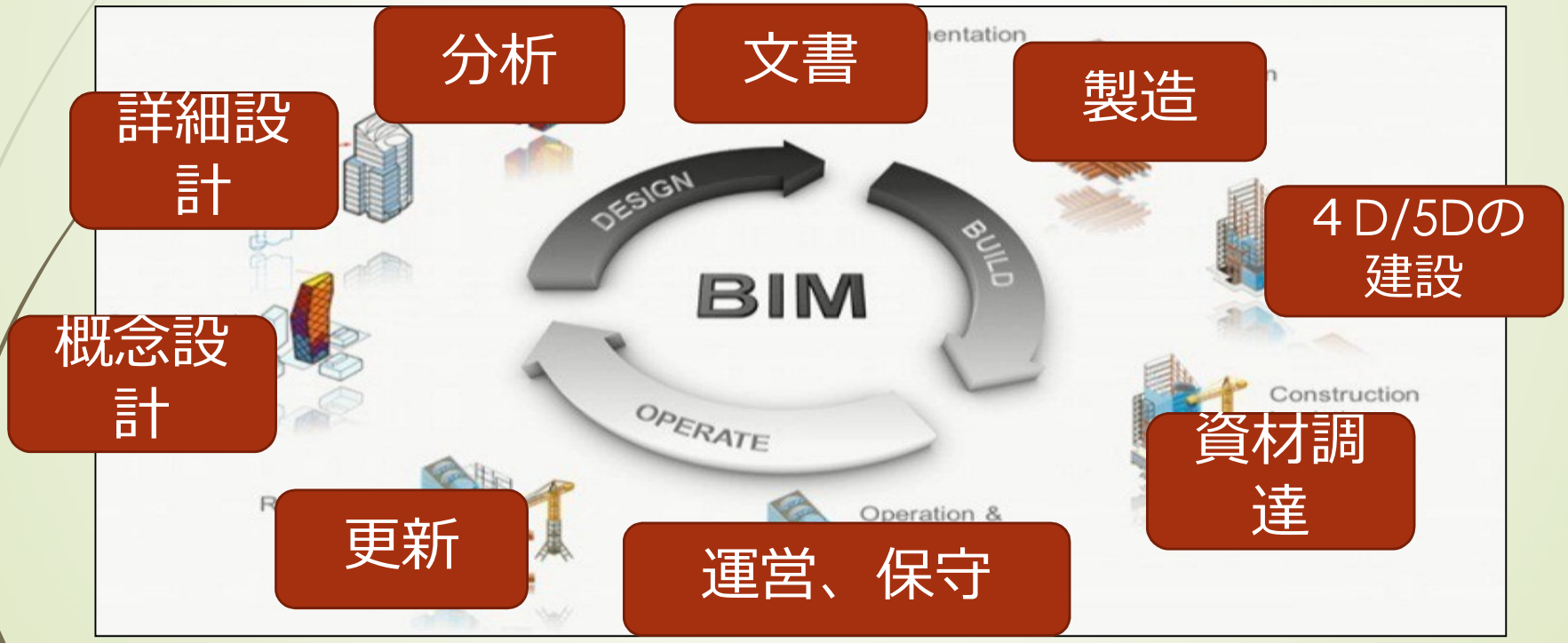
The Most serious issue might be related to the way of management of entire project.

Thanks!

参考

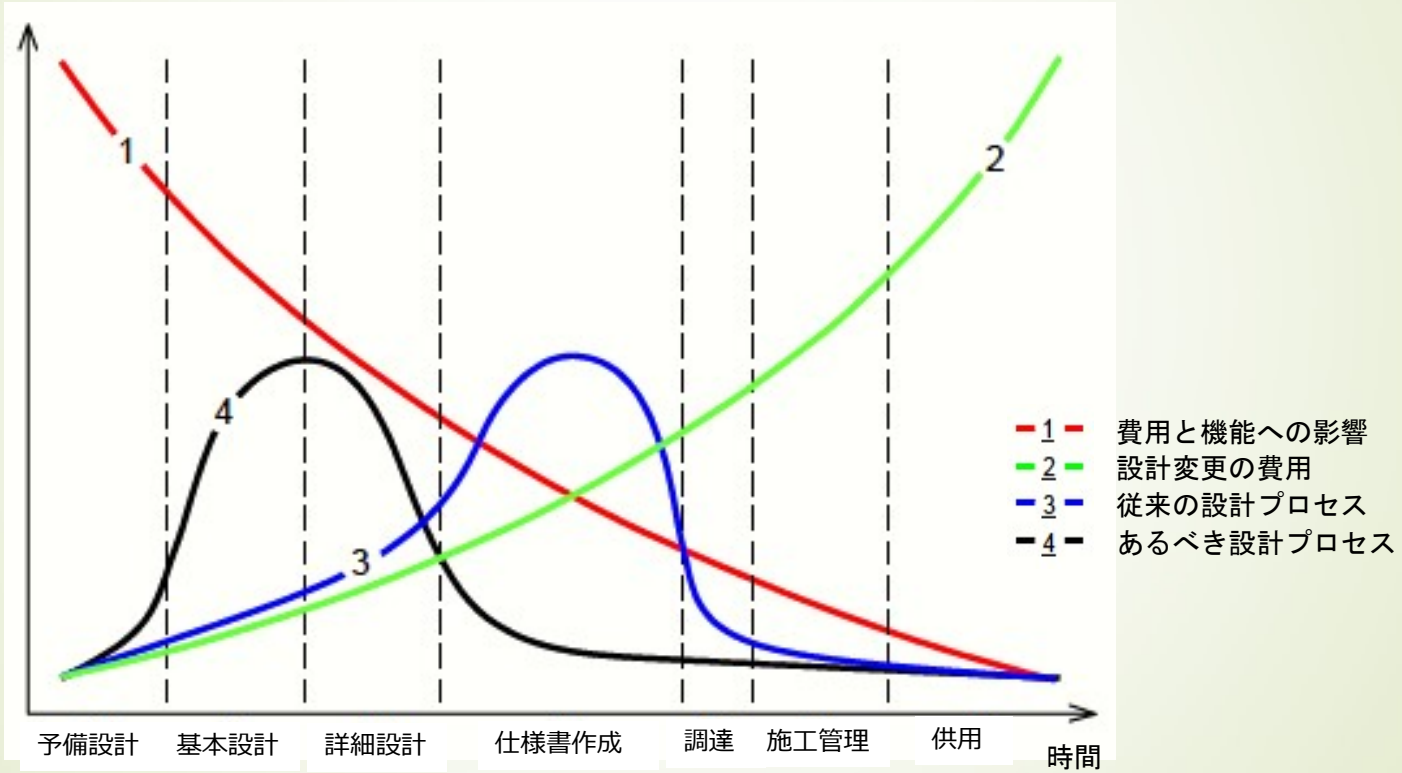
1．BIM(Building Information Modeling)概要

コンピューター上で作成した平面情報、立面情報などを有する建物情報モデルに工期などのスケジュールやコストなど建物のライフサイクルで扱われるデータを追加し、集合体として電子的に作成・保持・相互運用していく手法



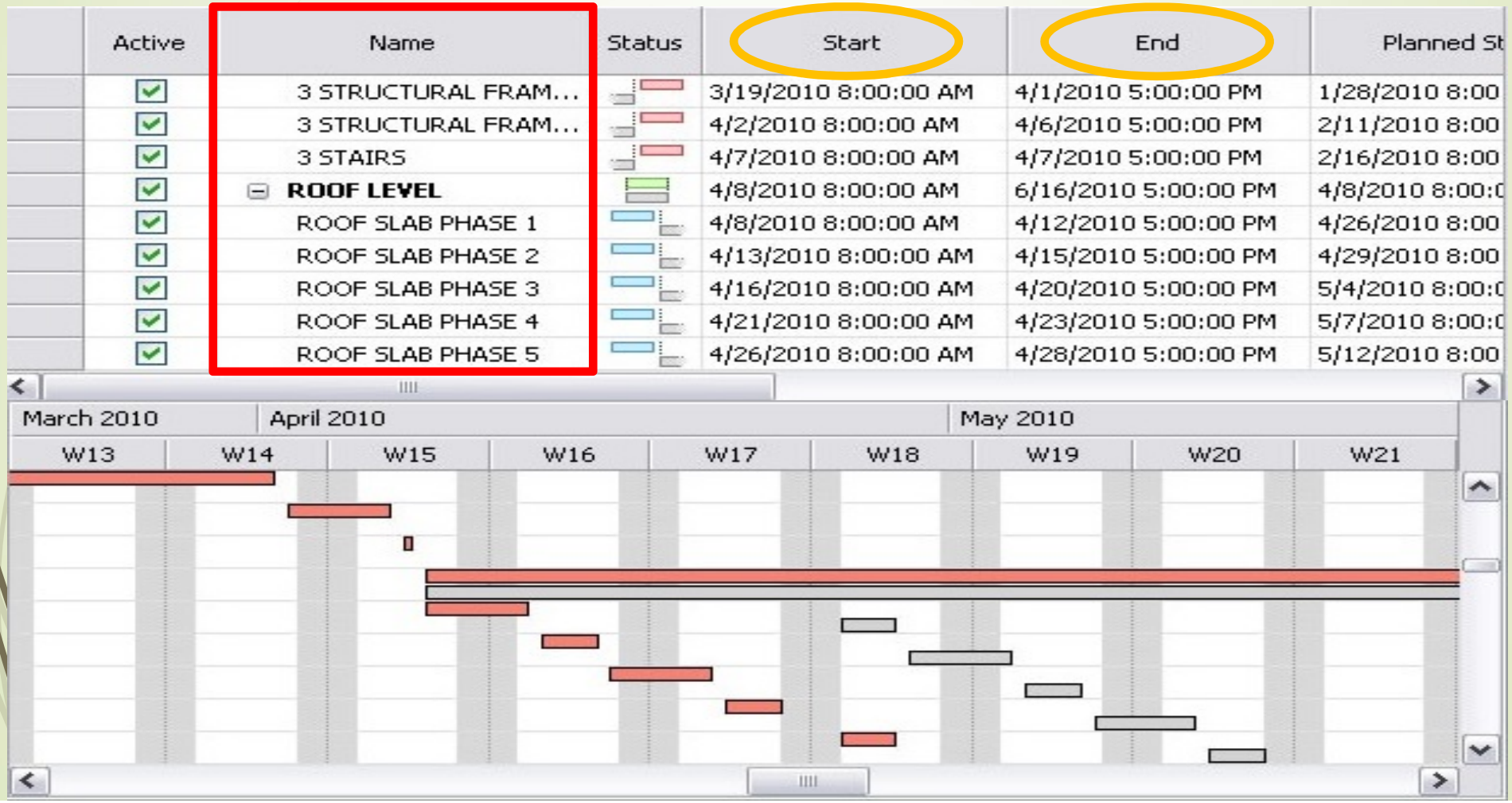
フロントローディング

- 資源の投入をプロジェクトの初期段階へ移し、全体効率を向上
- 設計変更に伴う経費は、後プロセス程急速に増加



"Collaboration, Integrated Information, and the Project Lifecycle in Building Design, Construction and Operation"
The Construction Users Roundtable (CURT), WP-1202 August 2004

BIMによる有用性－建設プロジェクト全体の効率化、工期短縮②



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✓	3 STAIRS		4/7/2010 8:00:00 AM	4/7/2010 5:00:00 PM	2/16/2010 8:00
✓	**ROOF LEVEL**		4/8/2010 8:00:00 AM	6/16/2010 5:00:00 PM	4/8/2010 8:00:0
✓	ROOF SLAB PHASE 1		4/8/2010 8:00:00 AM	4/12/2010 5:00:00 PM	4/26/2010 8:00
✓	ROOF SLAB PHASE 2		4/13/2010 8:00:00 AM	4/15/2010 5:00:00 PM	4/29/2010 8:00
✓	ROOF SLAB PHASE 3		4/16/2010 8:00:00 AM	4/20/2010 5:00:00 PM	5/4/2010 8:00:0
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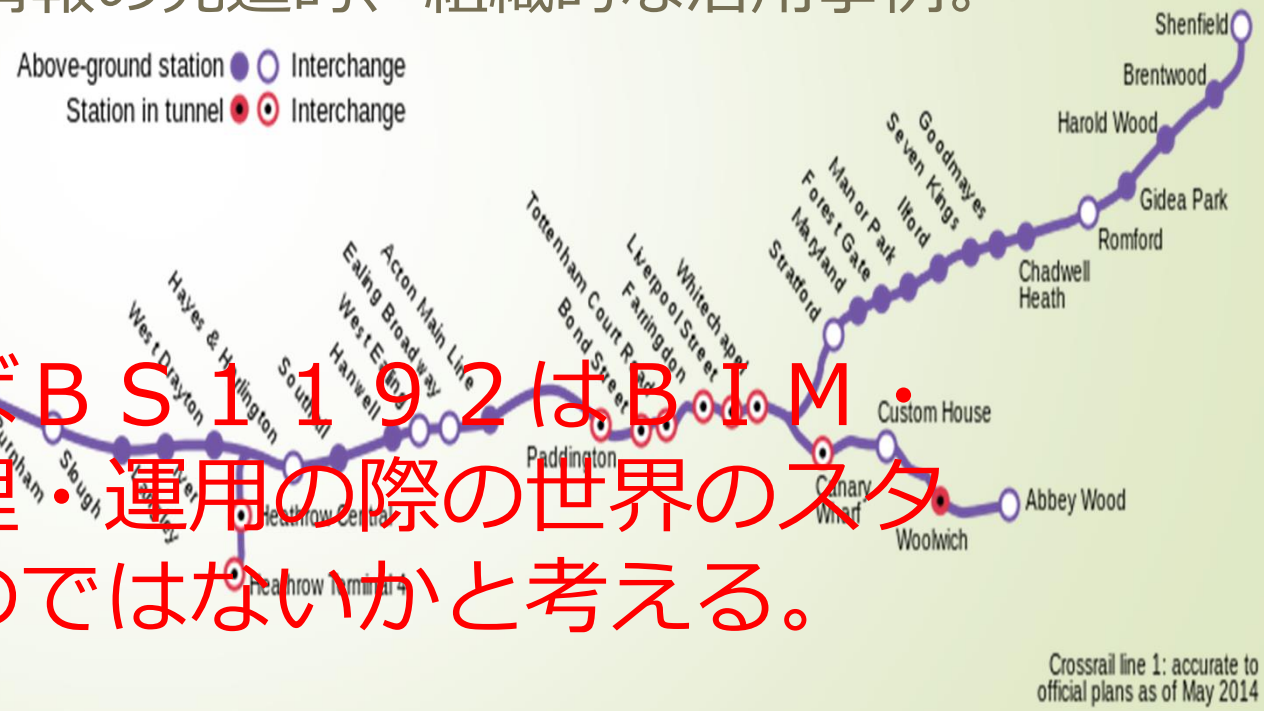
海外でのBIM活用事例（英国）

クロスレール計画

「北半球最大のプロジェクト」と言われる英国ロンドンの「クロスレール（Crossrail）」プロジェクトは英国工業規格（BS1192）に基づき、徹底したIT化を図ったプロジェクト情報の先進的、組織的な活用事例。

クロスレールはロンドンの東西間を結ぶ新路線である。



事業が成功すればＢＳ１１９２はＢＩＭ・ＣＩＭの情報管理・運用の際の世界のスタンダードになるのではないかと考える。

出典：Scott Wilson Ltd，Crossrail: BS1192 Design Information Coordination & Control.

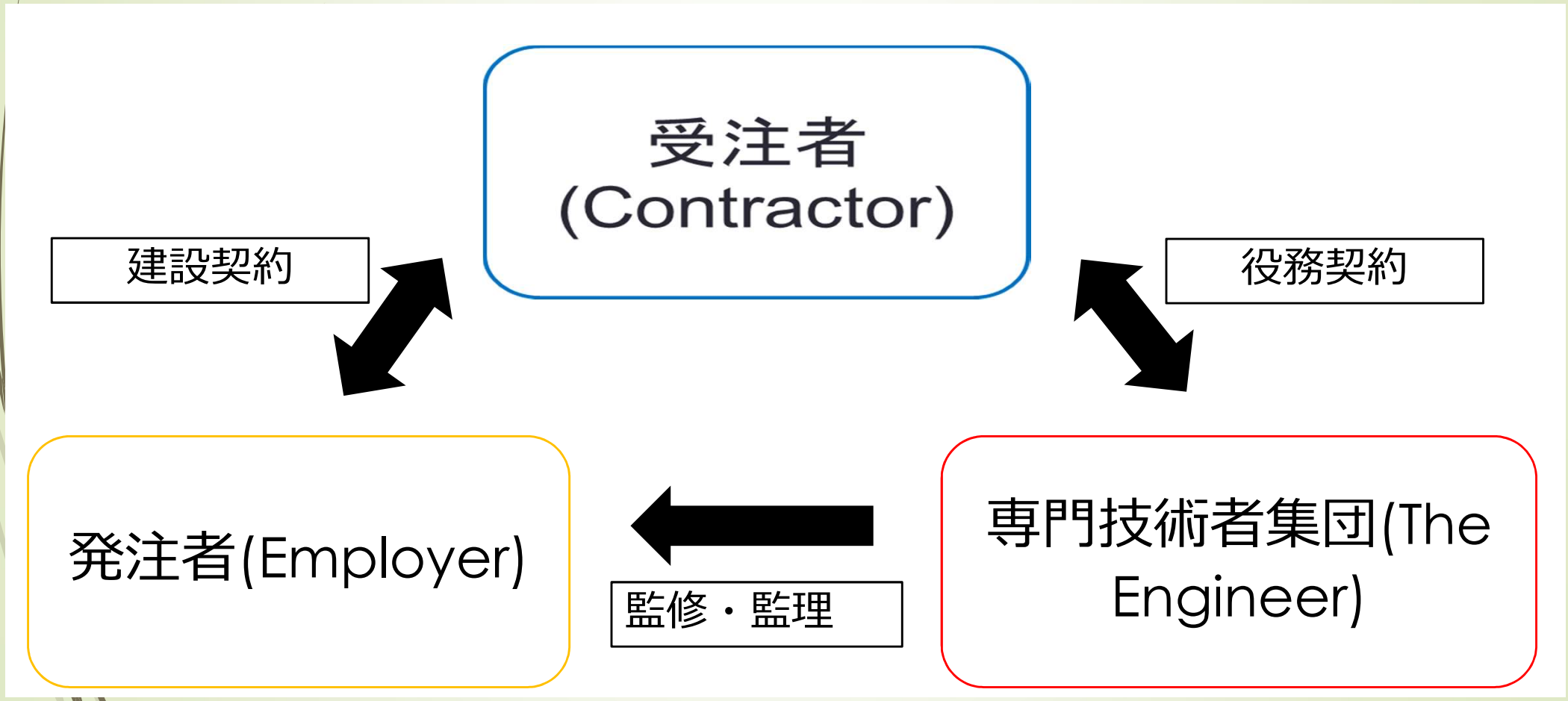
Case:World Trade Center Redevelopment Project

Owner:
New York & New Jersey State
WTC統合交通ターミナル施設建設パーソンズブリンカホフ＆URSプログラムマネージメント共同業体

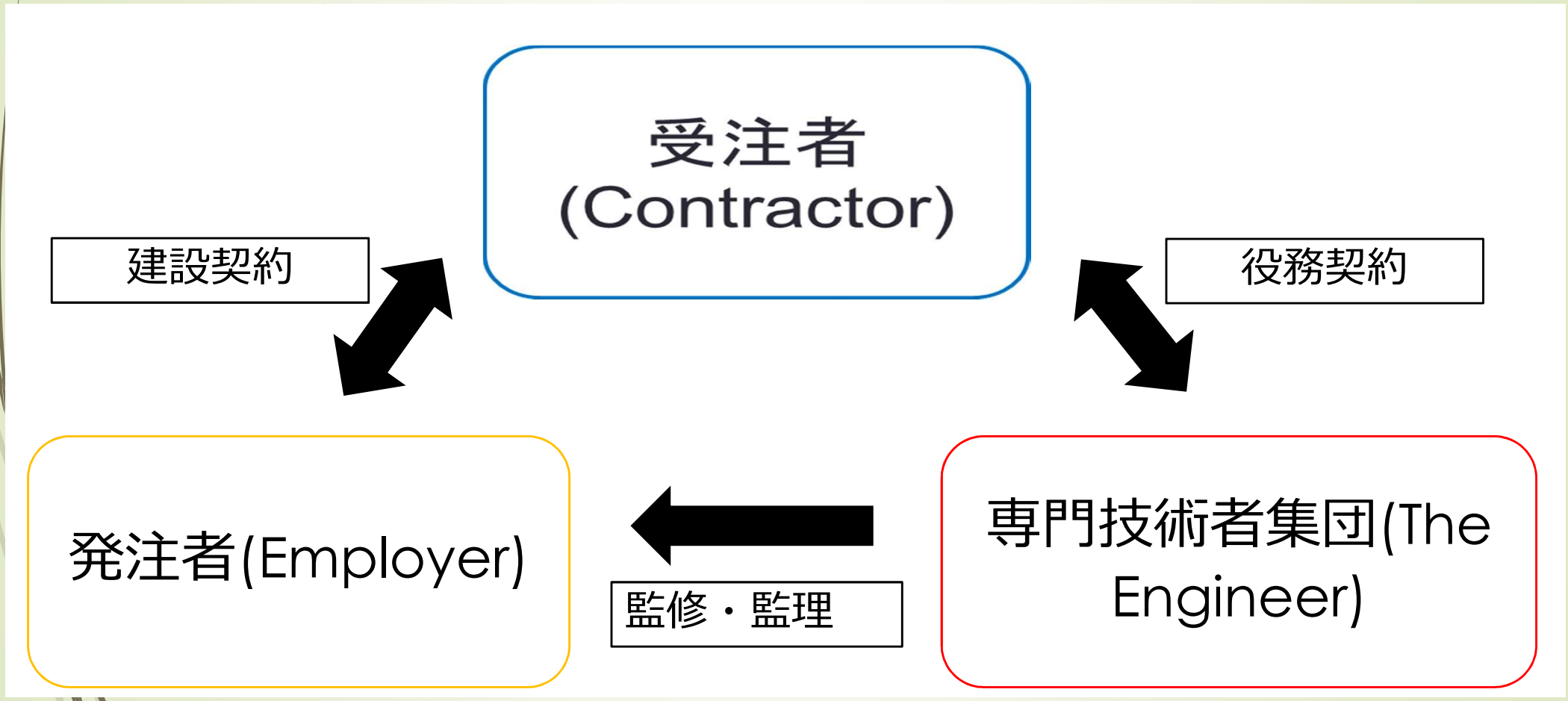
WTC統合交通ターミナル施設総事業費
２，２００億円

出典：米国におけるCIM技術調査2013報告書

日本のプロジェクト執行形態



日本のプロジェクト執行形態



情報共有システム機能要件の策定

国土交通省で1000件の工事で試行された