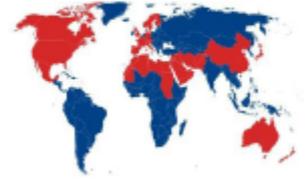




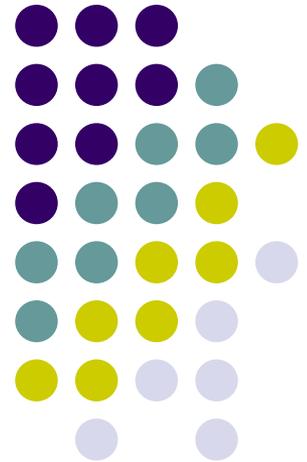
buildingSMART®  
International Alliance for Interoperability



# BIMの動向について

## Building Information Modeling

一般社団法人 IAI日本  
技術検討分科会  
足達嘉信

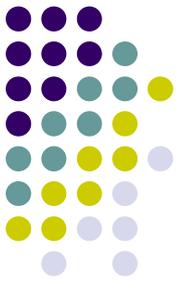


# 内容



- BIMの動向
  - 北欧：ノルウェーオスロ美術博物館BIMコンペ・フィンランド
  - アメリカ連邦調達庁 (GSA)
- BIMプロジェクトを支える仕組み
  - BIMガイドライン整備について
  - IDM, MVD
- GIS (地理情報システム) とBIMの連携
- BIM & AR (拡張現実) プロジェクト

# ノルウェー・オスロの国立美術館コンペ



- STATSBYGG (国交省・営繕と同様の組織) が主催 (2009年開始)
- 2010年9月最終審査発表
- IFCによるBIMデータの提出を義務付けている

3D敷地モデルはIFC形式・3D-PDF形式で公開 ←→



コンペ案内書 (英文)



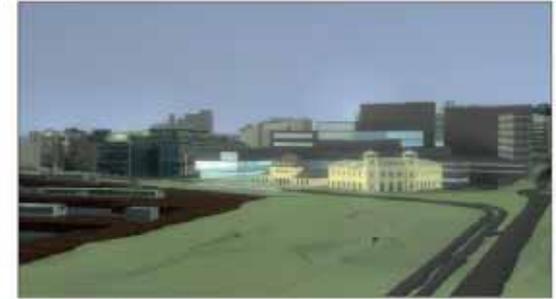
# STATSBYGGによるコメント



- ステージ1で使われたツール
  - AutoCAD Architecture
  - Autodesk Revit
  - Bentley Triforma
  - Graphisoft Archicad
  - Nemetschek Allplan
  - Nemetschek VectorWorks
- ステージ2における要求事項
  - 数量積算、CO2放出量
  - エネルギー分析
  - セキュリティならびに動線
  - 設備配管・配線スペース



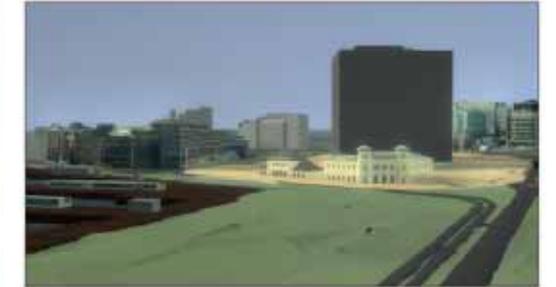
147 URBAN TRANSITION



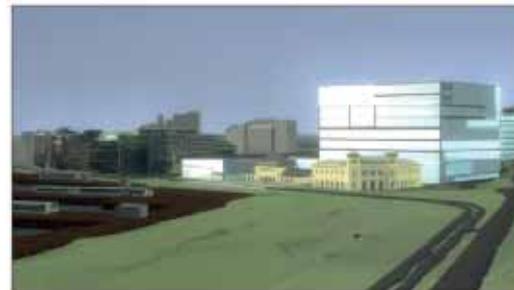
148 BACK IN BLACK



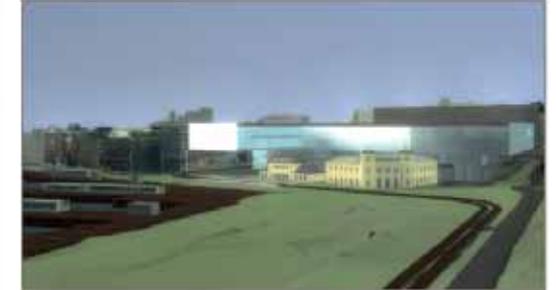
164 FORUM ARTIS



203 URBAN CANVAS



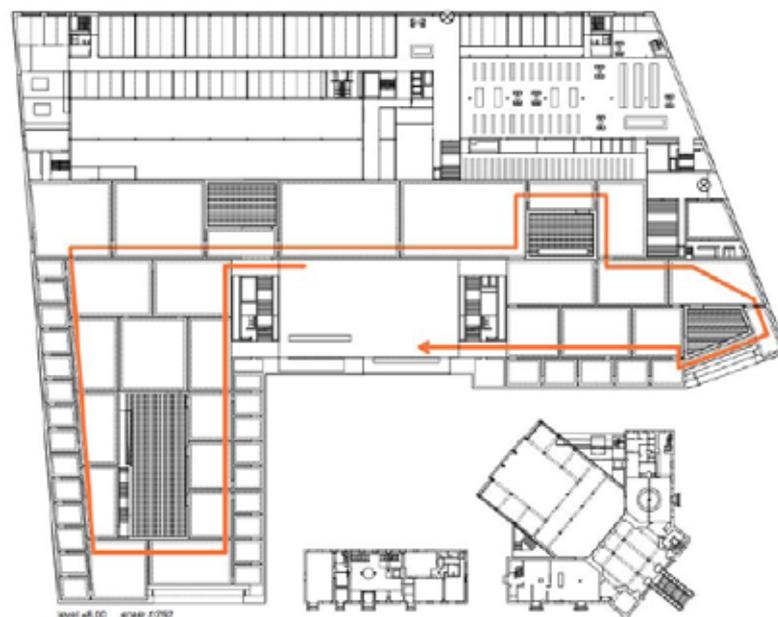
209 TRYLLEESKEN



214 M\_BOX

ステージ1を通過した6案

# ノルウェー・オスロの国立美術館コンペ (最優秀案)



# BIMガイドライン



## BIM-MANUAL 1.1

SBM1.1



04.02.2009

### Statsbyggs generelle retningslinjer for bygningsinformasjonsmodellering (BIM)

BIM-manual 1.1 inneholder Statsbyggs generelle retningslinjer for bygningsinformasjonsmodellering (BIM) i prosjekter og ved eiendommer. Manualen bygger på erfaringer med og tilbakemeldinger på BIM-manual 1.0 og tilfører noen nye erfaringer, særlig knyttet til programfase og detaljprosjekt.

Tilbakemeldinger på innhold og form gis til [bim@statsbygg.no](mailto:bim@statsbygg.no).

Dekke / Slab	
<p>ifc navn:</p> <p><a href="#">ifcSlab</a>  <a href="#">IfcSlabType</a>  <a href="http://www.iai-international.org/ModeVR2x3_final/ifcsharedbldgkments/lexical/ifcramp.htm">http://www.iai-international.org/ModeVR2x3_final/ifcsharedbldgkments/lexical/ifcramp.htm</a></p>	<p>En slab er en del av en konstruksjon som normalt lukker en spaco vertikalt. En slab kan være både gulv og tak. Man skal notere seg at det bare er kjernen eller konstruksjonsdelen som er en slab. Ifht iai definisjonen er overflatens coverings.</p> <p>En spesiell type slab kan være et repos som kryttar en eller flere trappor/rampor sammen. Den trenger ikke å ligge nær et utsjødakke.</p> <p>En slab kan ha åpninger – så som utsparinger. De defineres som <a href="#">IfcOpeningElement</a>.</p>

Modellteknisk beskrivelse:  
 Dekker skal plasseres i den etasjen som de bæres. Påstep og eventuell toppsjikt (som bygger noe) parkett, flis osv. plasseres i den etasjen hvor de hører hjemme. Ifc-standarden har ingen definisjon av himling og sier klart at dette er IfcCovering vi har imidlertid behov for fysiske objekter og modellerer dette ved hjelp av Slab-verktøyet med usardefinert objekt type. Overflatar modelleres som IfcCoverings.

Egenskapsnavn	Property Type	Data Type	Eksempler	0	1	2	3	4	5
GlobalID	<a href="#">IfcGloballyUniqueId</a>	<a href="http://www.iai-international.org/ModeVR2x3_final/ifcmeasurements/lexical/ifcext.htm">http://www.iai-international.org/ModeVR2x3_final/ifcmeasurements/lexical/ifcext.htm</a>			A	B	A	A	A
OwnerHistory			Eierhistorikk som genereres automatisk av CAD-verktøylene					A	A
Name		<a href="#">IfcLabel</a>	Dekketypen – tag eller prosjektspesifikk marking					A	A
Description		<a href="#">IfcText</a>	Beskrivelse					A	A
ObjectType		<a href="#">IfcLabel</a>	Usarddefinert spesifiseres her					A	A
PredefinedType	<a href="#">IfcSlabTypeEnum</a>	IfcIdentifier	<a href="http://www.iai-international.org/Model/R2x3_final/ifcsharedbldgkments/lexical/ifcslabtypeenum.htm">http://www.iai-international.org/Model/R2x3_final/ifcsharedbldgkments/lexical/ifcslabtypeenum.htm</a>		A	B	A	A	A
Tag		<a href="#">IfcText</a>	Spesiell marking av dakke						

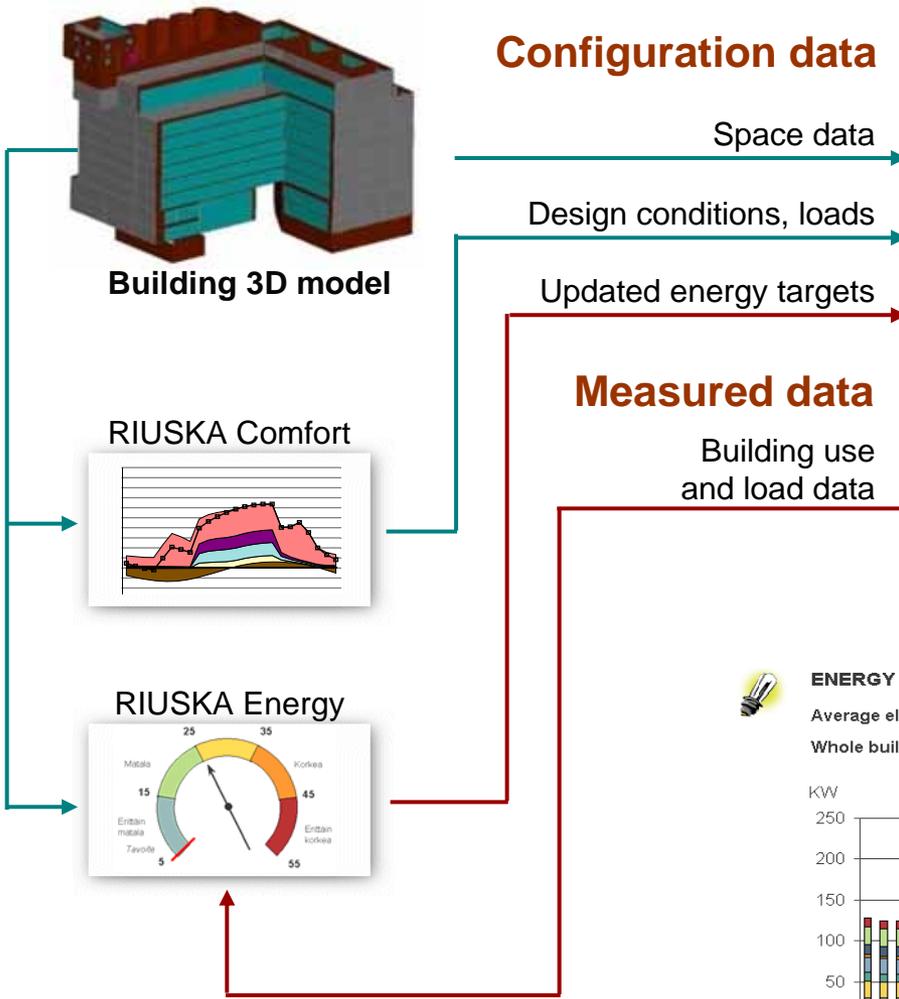
Pset SlabCommon									
Materialance	<a href="#">IfcPropertySingleValue</a>	IfcIdentifier	Fremtidig Ifc-kode – informasjonell bibliotekreferanse					A	A
AcousticRating	<a href="#">IfcPropertySingleValue</a>	IfcLabel	lydklasse – krav			A	A	A	A
FireRating	<a href="#">IfcPropertySingleValue</a>	IfcLabel	brannklasse – krav			A	A	A	A
Combustible	<a href="#">IfcPropertySingleValue</a>	IfcBoolean	Bostår dekket av brennbart material – true or false			A	A	A	A
SurfaceSpreadOfFlame	<a href="#">IfcPropertySingleValue</a>	IfcLabel	Brandteknisk klassifisering av dekkets overflate ifht 87-24			A	A	A	A
ThermalTransmittance	<a href="#">IfcPropertySingleValue</a>	IfcThermalTransmittanceMeasure	U-verdi på dakke			A	A	A	A
IsExternal	<a href="#">IfcPropertySingleValue</a>	IfcBoolean	True or false			A	A	A	A
LoadBearing	<a href="#">IfcPropertySingleValue</a>	IfcBoolean	Er dekket bærende – true or false			A	A	A	A
Compartmentation	<a href="#">IfcPropertySingleValue</a>	IfcBoolean	Er dekket en del av en branncelle – true or false			A	A	A	A

# フィンランドにおけるBIMとBEMSの連携



BIM

BEMS (Building Energy Management System)



**Senaatti**

Weather at 08:06  
Outdoor temp.: 6,3 °C  
Wind speed: 10,9 m/s

**Comfort**  
Target temperature  
91 spaces

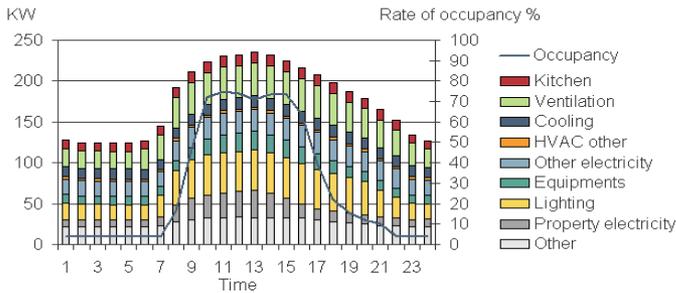
**Energy**  
+21 kWh per month

**Environment**  
+23 kWh per month

Granlund Software  
Taloinfo

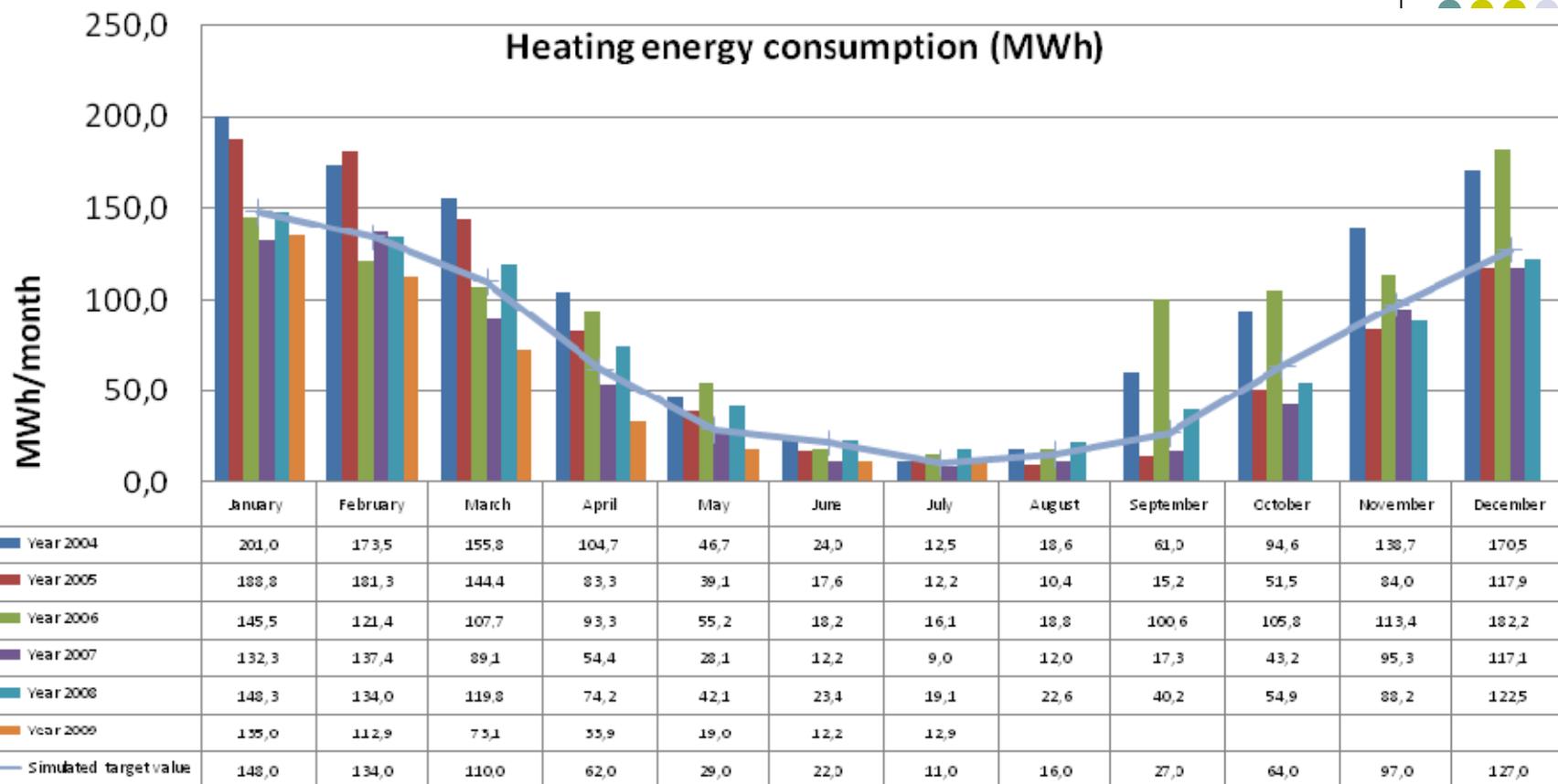
**ENERGY ECONOMY**

Average electricity consumption during a working day  
Whole building

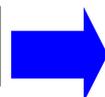


- XML interface
- Energy measuring
- Access control
- Building automation
- Facilities management
- FM plan and history

# フィンランドにおけるBIMとBEMSの連携



BIMによるエネルギーシミュレーション



実運用での目標値達成を含んだサービス提供

# GSA (連邦調達庁) のBIM - IFC活用



United States General Services Administration  
Public Buildings Service  
Office of the Chief Architect  
1800 F Street NW 3261, Washington DC 20403

**GSA's National 3D-4D-BIM Program**  
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VISUALIZE — COORDINATE — OPTIMIZE  
OBJECT INTELLIGENCE — INTEROPERABILITY  
VIRTUAL DESIGN AND CONSTRUCTION

**Strategic and Incremental Adoption of 3D-4D-BIM**  
In 2003, the Office of the Chief Architect (OCA) of the U.S. General Services Administration (GSA) Public Buildings Service (PBS) spearheaded the National 3D-4D-BIM Program. To date, OCA has led a pilot program with over 25 projects that incorporated a variety of 3D, 4D, and BIM technologies to address different programming, design, and construction challenges faced by GSA capital projects. In addition, OCA is assessing and supporting 3D, 4D, and BIM applications on over 35 ongoing GSA projects across different regions. For all major projects (prospects level) receiving design funding in Fiscal Year 2007 and beyond, a spatial program BIM will be the minimum requirement for submission to OCA for Final Concept approvals by PBS Commissioner and the Chief Architect. In addition, OCA is encouraging the implementation of various 3D, 4D, and BIM technologies above the minimum requirement on a project-by-project basis. GSA is committed to a strategic and incremental adoption of 3D-4D BIM technologies.

**Highlights of the 3D-4D-BIM Program Managed by GSA Office of the Chief Architect**

- Establishing policy to incrementally adopt 3D, 4D, and BIM for all major projects
- Leading 3D-4D-BIM pilot applications and initiatives for current and future capital projects
- Providing expert support and assessment for ongoing capital projects to incorporate 3D, 4D, and BIM technologies
- Assessing industry readiness and technology maturity
- Partnering with BIM vendors, professional associations, open standard organizations, and academic/research institutions
- Formulating a GSA BIM Toolkit to include:
  - BIM Guide Series 01 - 3D-4D-BIM Overview
  - BIM Guide Series 02 - Spatial Program Validation
  - Upcoming BIM Guide Series: 3D Laser Scanning, 4D Phasing, Energy Performance and Operations, Circulation Design Validation, and more
  - Sample solicitation and contractual language for 3D-4D-BIM services
  - Case Studies

**Contacts**

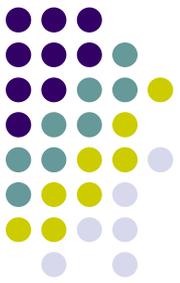
Charles Matto, FAIA (charles.matto@gsa.gov)	Director Center for Federal Buildings and Modernizations Office of the Chief Architect
Calvin Kam, Ph.D. (calvin.kam@gsa.gov)	National 3D-4D-BIM Program Manager Center for Federal Buildings and Modernizations Office of the Chief Architect

Visit <http://www.gsa.gov/bim> for a list of GSA BIM Champions across all regions, the latest versions of GSA BIM Guides, email lists, and more.

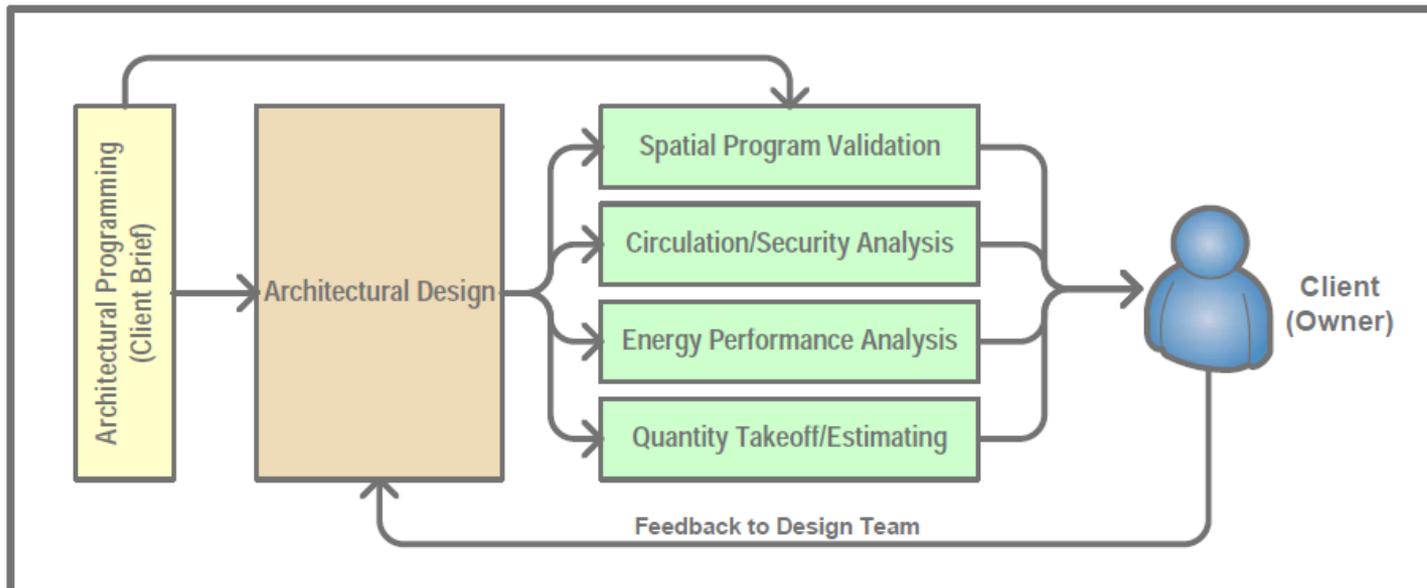
- 連邦調達局 (GSA, General Service Administration)
  - 全米に存在する約8300の連邦政府所有施設を管理する連邦政府機関
  - 膨大な量の施設管理を効率化し、価値を増大させるためのソリューションとして2007年度からBIM(IFC)データ提出を要求。
- GSAによるBIMガイドライン
  - Series 01 - 3D-4D-BIM Overview: BIM概要・目的
  - Series 02 - Spatial Program Validation: 空間計画・ゾーニング
  - Series 03 - 3D Laser Scanning: レーザースキャン
  - Series 04 - 4D Phasing
  - Series 05 - Energy Performance and Operations: エネルギーシミュレーション
  - Series 06 - Circulation and Security Validation: 人動線・セキュリティ分析
  - Series 07 - Building Elements: 建物要素
  - Series 08 - Facility Management: FM

注: Series 06-08は策定中

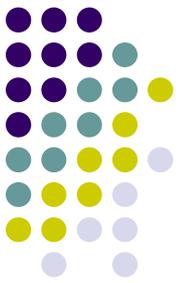
# GSAのBIMガイドライン動向



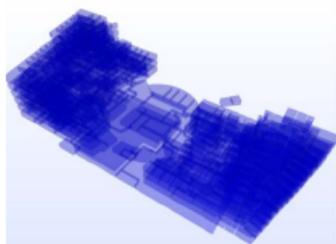
- CDB2010 (Concept Design BIM 2010)
  - GSAのBIMガイドラインシリーズをベースに、より詳細なBIMデータ連携仕様をIDM(Information Delivery Manual)、MVD(Model View Definition)のフォーマットによりドキュメント化を進めている。
  - GSA、Senate Properties(フィンランド)、STATSBYGG(ノルウェー)が連携し、フィードバック、実プロジェクト適用などを進めている。
  - スコープ
    - 空間計画検証
    - 人動線・セキュリティ分析
    - エネルギー性能分析
    - 数量ひろい・コスト見積もり



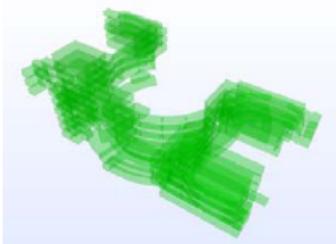
# GSAのBIMガイドライン:人動線・セキュリティ分析



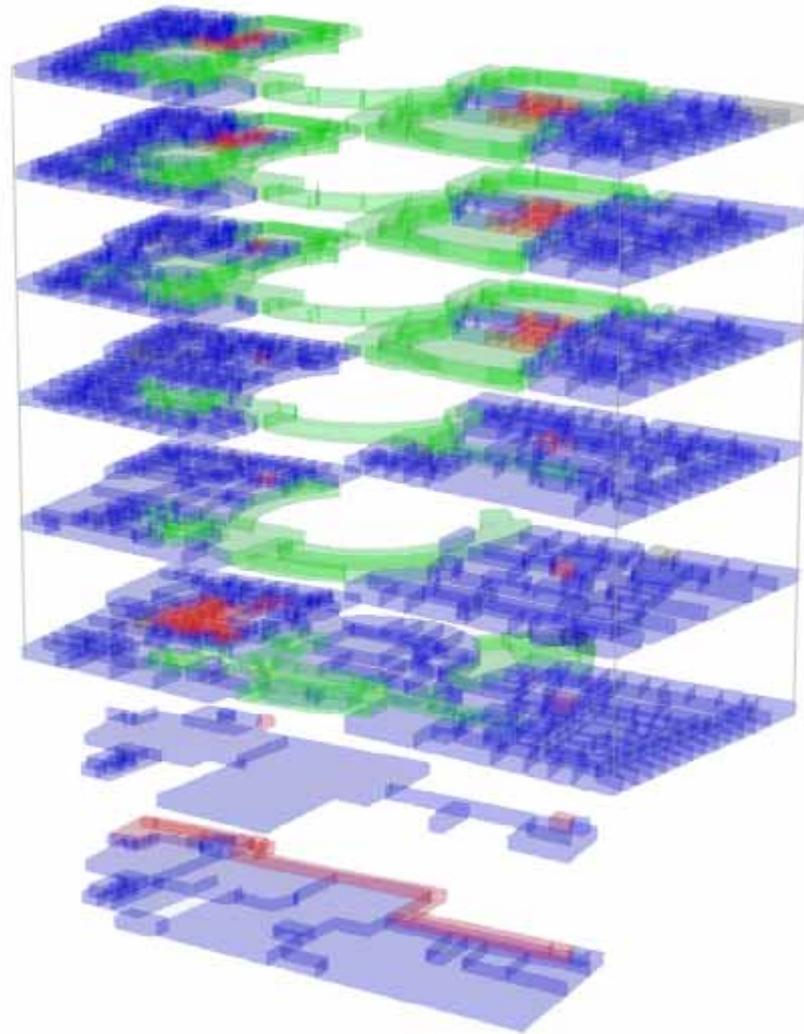
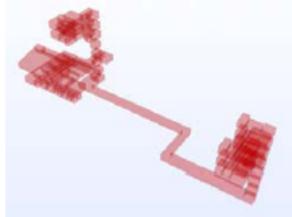
Public (e.g., visitors, media & press)



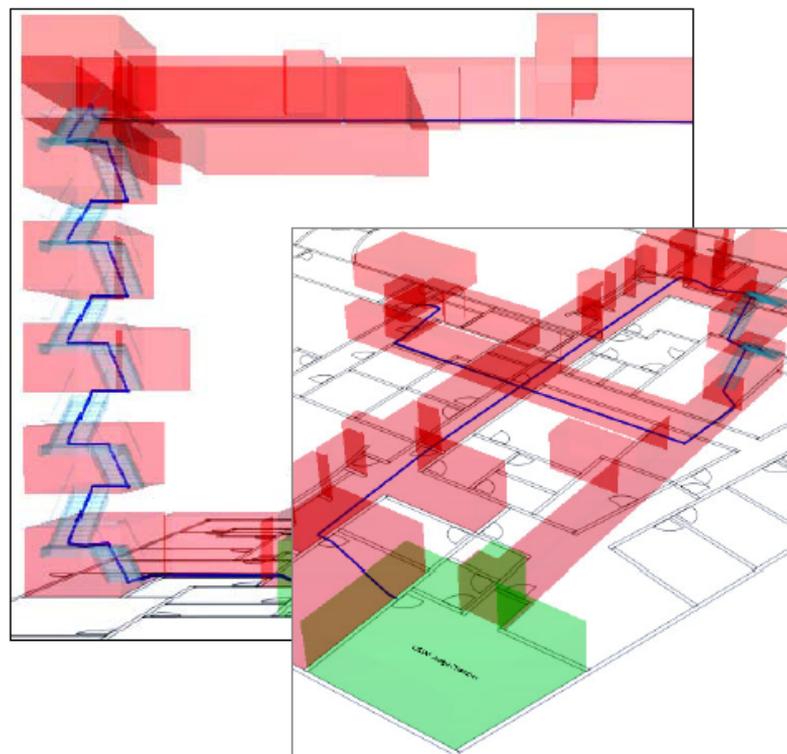
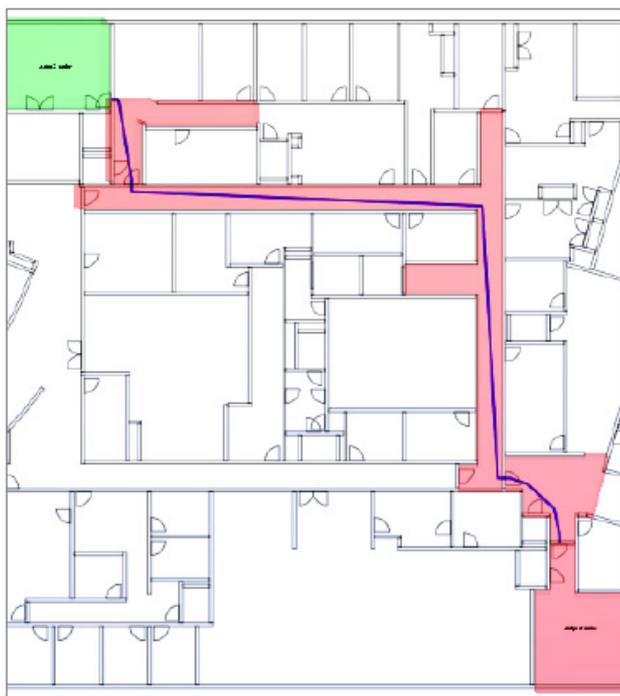
Restricted (e.g., judges, US Attorneys)



Secure (e.g., US Marshalls, defendants)



# GSAのBIMガイドライン:人動線・セキュリティ分析

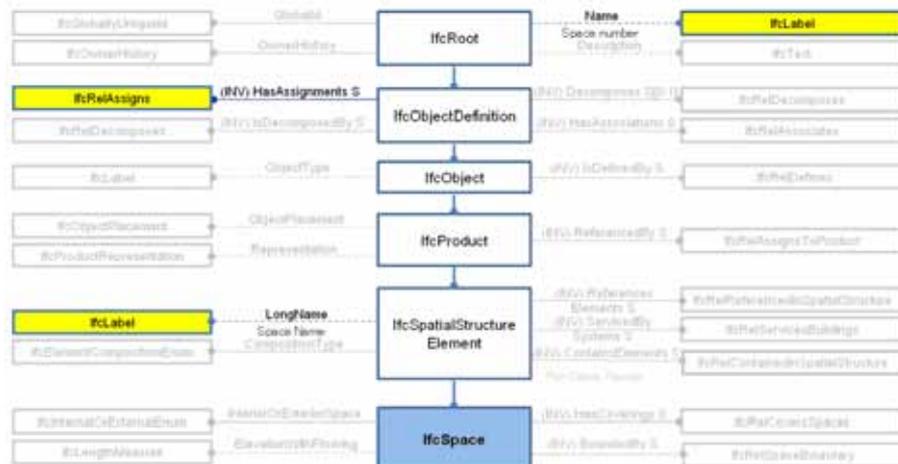


人動線の共通理解・検証へBIMモデルを活用(モデルチェッカー)

# GSAのBIMガイドライン:人動線・セキュリティ分析

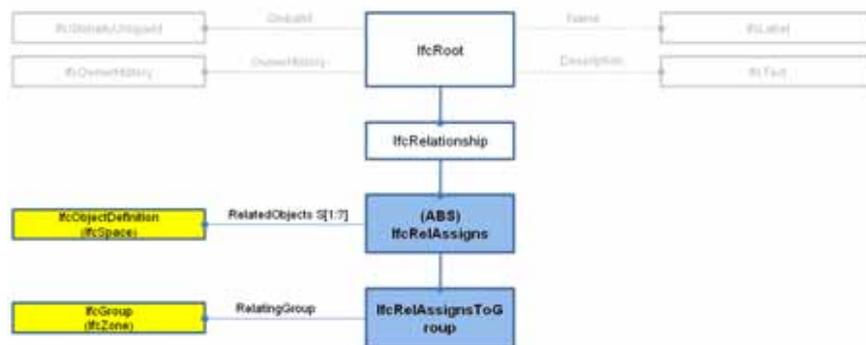


Assigning space circulation functionality using zone



Way to define additional space function, using zone and P-sets

Assigning space circulation functionality using zone



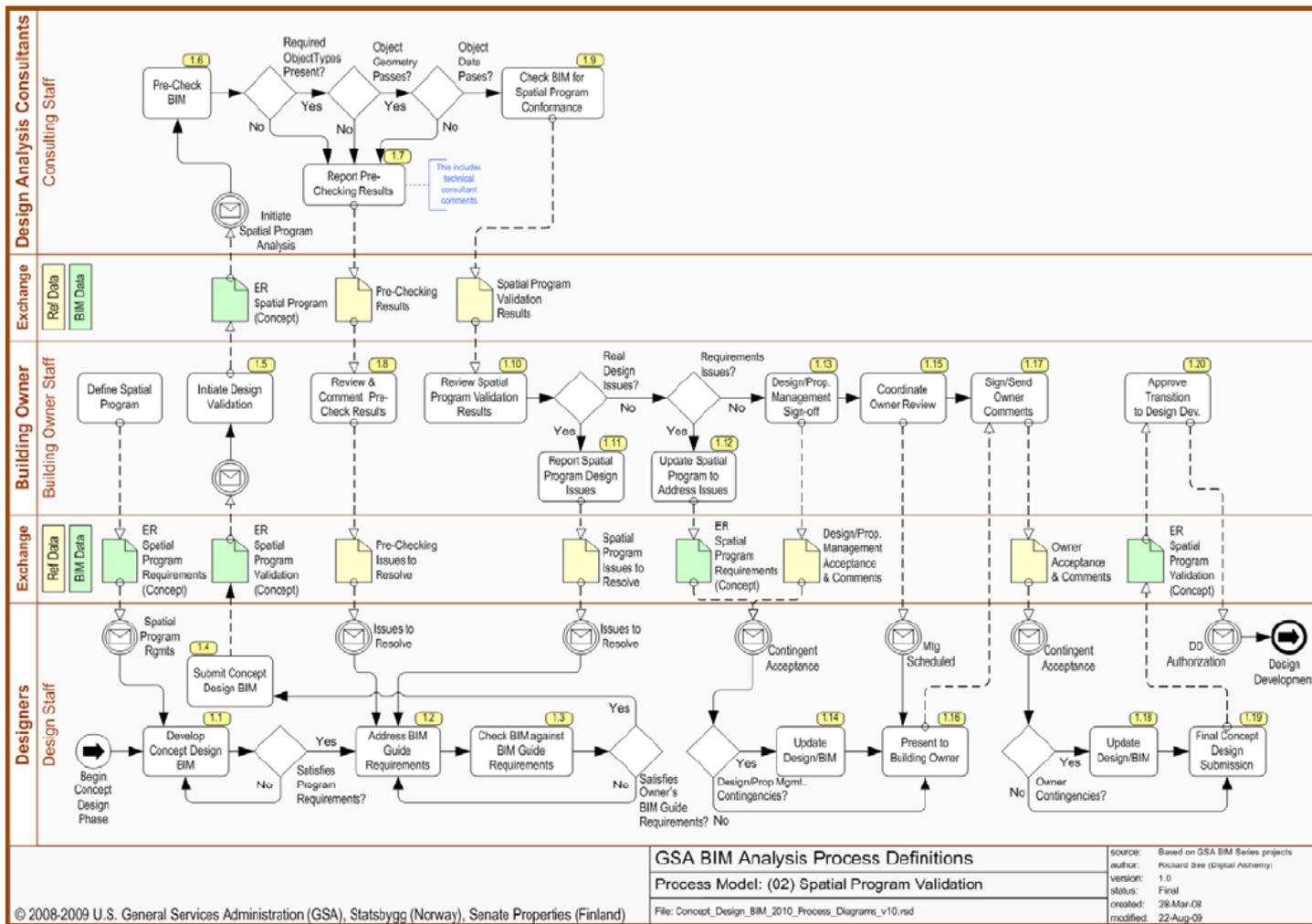
Way to define additional space function, using zone and P-sets

人動線・セキュリティ分析に必要なBIMモデル情報をIFCへ設定する際の仕様検討資料の例

# IDM・MVDによるBIMデータ連携プロセス仕様記述



## Concept Design Phase Spatial Program Validation



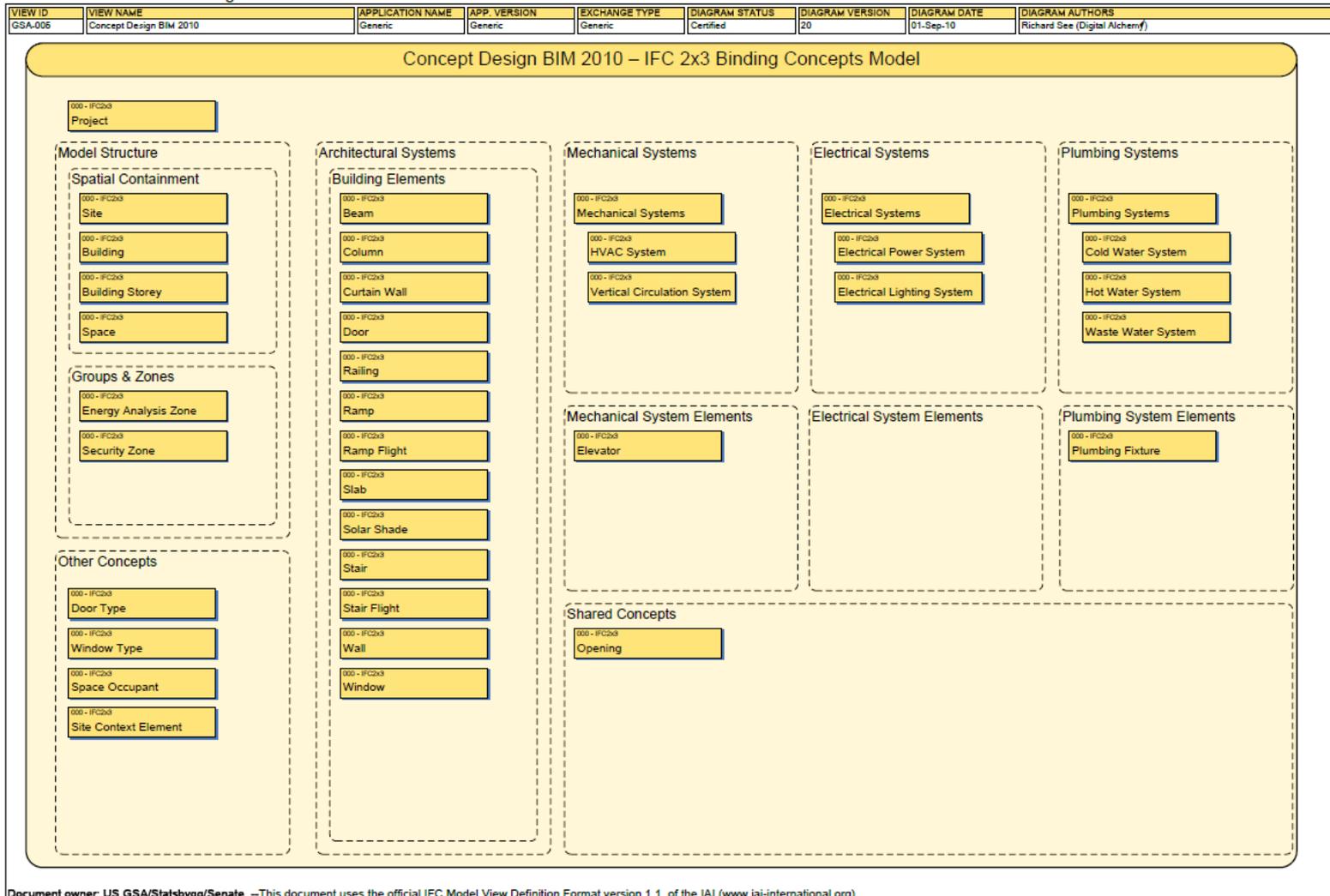
IDMに含まれるプロセスモデル図 (Concept Design Phase) : 空間計画検証

資料: IDM Exchange Requirement: ER\_Spatial\_Program\_Validation\_(concept)

# IDM・MVDによるBIMデータ連携プロセス仕様記述



IFC Model View Definition Diagram : MVD Overview IFC2x3



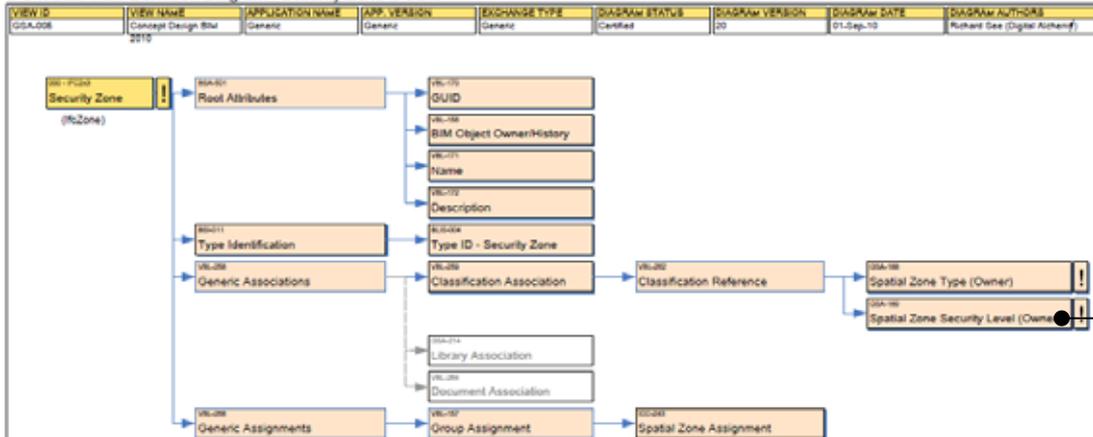
Concept Design BIM 2010で要求されるBIMデータ連携仕様をMVD形式で表現

資料:MVD, Concept Design BIM 2010-IFC2x3 Binding Concepts Model, buildingSMART (IAI)

# IDM・MVDによるBIMデータ連携プロセス仕様記述



IFC Model View Definition Diagram : Security Zone IFC2x3



MVDダイアグラム  
BIMモデルの属性仕様の構成を中立に表現

Concept Binding (IFC2x3)  
Spatial Zone Security Level (Owner)

**Summary**  
An owner defined security level classification for the spatial zone.

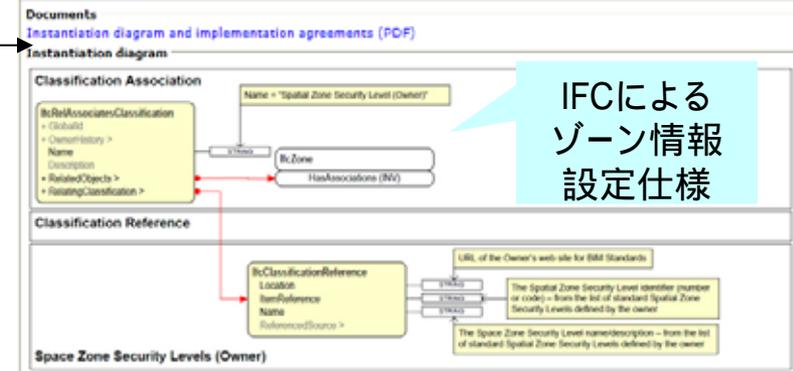
Reference	GSA-189	Version	1	Status	Draft
-----------	---------	---------	---	--------	-------

**Relationships**  
Hierarchy  
Generic Associations  
Provides binding for the generic concept Spatial Zone Security Level (Owner)

**History**  
-

**Authors**  
Richard See

**Editor**  
US General Services Administration



IFCによる  
ゾーン情報  
設定仕様

Document owner: US GSA/Statsbygg/Senate -- This document uses the official IFC Model View Definition Format version 1.1, of the IAI (www.iai-international.org).

Concept Design BIM 2010で要求されるBIMデータ連携仕様  
空間ゾーンの属性情報定義

**Implementation agreements**

**IfcRelAssociatesClassification**

Attribute	Implementation agreements
GlobalId	Providing a GUID is mandatory, but the GUID is allowed to change.
OwnerHistory	Providing an OwnerHistory is mandatory, but it is allowed to use dummy data.
Name	STRING = "Spatial Zone Security Level (Owner)"
Description	Not required.
RelatedObjects	Must be an IfcZone where the "ObjectType" attribute is set to "SpatialZone".
RelatingClassification	Must be IfcClassificationReference.

**IfcClassificationReference**

Attribute	Implementation agreements
Location	STRING = The URL of the Owner's web site for BIM Standards.
ItemReference	STRING = The Spatial Zone Security Level identifier (number or code) -- from the list of standard Spatial Zone Security Levels defined by the Owner. Example: A US government agency's Spatial Zone Security Level for "IT Staff only" might be: Secure-3
Name	STRING = The Spatial Zone Security Level description -- from the list of standard Spatial Zone Security Levels defined by the Owner. Example: A US government agency's Spatial Zone Security Level description for "Secure-3" might be: Staff with security clearance level 3.
ReferencedSource	Not currently required by this concept --- but anticipated in the future --- when owner BIM requirements are more commonly posted to web sites.

# 発注者によるBIM要求の動向



- アメリカ
  - GSA(連邦調達庁): 2007年度予算のプロジェクトからBIM要求・FMフェーズへのデータ活用
  - USCG(沿岸警備隊)・USACE(陸軍工兵隊)・NASA等が同様な動き
- デンマーク
  - 公共工事分野
  - 2007年1月からBIMを要求
- フィンランド
  - 大手不動産管理Senate Properties社
  - 2007年10月からBIMを要求
- ノルウェー(建設局)
  - 建築確認分野(ゾーニング計画審査)にIFCとGIS活用を展開中
  - オスロ美術博物館でBIMによるコンペを実施(最終選考が2010年9月に発表)
- ドイツ
  - バーバリア州政府の公共工事へのBIM実証実験(2002年)
  - ドイツ連邦政府レベルでのBIM活用が計画中
- シンガポール(建設局)
  - 2002年に建築確認の完全電子化(紙から電子データ)
  - IFCによる自動建築確認Webポータル(e-PlanCheck)展開を準備中
- 韓国
  - 2008年より、国家プロジェクトとしてBIMを活用
  - 2010年春、BIMガイドライン初版を発行
- オーストラリア
  - シドニーオペラハウスFMプロジェクトでBIMを活用
  - クイーンズランド州の公共建築プロジェクトでBIM活用が増加
- 中東
  - 近年BIM活用のプロジェクトが増加
  - ヨーロッパ・アジアの設計・建設会社・関連IT企業が参入。

# 発注者によるオープンBIM宣言



- 公共建築発注者による、オープンな標準を活用したBIMプロジェクト推進のための宣言
- BIMガイドライン、発注者BIM活用の戦略の共有
- IFC (Industry Foundation Classes) ・IFD (International Framework for Dictionaries) ・IDM (Information Delivery Manual) ・MVD (Model View Definition) などの標準活用へのコミットメント
- 下記の組織が署名
  - GSA (General Services Administration: 米国連邦調達庁)
  - DECA (Danish Enterprise and Construction Authority: デンマーク)
  - Senate Properties (フィンランド)
  - STATSBYGG (ノルウェー)

Washington, DC  
January 17, 2008

## Public Statement

### STATEMENT OF INTENTION TO SUPPORT BUILDING INFORMATION MODELING WITH OPEN STANDARDS

#### Background

Government clients of the AEC/FM (Architecture, Engineering, Construction, and Facilities Management) sector have an interest in the continuous advancement of productivity, efficiency, and quality in the AEC/FM industry, leading to a better built environment for end users, clients, and stakeholders.

We believe that sharing AEC/FM-related information throughout the life cycle (scoping, planning, design, tendering, procurement, construction, operation, maintenance, refurbishment, and disposal) of capital facilities globally and across all disciplines and technical applications, is key to achieving this goal.

It is of common interest to real estate agencies and public owners to support the development and implementation of open communication standards for our sector and to facilitate the utilization of information technologies based on these open standards, to create the best possibilities for the exchange of relevant information and efficient collaboration between AEC/FM stakeholders.

Open Building Information Modeling (BIM) object-oriented standards are an important aspect of this strategy, enabling the exchange of interoperable digital data supporting different representations of the building processes and the built environment in which they reside. This digital representation may include 3D geometry, 4D phasing (3D space + time), 5D costing (4D + cost), as well as spatial information, geographic information, and properties of building components and elements.

Industry Foundation Classes (IFCs) from the International Alliance for Interoperability (IAI) are recognized as a leading example of an open, freely-available, BIM standard specification for sharing data throughout the life cycle across multiple professional disciplines and technical applications in the AEC/FM sector.

#### Signatory 1:

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#### Signatory 3:

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#### Signatory 4:

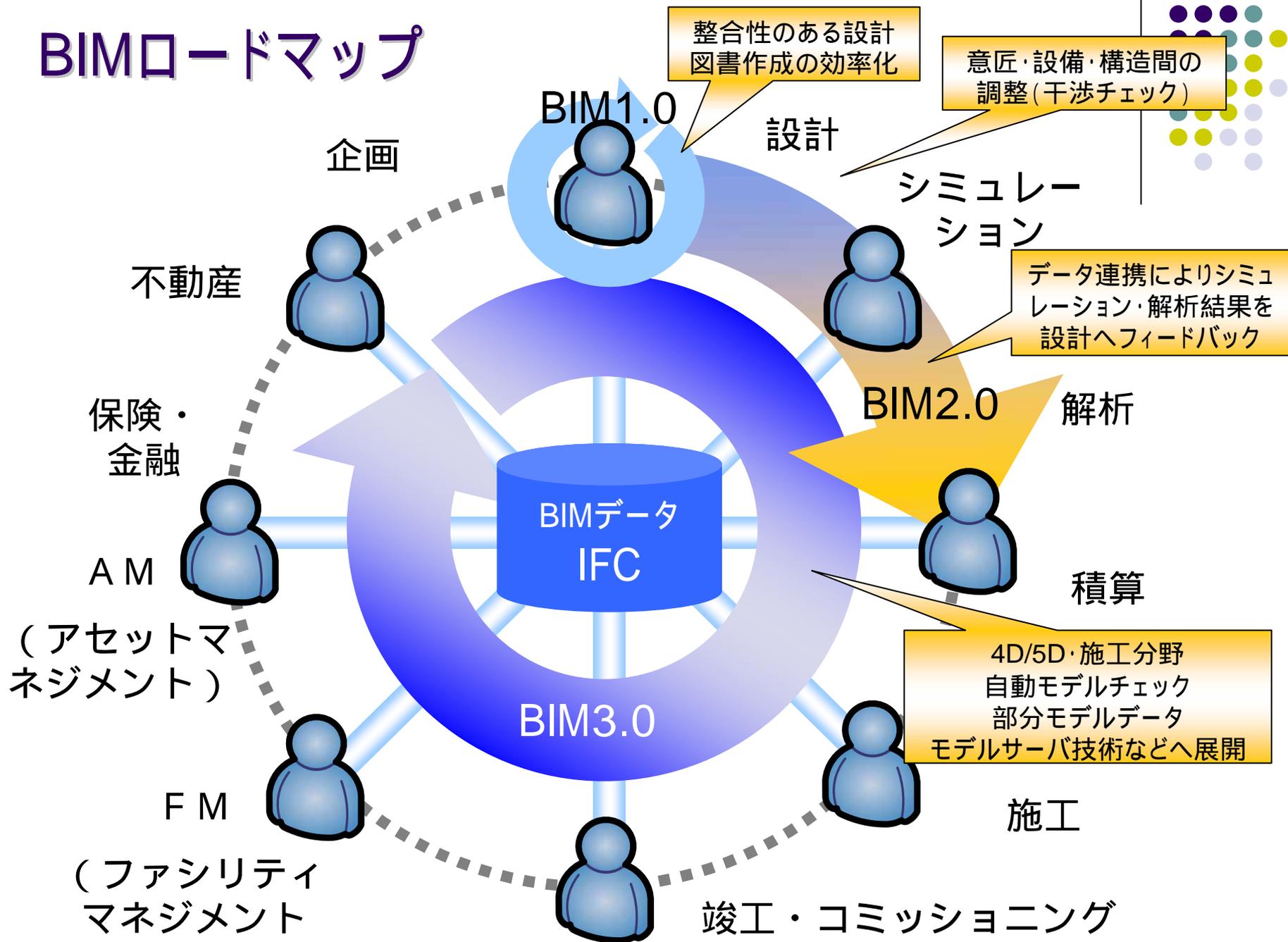
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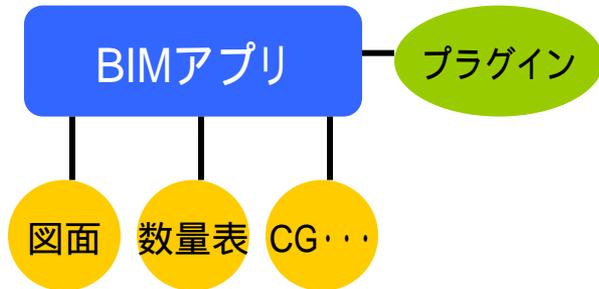
# BIMロードマップ



# BIMロードマップ



## BIM1.0

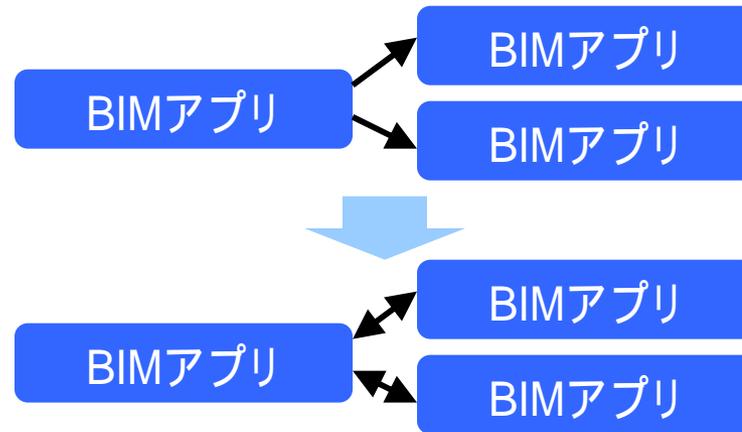


シングルアプリケーション上でのモデリング

整合性のある設計図書作成の効率化  
プラグインの活用によるシミュレーションの実施

BIM1.0効率化のための部品ライブラリ・モデルガイドラインの充実

## BIM2.0



一方通行BIMデータ連携

双方向BIMデータ連携

企業内BIMデータ連携

企業間BIMデータ連携

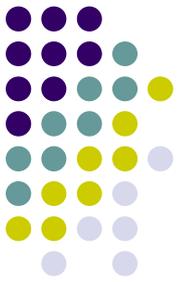
BIMデータ連携ガイドライン・契約・組織化・BIMマネジメントなど社会工学的アプローチが必須

# IAI日本:BIMガイドラインの調査活動



地域	組織	ガイドライン
米国	GSA	GSA BIM Guide Series
		01 Overview
		02 Spatial Program Validation
		02 Appendices
		03 3D Imaging
		04 4D Phasing
05 Energy Performance		
米国	Wisconsin州	BIM Guideline and Standard for Architects & Engineers
米国	Penn St. Univ.	BIM Project Execution Planning Guide
米国	ASHRAE	An Introduction to BIM
米国	NIBS	NBIMS (National BIM Standard)
フィンランド	Senate Properties	BIM Requirements 2007
		Volume 1: General part
		Volume 2: Modeling of the starting situation
		Volume 3: Architectural Design
		Volume 4: MEP design
		Volume 5: Structural design
		Volume 6: Quality assurance and merging of models
		Volume 7: Quantity take-off
		Volume 8: Using models for visualization
Volume 9: Use of models in MEP analysis		
デンマーク	bips	3D Working Method 2006
		3D CAD Manual 2006
		Layer and Object Structures 2006
ノルウェー	Statsbygg	BIM Manual 1.1
ノルウェー	Statsbygg	Appendix 5 6 Digital 3D model and BIM requirements
オーストラリア	CRC	National Guidelines for Digital Modeling
韓国	MLTM	BIM Application Guide
シンガポール	BCA	BIM Regulatory Submission Pilot Guideline

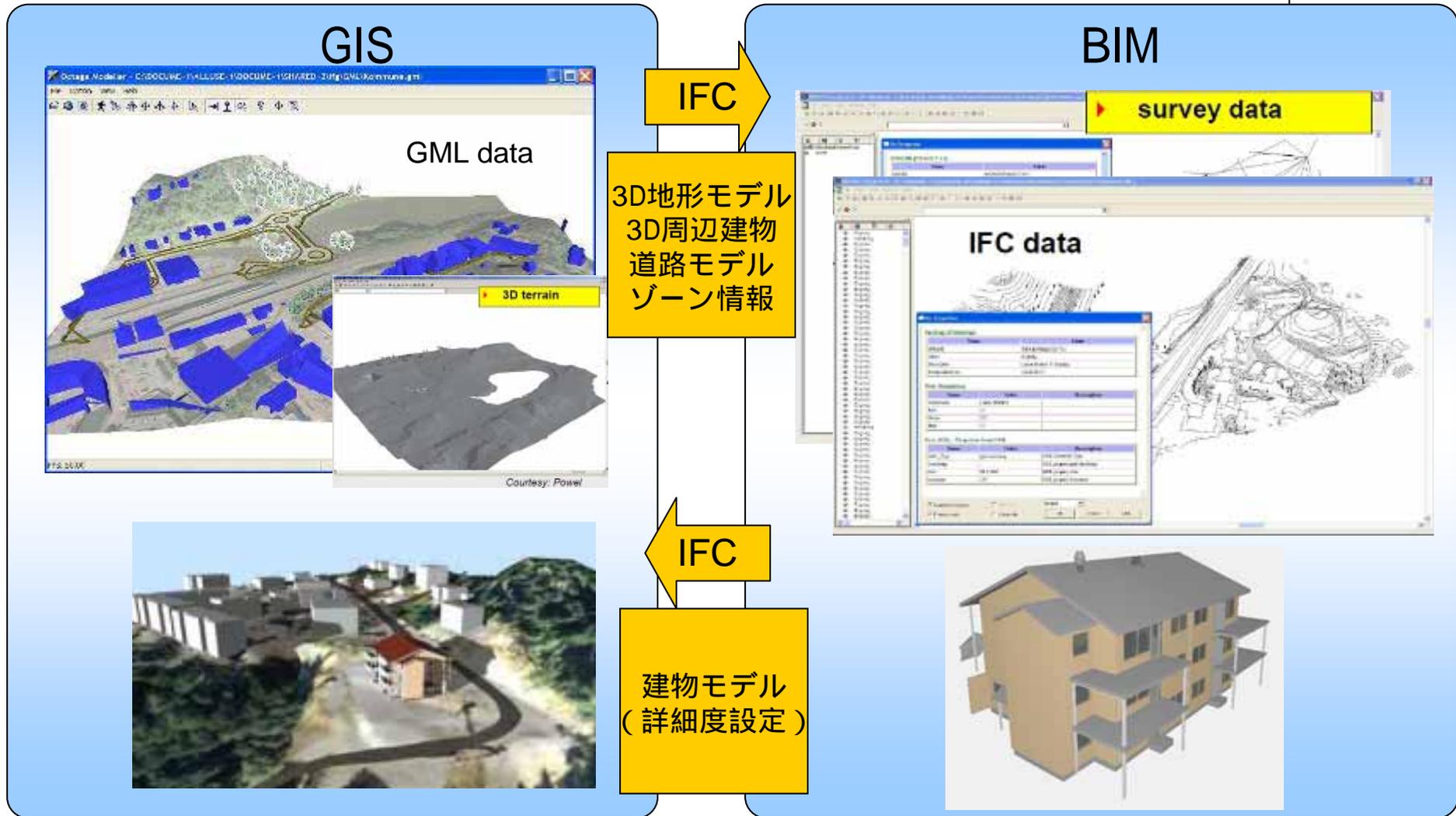
参考:IAI日本 BIMガイドラインWG資料から



## GISとBIMの連携

地理情報システム (Geographic Information System) & BIM

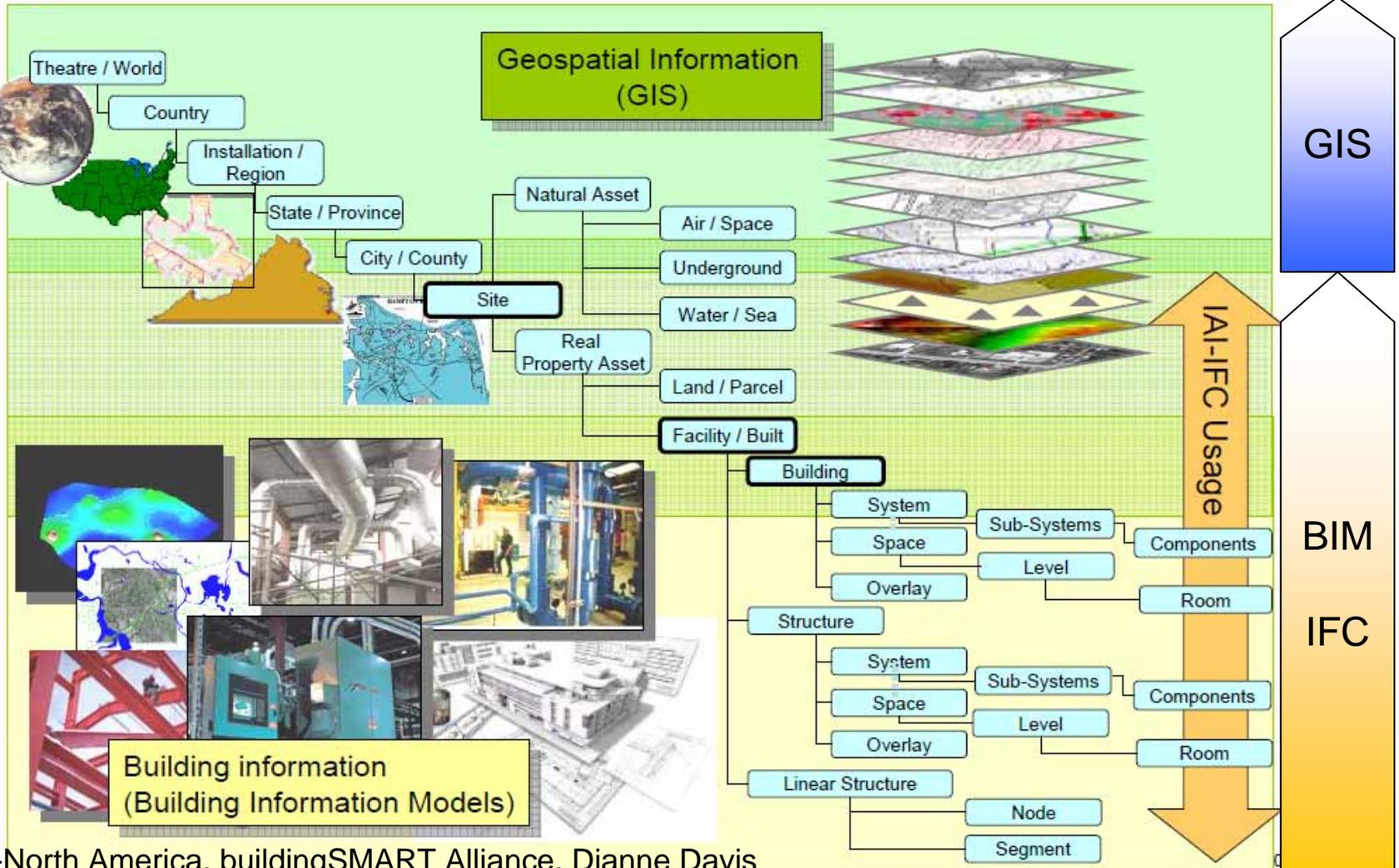
# GISとBIMのデータ連携の仕組み



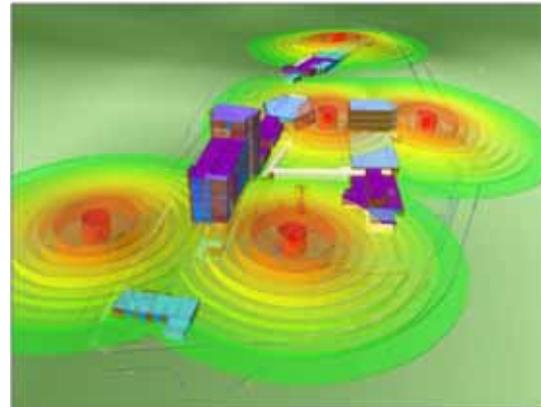
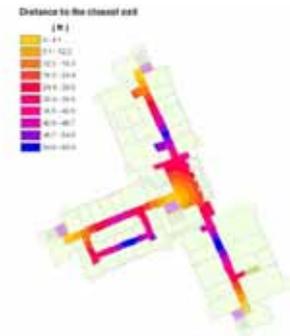
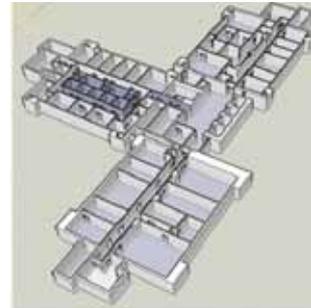
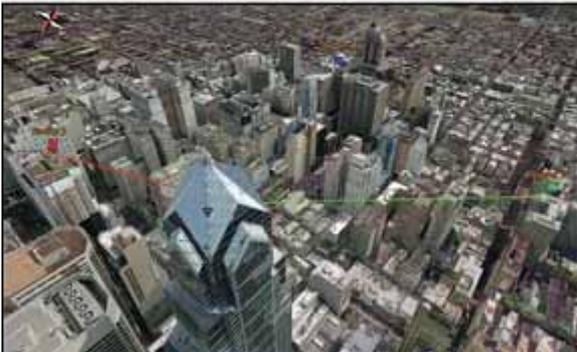
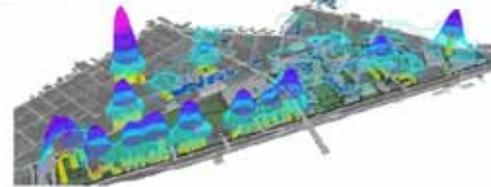
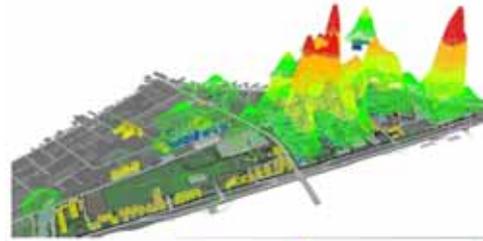
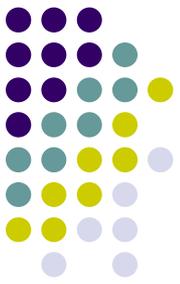
# 地理情報とBIMデータ統合



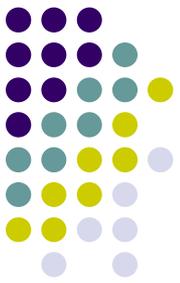
## Hierarchical Information Relationships



# GISとBIMデータ連携による可視化



参照: Journal of BIM, 2010 Fall, buildingSMART Alliance  
参照: Geographic Information Systems (GIS) for Facility Management, IFMA



# AR (拡張現実)技術とBIM

VTT フィンランド技術研究所  
建設分野へのAR活用プロジェクトの紹介

# AR（拡張現実）とは



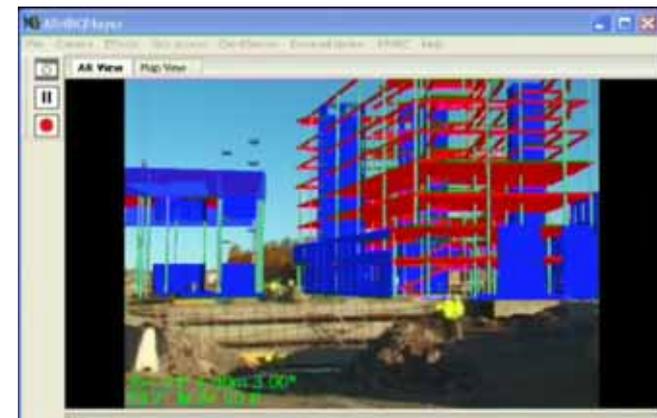
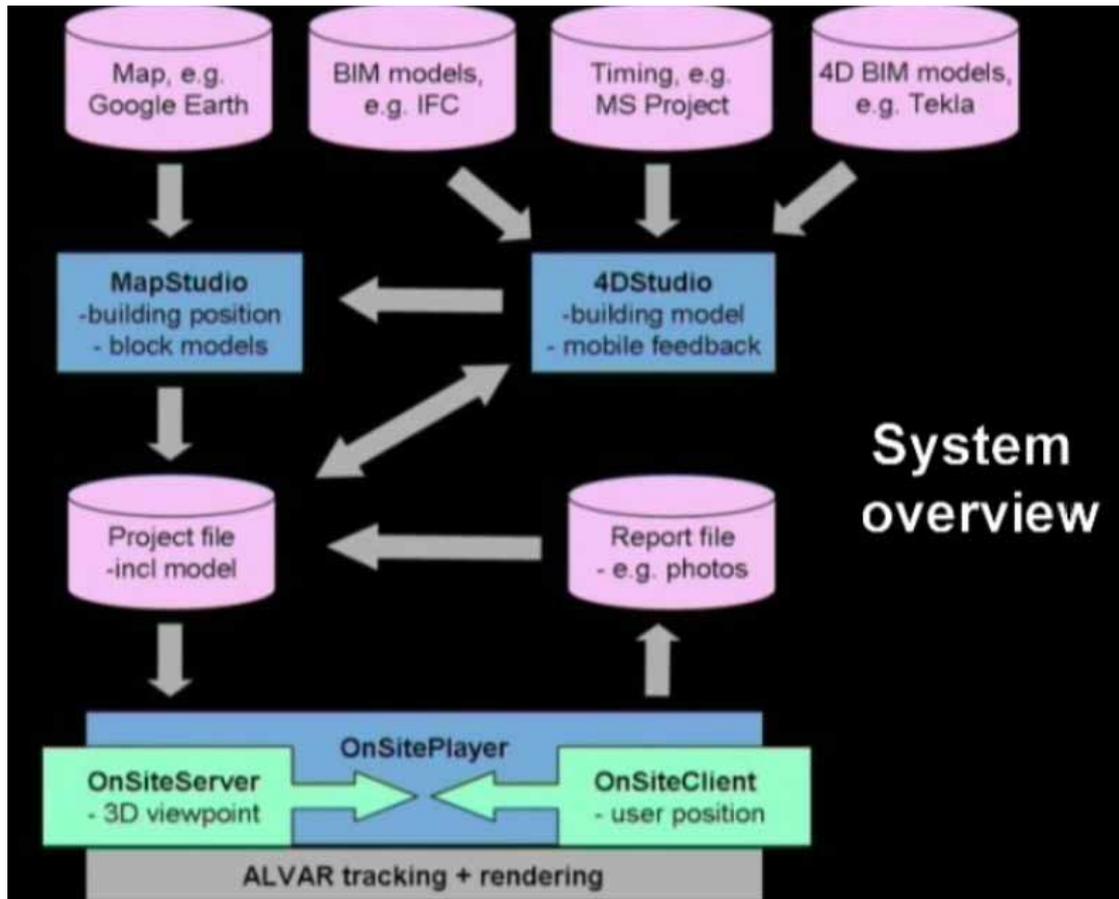
- Augmented Realityとは「拡張現実」
  - 現実環境の一部に付加情報としてバーチャルな物体・文字情報等を電子情報として合成提示
  - 例：iPhoneのセカイカメラ：モバイル機器のカメラ・GPS（位置情報）機能を活用して、写している場所・対象（建物・看板）などに関連する付加情報をエアタグとして表示するアプリ。
- AR4BCプロジェクト (AR for Building & Construction)
  - フィンランドVTT研究所の研究チームが開発したARシステム。
  - BIMモデルをARで扱えるようにして、設計レビュー・建設現場・維持管理で活用する実証実験を進めている。



# AR4BC：施工フェーズでのBIM活用



- 工事現場において、ARによってBIMの4D情報を活用
- 現場における設計変更・仕上がりチェック等を効率化





# おわり

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