

# Passer au BIM : formez-vous !

Découvrez les métiers du BIM, les compétences liées et l'offre de formation actuelle

**Vers un référentiel de compétences BIM européen**

S. Kubicki, LIST & A. Bradley, Cardiff University

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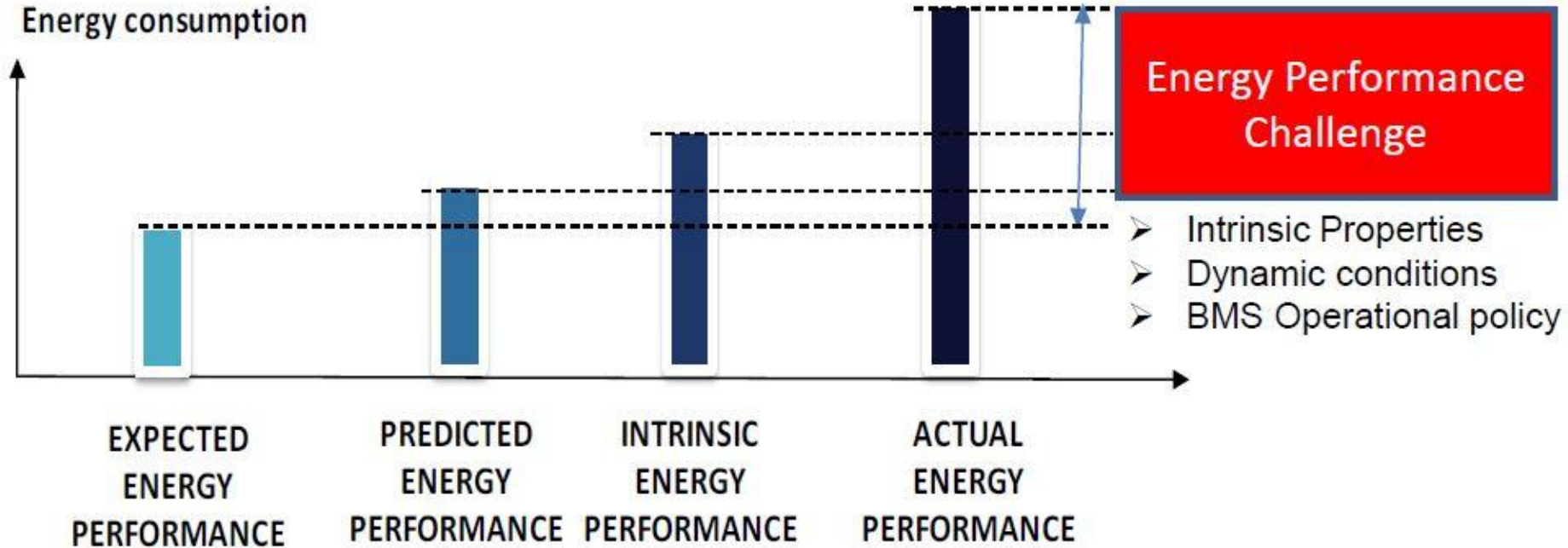
- 09.30 - 10.00 Accueil
- 10.00 - 10.10 Introduction, **A. Guerriero, LIST**
- 10.10 - 10.40 BuildingSmart professional certification program, **D. Rossiter, Building Research Establishment (BRE)**
- 10.40 - 11.00 Vers un référentiel de compétences BIM européen, **S. Kubicki, LIST & A. Bradley, Cardiff University**
- 11.00 - 11.20 Un retour d'expérience au Luxembourg, **D.Zignale, BIMConsult**
- 11.20 - 11.40 BIM4VET, un outil pour sélectionner des formations BIM, **A. Guerriero & N. Mack, LIST ; J-P. Poli, CEA**
- 11.40 - 12-00 Une démarche sectorielle pour la formation BIM au Luxembourg, **M. Viola, CRTI-B**
- 12.00 - 12.15 Conclusion, **S. Kubicki, LIST**
- 12.15 - 14.00+ Walking lunch et visite des stands

- Introduction
- BIM : Définitions et état des pratiques
- Profils et responsabilités pour la mise en oeuvre du BIM
- Vers l'évaluation de la maturité des compétences
- Présentation de l'outil









# INTRODUCTION

## “Improving the human capital basis

[in construction]” EC Report, April 2017

- « L’innovation et de nouvelles réglementations influencent le développement du secteur » (p5)
- La demande en compétences s’articulent autour de :
  - **L’efficacité énergétique** : initiatives nationales Build-UP (qualifications et plateformes de formations)
  - Le **numérique et le BIM**: besoin de nouvelles méthodes et compétences
- ...À tous les niveaux de compétences



<http://www.buildup.eu/en/practices/publications/ecso-report-improving-human-capital-basis>

### Key takeaways

✓ The integration of BIM in the construction sector is being supported by national strategies with a knowledge-sharing and best-practice exchange component. Though not specifically training initiatives, these set the general framework for the creation of education and training, ultimately increasing the levels of BIM skills and knowledge among the workforce (e.g. Germany, the Netherlands, Denmark, Lithuania);

✓ In some countries, the digital skilling of the workforce can also be initiated explicitly at the public sector level (e.g. France and the UK) or through specific BIM trainings and learning resources offered by non-governmental institutions (e.g. Ireland, Spain, Latvia);

✓ Some Member States are also teaming up to define digital skill needs and create appropriate training programmes by participating in EU-funded projects (e.g. BIM4VET and BIM-TRAIN).



# INTRODUCTION



## Compétences digitales dans la construction

- Architecture, Engineering, Construction and Operation/Maintenance
- Cycle de vie du bâtiment
  - Multi **marchés** : logement neuf, rénovation, bureaux/tertiaire, industrie
- À différentes **échelles**
  - Bâtiments, Groupe de bâtiments... Quartier, Ville
- Pour toute la **chaîne de valeur**



# Building Information Modeling

## Définitions et états des pratiques

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Passez au BIM. Formez-vous!



**Pre-BIM** S. Kubicki - LIST - 2018

- Plans, métrés, cahiers de charges développés séparément
- Incohérences fréquentes
- Collaboration ad-hoc
- Echanges non rationalisés et non standardisés
- Investissements IT faibles
- DAO répandu
- PF de gestion de projets multiples & non standardisées



(Succar, 2008)

**Niveau de maturité 1**

**Modélisation orientée-objet** S. Kubicki - LIST - 2018

- Modèles mono-disciplinaires
- Automatisation de la génération des documents 2D ou 3D
- Interne : re-structuration de la production, charte de modélisation, templates
- Logiciels "BIM" Architecture, Structure, MEP

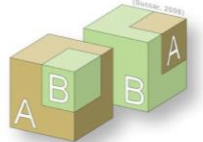


(Succar, 2008)

**Niveau de maturité 2**

**Collaboration orientée-modèle** S. Kubicki - LIST - 2018

- Modélisation "avancée" : contrôle des paramètres, y.c. données non géométriques - nDimensions 4D, 5D, envir.
- Processus d'échange formalisé
- Contrôle des données liées
- Effort de conception et prise de décisions en amont
- Format d'échange standard et/ou propriétaire
- Logiciels "interfaces au BIM" avec persistance des données




(Baker, 2006)

**Niveau de maturité 3**

**Intégration orientée-réseau** S. Kubicki - LIST - 2018

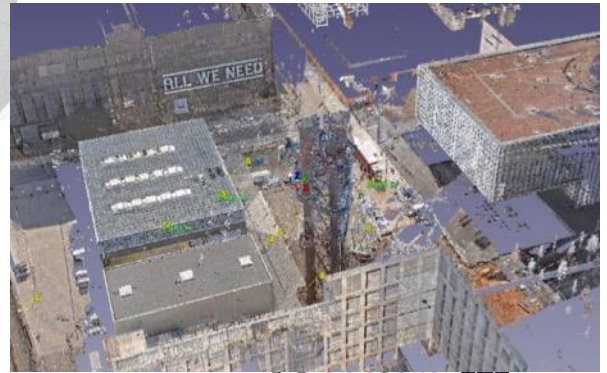
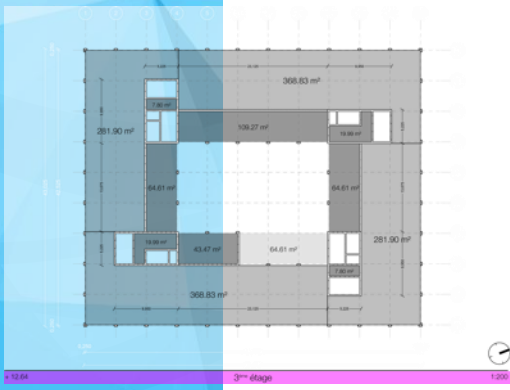
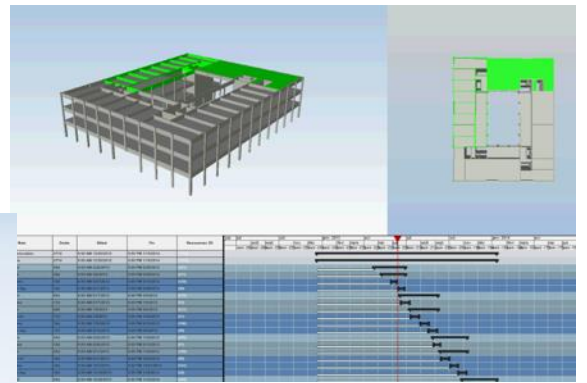
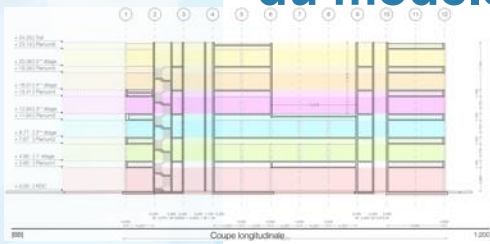
- Co-modélisation, multi-disciplinaire
- Echanges de données synchrone
- Recouvrement voire gommage des phases (IPD)
- Serveurs de modèles interopérables
- Données BIM+PM+FM centralisées ou réparties



(Baker, 2006)

# BUILDING INFORMATION MODEL(S)

## Activités de modélisation et développement du modèle d'information

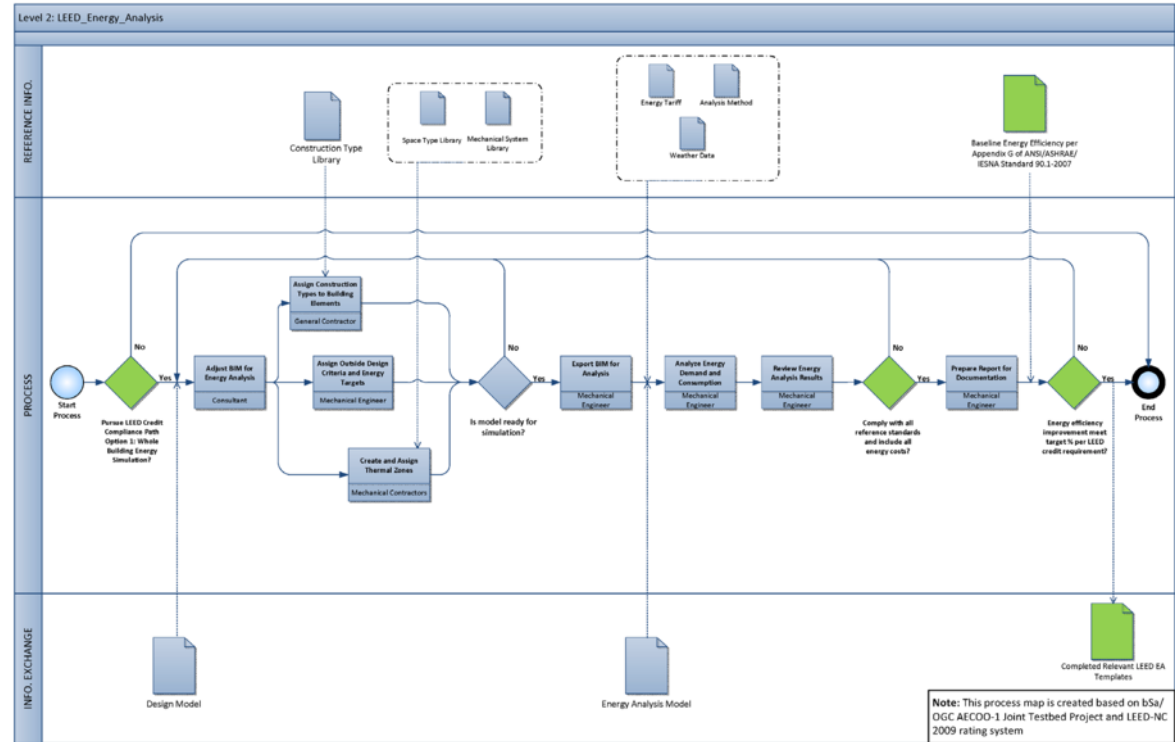


# BUILDING INFORMATION MODELING



## Processus de production de l'information

- Gestion des échanges d'information
  - Exigences (ex. Niveau de détails, données attendues)
  - Suivi
- Echelle
  - Organisation
  - Projet
- Implications contractuelles
  - Nouveaux rôles ?
  - Vs. Nouvelles missions ?

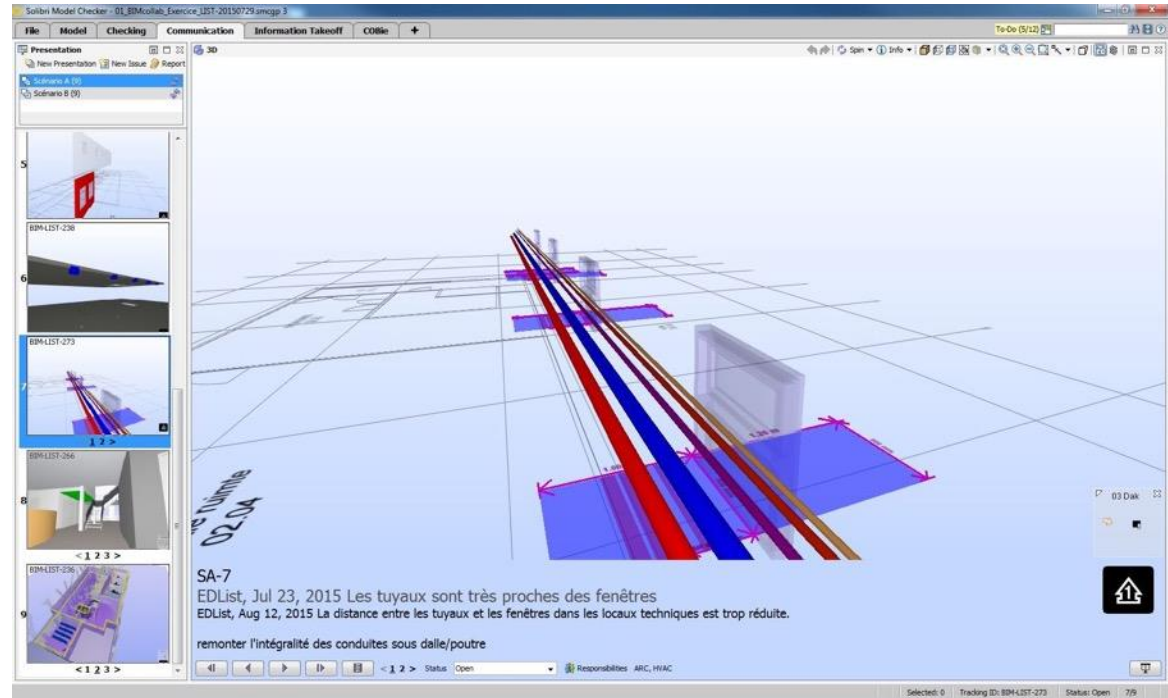


Integrated Process Mapping For bim Implementation In Green Building Project Delivery. Wu, W. & Issa, R. (2013). 13th International Conference on Construction Applications of Virtual Reality

# BUILDING MODELS AND INFORMATION COORDINATION



- Contrôle qualité
  - Export/import
  - Aggrégation
- Formats de fichiers
- Contenu modélisé
- Gestion des problèmes de coordination 3D



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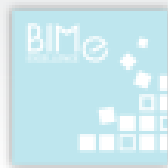


# Profils et responsabilités pour la mise en oeuvre du BIM

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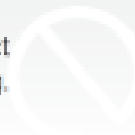


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### Operation Set

**Summary:** the daily, hands-on individual efforts required to deliver a project or part/aspect of a project. Operational competencies include designing, simulating and quantifying.



CODE	COMPETENCY TOPIC	DESCRIPTION
001	General Modelling	Using software tools to model project requirements and generate <b>Model-based Deliverables</b> across industries, information systems and knowledge domains
002	Capturing and Representing	Using software tools and specialized equipment to capture and represent physical spaces and environments
003	Planning and Designing	Using software tools for conceptualization, planning and design
004	Simulating and Quantifying	Using software tools to conduct various types of model-based simulations and estimations
005	Constructing and Fabricating	Using <b>BIModels</b> for the specific purposes of construction and fabrication
006	Operating and Maintaining	Using models to operate, manage and maintain a <b>Facility</b>
007	Monitoring and Controlling	Using models to monitor <b>Building Performance</b> or control its spaces, systems and equipment
008	Linking and Extending	Linking <b>BIModels</b> and their components to other databases
009	Custom Modelling	Using software tools to deliver a custom combination of <b>Model-based Deliverables</b> reflecting a variety of <b>Model Uses</b>

**Managerial Set**  
 Summary: the decision-making abilities which drive the set strategies and initiatives. Managerial competencies include and organizational management.

CODE	COMPETENCY TOPIC	DESCRIPTION
M01	General Management	Defining and communicating overall mission, vision, new systems and workflows
M02	Leadership	Leading and guiding others throughout the project lifecycle and systems and workflows
M03	Strategic Planning	Identifying strategic objectives and developing strategies
M04	Organizational Management	Identifying the organizational changes needed for monitoring and improving BIM Adoption
M05	Business Development and Client Management	Maximizing the value achieved by the organization through BIM tools and workflows
M06	Partnership and Alliances	Initiating partnerships and alliances with clients, suppliers and other stakeholders to deliver BIM Deliverables and workflows

**Administration Set**  
 Summary: the day-to-day organizational activities required to maintain strategic objectives. Administration competencies include and procurement, contract management, and human resource management.

CODE	COMPETENCY TOPIC	DESCRIPTION
A01	Administration, Policies and Procedures	Developing managerial initiatives into policies and procedures to facilitate the adoption of BIM tools and workflows
A02	Finance, Accounting and Budgeting	Planning, allocating and monitoring the financial resources of the organization
A03	Performance Management	Assessing organizational BIM capability/ performance using standard metrics and project performance using standard metrics
A04	Human Resource Management	Planning, developing and managing human resources to organizational BIM goals
A05	Marketing	Promoting an organization's BIM Capability to its stakeholders
A06	Tendering and Procurement	Developing the necessary specifications, requirements and procure BIM products and services
A07	Contract Management	Administering the contractual document and ensuring compliance with BIM Processes and workflows
A08	Risk Management	Managing the risks associated with using BIM tools and workflows
A09	Quality Management	Establishing, managing and controlling the quality of BIM Deliverables and other project Deliverables

technology and data and network

supporting staff in resolving issues related to the use of data, documents, 2D Drawings and BIM Hardware

Software Tools, facilitating relevant staff to work with software

Software Tools, productivity software or other software

Research and development activities in the construction industry, R&D competencies in industry engagement.

Research and development activities in the construction industry, R&D competencies in industry engagement.

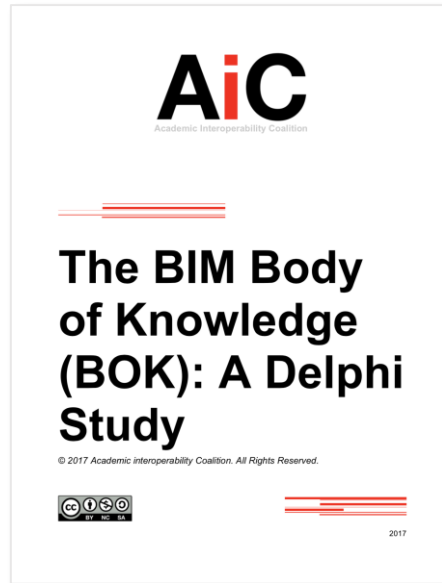
Research and development activities in the construction industry, R&D competencies in industry engagement.



# INITIATIVES INTERNATIONALES

## BIM BOK (Body Of Knowledge) – USA (1)

- © 2017 Academic interoperability Coalition
- 67 “Line of Knowledge” (+-compétences) relatives au BIM



<https://dcp.ufl.edu/dcp/uploads/sites/43/2017/06/BOK.pdf>



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# INITIATIVES INTERNATIONALES



## BIM BOK (Body Of Knowledge) – USA (2)

- Dimensions
  - Roles (métiers)
  - Niveau de performance (maturité de la compétence)
  - Type de connaissance (organisationnelle, relative au projet)
- Exercice de convergence
  - Etude Delphi 3 temps

a)

LOI: Plan It - BIM BOK Description	LOP: Entry Level						LOP: Middle Level						LOP: Full Performance					
	D/O	D/P	C/O	C/P	F/M/O	F/M/P	D/O	D/P	C/O	C/P	F/M/O	F/M/P	D/O	D/P	C/O	C/P	F/M/O	F/M/P
1 Organizational mission statement																		
2 BXP: Process mapping																		
3 BXP: Information exchange																		
4 BXP: Goals																		
5 BXP: BIM usage																		
6 BXP: Procurement strategy																		
7 ISO 15686-10: Life cycle functional performance																		
8 Infrastructure planning																		
9 Quality assurance effort																		
10 Business process mapping																		
11 Employer information requirements																		
12 Benchmarking practices																		
13 Security policy																		
14 Risk management																		

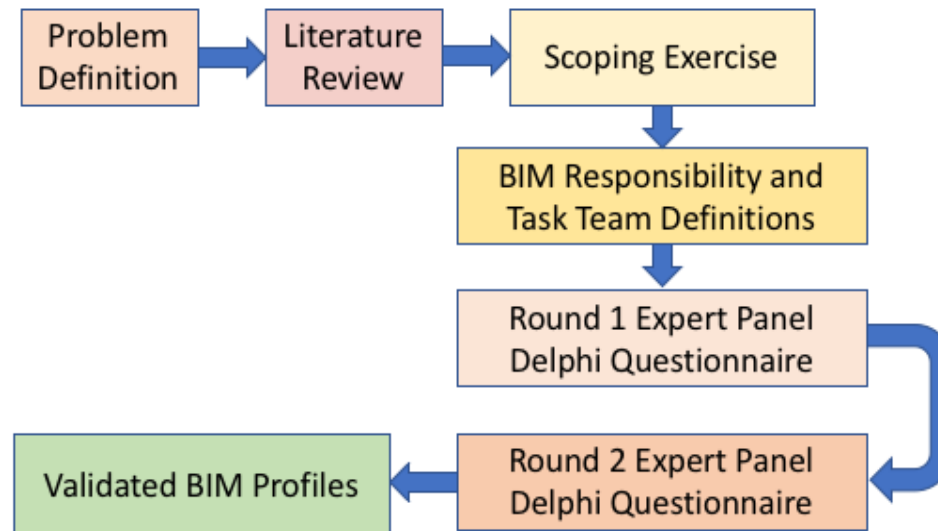
Roles of Users (ROU)	Designer			Contractor			Facility Manager/ Operator			Consultant/ Generalist		
	Entry Level	Mid Level	Full Performance	Entry Level	Mid Level	Full Performance	Entry Level	Mid Level	Full Performance	Entry Level	Mid Level	Full Performance
Levels of Performance (LOP)												
Types of Knowledge (TOK)	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project	Organizational Project
Levels of Implementation (LOI)	Plan It											
Coordinate It												
Manage It												
Do It												

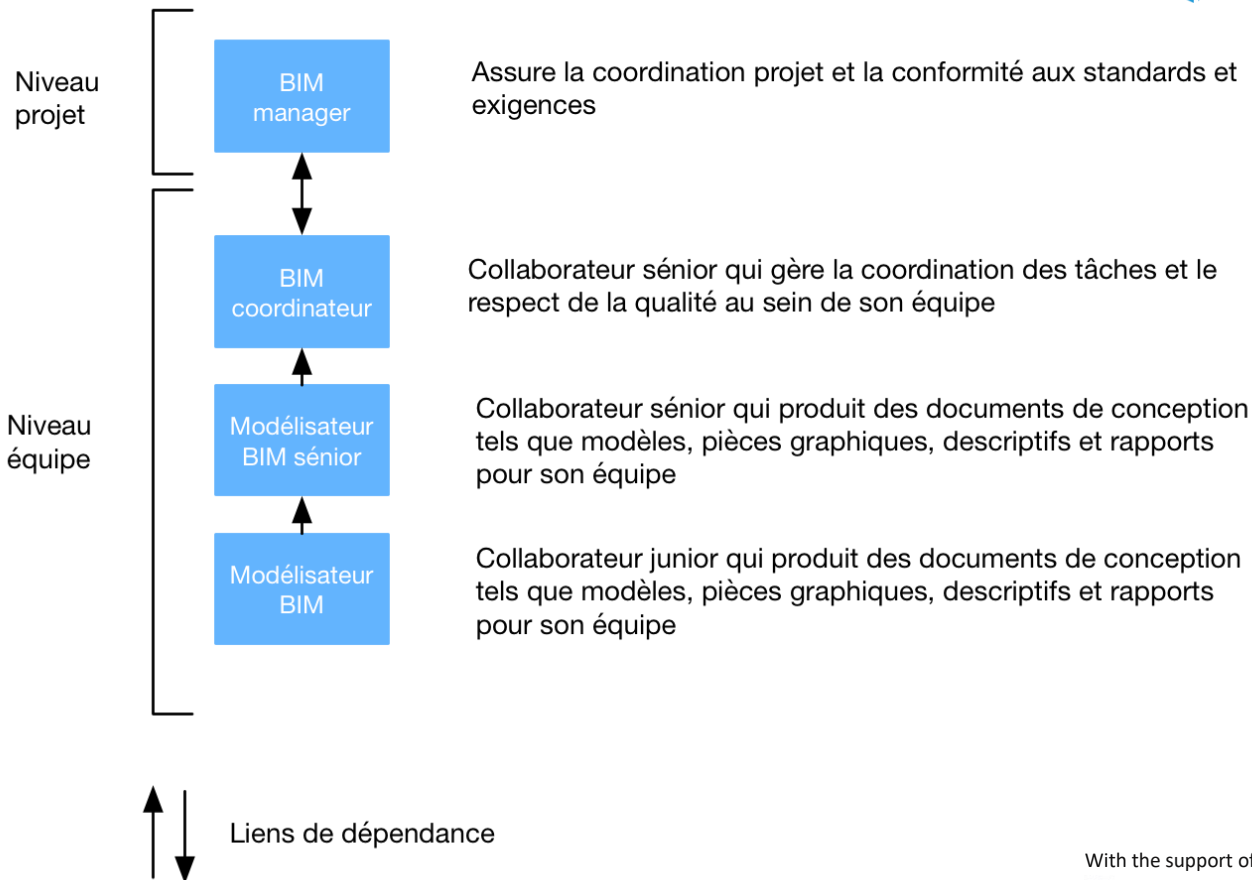
Figure 4. The Dimensionality of the BIM BOK Classification and Categorization.

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- Compétences BIM (BIMe) <> Rôles (BIM BOK)
- BIM4VET :
  - **Compétences BIM <> Responsabilités <> Profils BIM**





Profile A	<b>BIM author</b>
	<i>Junior staff who produces design output such as models, drawings, schedules and reports for their team</i>
<b>1</b>	Refer to the work done by other project team members
<b>2</b>	Develop & maintain Graphical and Non-graphical models against Project Standards
<b>3</b>	Prepare model for sharing with internal and external stakeholders
<b>4</b>	Produce project outputs from graphical and non-graphical models
<b>5</b>	Revise outputs to incorporate clash resolution - Maintain a continuous interface with the BIM Coordinator - Participate in coordination and BIM technology meetings
<b>6</b>	Reference of other shared models to ensure design coordination and clash avoidance.
<b>7</b>	Revise Outputs regarding QA/QC protocols
Profile B	<b>Senior BIM author</b>
	<i>Senior Staff member who produces design outputs as well as supervising junior members of staff within their team</i>
<b>2</b>	Develop & maintain Graphical and Non-graphical models against Project Standards
<b>4</b>	Produce project outputs from graphical and non-graphical models
<b>6</b>	Reference of other shared models to ensure design coordination and clash avoidance
<b>8</b>	Assist in Maintaining Project Standards
<b>9</b>	Address immediate software issues and support the upskilling of staff
<b>10</b>	Remain fully UP TO DATE with Industry good practice around the production and exchange of Information
<b>11</b>	Help maintain internal CAD standards and workflow by providing feedback to BIM coordinator

Profile C	<b>BIM coordinator</b>
	<i>Staff member who oversees co-ordination and standards compliance within their team</i>
12	Ensure compliance to project standards
13	Ensure compliance to corporate standards
14	Ensure compliance to relevant national and international standards
15	Coordinate the different BIM author's outputs to ensure the good quality and compliance of the model according to the BIM Project Execution Plan / BIM Protocol / client's requirements
16	Supervise Clash detection, reporting and resolution
9	Address immediate software issues and support the upskilling of staff
17	Ensure implementation of BIM software
Profile D	<b>BIM manager</b>
	<i>Staff member who ensures project co-ordination and standards compliance lead</i>
18	Define & maintain project standards
19	Agree software solutions to be implemented
20	Define project outputs, according to the clients requirement
21	Create & maintain a coordination programme for delivery
21	Ensure the implementation of a system to share project information
23	Lead BIM activities at project level
24	Assess project team capabilities to comply with project standards

# VALIDATION

## Evaluation via un groupe d'experts

- Questionnaire
  - Validation des **responsabilités**, et du lien avec les **profils**
  - Validation des **compétences associées**
- Delphi étape #1
  - 45 professionnels invités / 18 questionnaires reçus
- Delphi étape #2
  - 18 invitations / 13 questionnaires reçus



Senior Staff member who oversees co-ordination and standards compliance within their team			
EQF SCORE	6-7	Proposed Score if different?	1-7
Which of responsibilities are relevant to this role?		Which of these competencies are relevant to each responsibility?	
Ensure compliance to project standards	y	A09: Quality Management	Y/N
		I01: Implementation Fundamentals	Y/N
		<a href="#">Add extra competencies here</a>	
		<a href="#">Add extra competencies here</a>	
Ensure compliance to corporate standards	y	A09: Quality Management	Y/N
		I01: Implementation Fundamentals	Y/N
		I04: Standardization and Templates	Y/N
		<a href="#">Add extra competencies here</a>	
Ensure compliance to relevant national and international standards	y	A09: Quality Management	Y/N
		I01: Implementation Fundamentals	Y/N
		I04: Standardization and Templates	Y/N
		<a href="#">Add extra competencies here</a>	
Coordinate the different BIM Modeller/Technicians outputs to ensure the good quality and compliance of the model according to the BIM Project Execution Plan / BIM Protocol/client's requirements	y	A09: Quality Management	Y/N
		F02: Collaboration	Y/N
		F03: Facilitation	Y/N
		I041: Implementation Fundamentals	Y/N
Supervise Clash detection, reporting and resolution	y	A09: Quality Management	Y/N
		F04: Project Management	Y/N
		I01: Implementation Fundamentals	Y/N
		O04: Simulating and Fabricating	Y/N
Address immediate software issues and support the upskilling of staff	y	O08: Linking and Exporting	Y/N
		<a href="#">Add extra competencies here</a>	
		I05: Technical Training	Y/N
		R03: Teaching and Coaching	Y/N
Ensure implementation of BIM software	y	S04: Software Support	Y/N
		<a href="#">Add extra competencies here</a>	
		T01: General IT	Y/N
		T02: Software Systems	Y/N
<a href="#">Add extra responsibilities here</a>		A09: Quality Management	Y/N
		<a href="#">Add extra competencies here</a>	
		<a href="#">Add extra competencies here</a>	
		<a href="#">Add extra competencies here</a>	

Example questionnaire for a given profile

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# QUELS USAGES ?

## Profils/Responsabilités/Compétences

- Une structure pour la mise au point des cycles de formations BIM au Luxembourg
  - Public cible
  - Acquis de formation
- Un cadre pour qualifier l'offre de formation existante
- Un référentiel pour l'auto-évaluation

Responsabilités	Acquis de formation Après avoir suivi la formation la personne sera capable de...
Faire référence aux tâches réalisées par les collaborateurs de l'équipe projet	<b>008. Lien &amp; extension : Lier et étendre les modèles BIM et leurs composants à d'autres base de données</b> Lier aux modèles BIM des informations hors processus-BIM (ex. Lier les exigences du programme, extension aux données de FM) Respecter les workflows internes (production, validations et diffusion)
Développer et maintenir les modèles (maquettes géométriques, paramètres et informations lié(e)s) conformément aux standards des projets	<b>T04. Modélisation : Générer des modèles BIM basés sur des standards de modélisation et des protocoles prédéfinis</b> <b>T07. Gestion de modèle : Gérer et maintenir des modèles BIM générés en utilisant des processus, protocoles et spécifications standards</b> Lire un protocole (en particulier règles de modélisation et GID) Générer des modèles BIM respectant les règles de modélisation définies au niveau du projet - liées aux logiciels et charte qualité de modélisation interne, par ex. Bibliothèques d'objets, - spécifiées dans les protocoles (GID, point d'origine) Maintenir les modèles BIM en respectant le processus défini
Préparer les modèles pour le partage avec les collaborateurs en interne	<b>T04. Modélisation : Générer des modèles BIM basés sur des standards de modélisation et des protocoles prédéfinis</b> <b>T07. Gestion de modèle : Gérer et maintenir des modèles BIM générés en utilisant des processus, protocoles et spécifications standards</b> Utiliser une plateforme de partage interne (comme un fileservers, un serveur de maquettes interne, ou l'espace WIP du CDE) Respecter le découpage des tâches, la répartition des tâches au sein de l'équipe, les règles de partage internes, et formats spécifiques si nécessaire



# Vers l'évaluation de la maturité des compétences

**Alex Bradley (Cardiff University)**

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