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A Framework for Building Design Management in an Imperfect BIM Environment

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Abstract

Building design process is a wide spectrum activity, regarding its complexity. It begins by simple compartments structures till large multistory administrative buildings, involving various specialties. Complex design management, where a multidisciplinary team or teams are involved in the design process; requires high level of collaboration to reach the optimized client goals economically and on time. BIM provides a wide range support for such an activity, where the most critical criterion in design management is ensuring the appropriate flow of information between design partners. Each participant in the design process should receive relevant data or information in a complete form and on time. And consequently design participant should send and share their design outputs with relevant personnel. The perfect BIM environment requires that all participants within the design process are using BIM supporting software, and vice versa. Markets where BIM application is still in the growing phase some of the design participants adopt BIM while others don't. The main target of this paper is to propose a collaborative scheme to ensure information flow between design participants, using COBIE forms and XBIM toolkit; in the case where some of the participants in design process are not using BIM supporting software.

Keywords: BIM, COBie, XBIM Xplorer, design management

1. Introduction

Mostly in environments, where BIM culture is still growing some of the participants in the design process adopt BIM based software, as a platform for their work; while others don't. This situation handicaps both BIM based and non BIM based participants, due to lack of reliable information transfer schemes between the two groups of participants. This situation has arisen the need for a tool oriented to bridging the gap between BIM using and non BIM using design participants. This paper presents such a tool in the form of a frame work, defining main design process elements, associated with two supporting tools. COBIE has been used for information transfer, while the BIM toolkit for information verification.

2. COBie Forms

COBie had been early invented to transfer data from the design to the construction to the facility management processes. They consist of a number of fixed format spread sheets, summarizing projects information. Each COBie form deals with specific type of information. This paper presents COBie forms not only to fill in the missing node in data transfer chain between design, construction, and facility management; but also as a tool for bridging the gap between BIM and non-BIM users. COBie forms have been automatically generated using the COBie extension plugin, as shown in Figure 1. It is not a must to transfer all COBie sheets every exporting cycle. A selective approach is to be adopted, to decide which sheets are to be exported, according to data required for sharing.

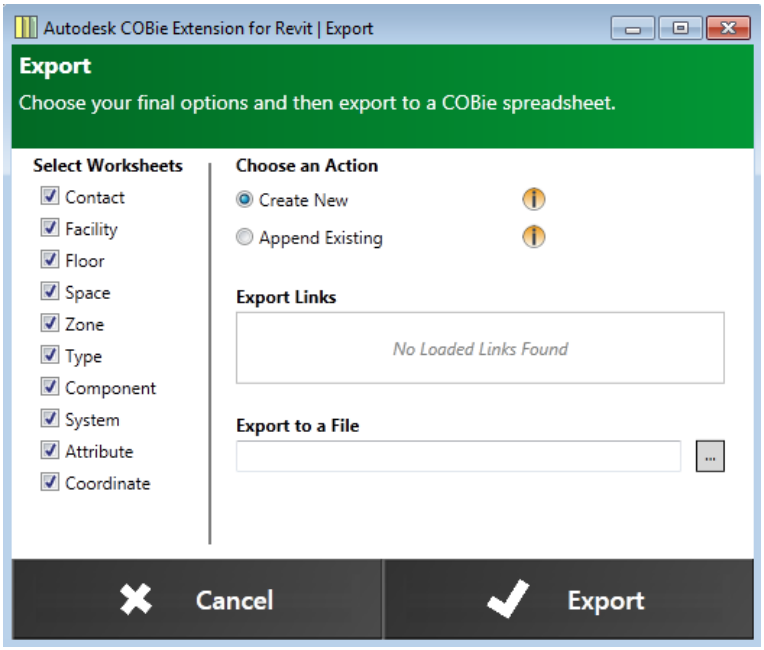

Figure 1. COBie extension plugin for revit

3. XBIM Xplorer

The XBIM Toolkit is an open source tool established to allow opening and rendering BIM models, in addition checking building model contents, to ensure all required fields are dragged into the model, defining various element's properties. It is compatible with IFC format and consequently able to support all software packages, prepared in accordance with IFC.XBIM Xplorer can't judge the quality of the BIM model contents. It just states whether the required fields are filled or empty. This nature of IFC clarifies its role in the imperfect BIM environment, where it allows human role to arise in managing to complete the BIM model. Figure 2 shows the XBIM Xplorer user interface, where information is represented in tabular and graphical forms.

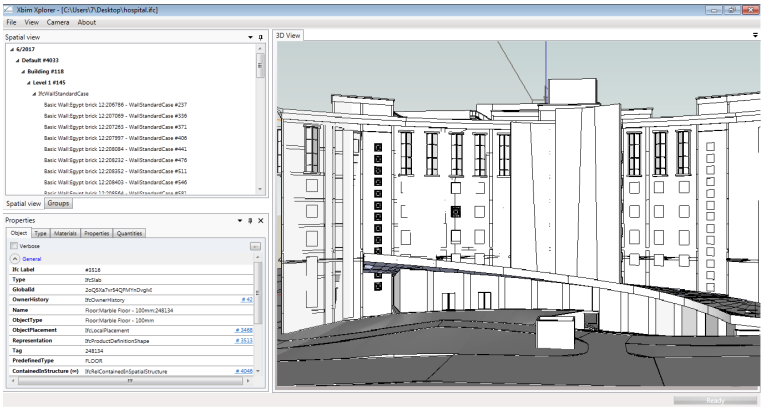

Figure 2. XBIM Xplorer user interface

4. Building Information History

Figure 3 shows patterns of building information history in case of BIM, Imperfect BIM, and non-BIM approaches. The perfect BIM environment ensures smooth flow of information throughout the design and construction processes. Once construction finishes a drop in processed data takes place, due to the use of COBie forms that keeps only essential information, required for facility management. On the other hand the non-BIM

based approach faces multiple data drops between different stages throughout the building life cycle. The imperfect BIM environment design represents a compromise between the perfect BIM and the non-BIM approaches. The imperfect BIM environment approach sustains a smooth flow of data between various stages along building life cycle, in the same pattern as perfect BIM approach; but conserving a lower amount of building information, because only some of the design parties are using BIM tools.

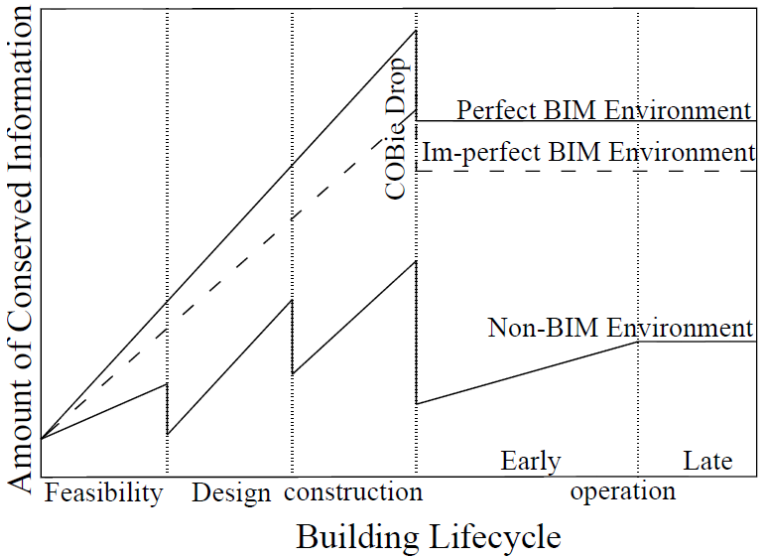

Figure 3. Building conserved information history

5. The Proposed Framework

The COBie forms in conjunction with XBIM Xplorerare considered complementary tools, used to ensure that the general BIM model is functioning efficiently. XBIM Xplorer is directly used in a frequent bases during the design to tune the process and validate the adequacy of model embedded data. While COBie is used for both documentation in a text form and assisting non-BIM participants to proceed in design activities.

Research body has been formulated as a flowchart, by which the implementation process is clarified. Each step in the flow chart is clearly formulated and inter-relationships between various steps are also presented. Figure 4 shows successive steps of the framework in the form of a flowchart.

6. Framework Implementation

Implementation of the proposed framework has been performed in a redesign process of a hospital project. The redesign was a client requirement to take into account some modifications, required for equipment installation. These modifications required re-assigning of spaces within different floors. Figures 5 to 16 show the reassigned floor spaces, in addition to isometrics and inter-plans relationships. Tables 1 up to 3 show data associated with the functional plans, in the form of COBie spread sheets; to complete the image for reassigned spaces for non-BIM participants.

A general goal throughout the design process, is to ensure all data required for each design activity are available to the responsible in a suitable form and on time. Some data may require verification, others need acceptance, while other data should be avoided. Disciplinary protocols should define for each discipline what type of data must be verified, or should be accepted, or could be avoided.

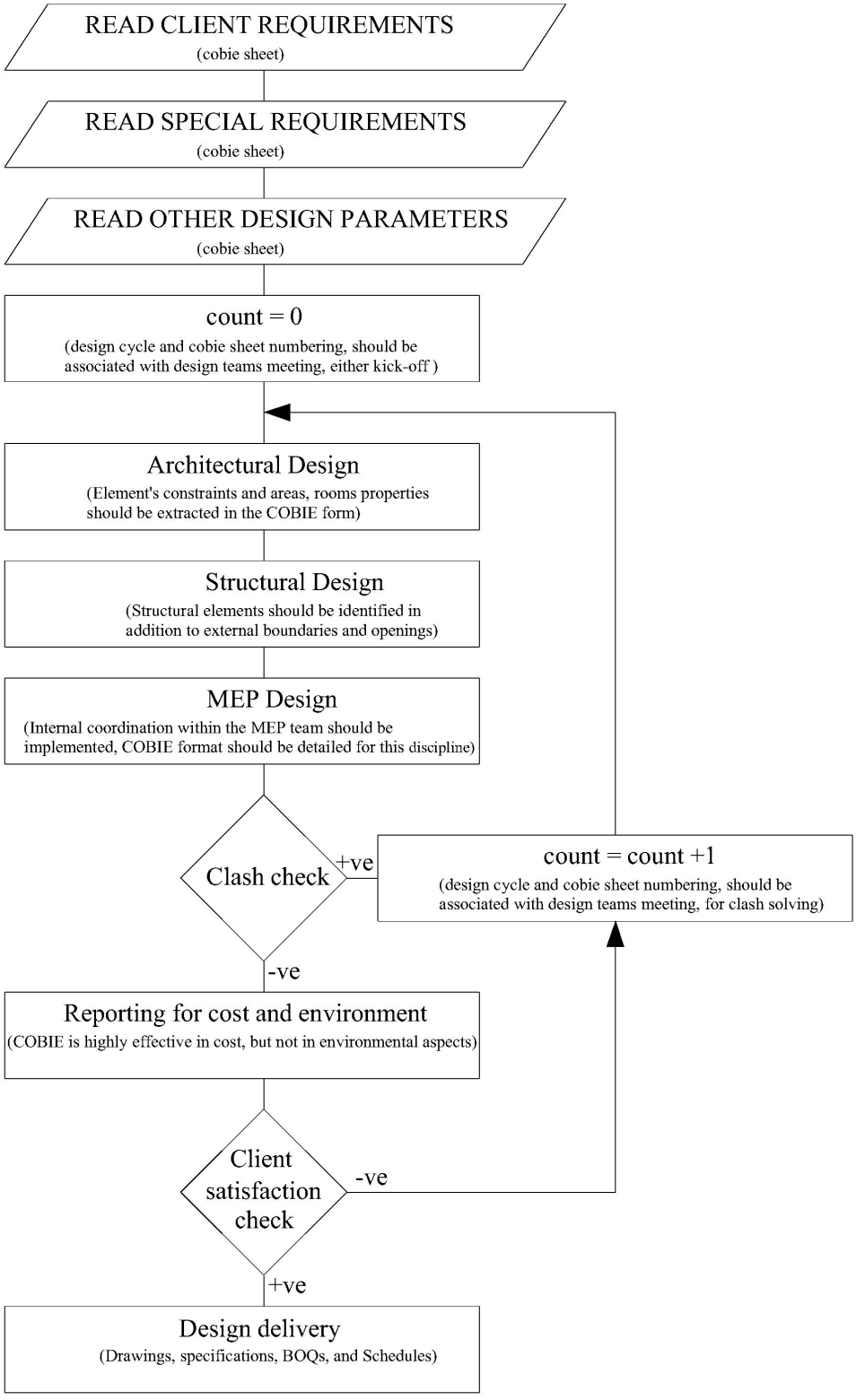

Figure 4. Proposed framework flowchart

Figure 5. Level [-2] Functional Plan

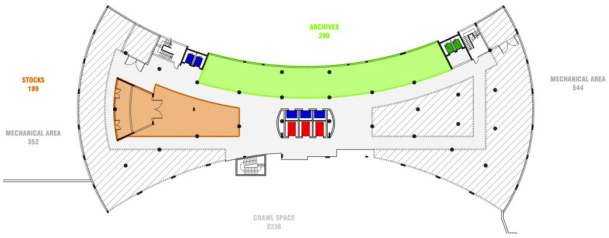

Figure 7. Level 00] Functional Plan

Figure 6. Level [-1] Functional Plan

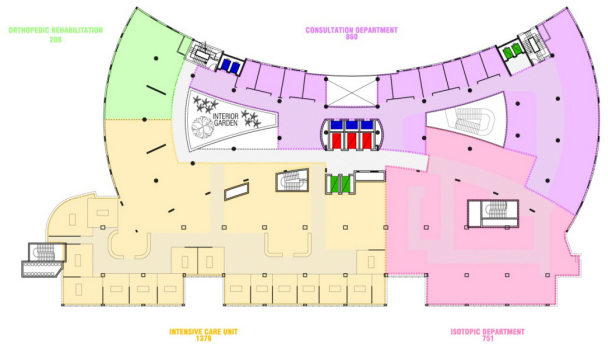

Figure 8. Level [01] Functional Plan

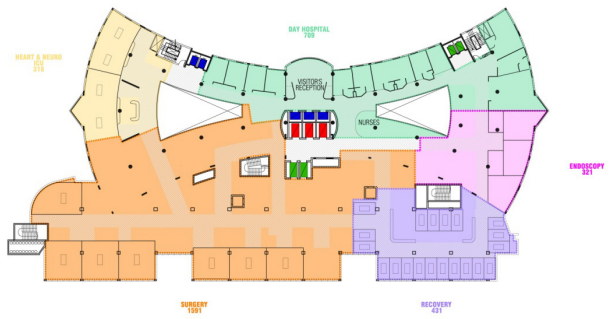

Figure 9. Level [02] Functional Plan

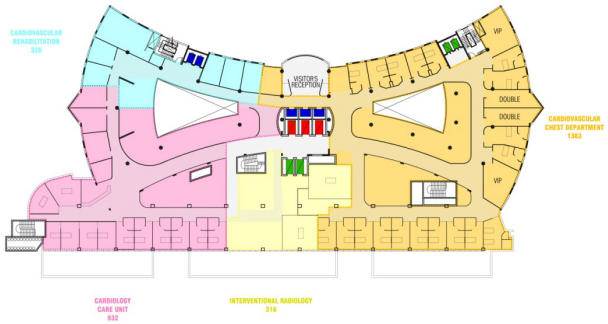

Figure 11. Level [04] Functional Plan

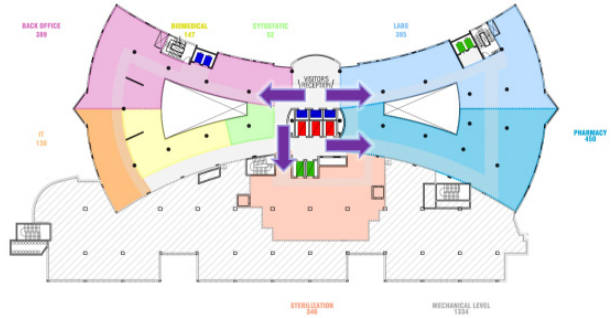

Figure 10. Level [03] Functional Plan

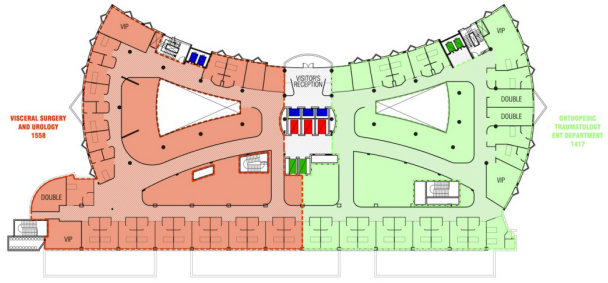

Figure 12. Level [05] Functional Plan

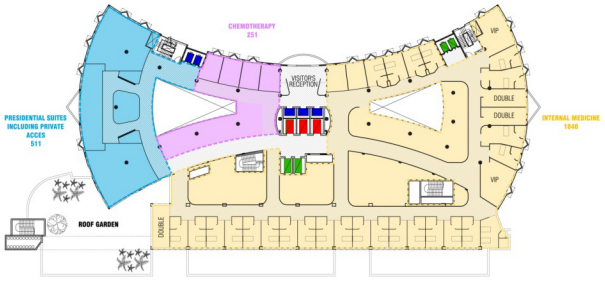

Figure 13. Level [06] Functional Plan

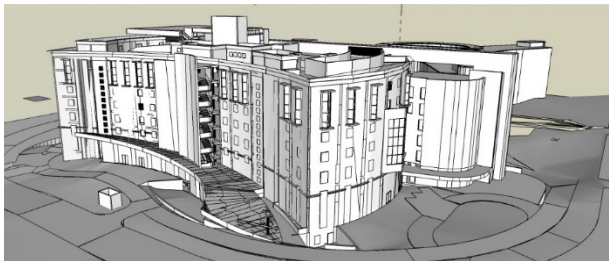

Figure 14. North-west Isometric

Figure 15. South-East Isometric

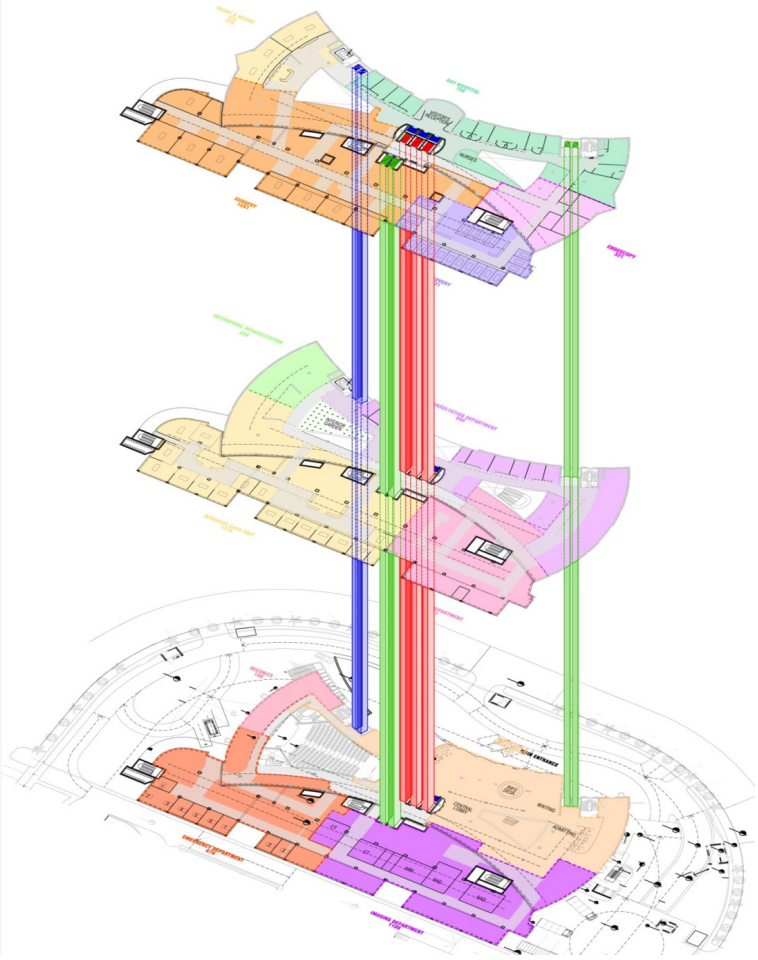

Figure 16. Multiple Plans Relations

Table 1. Contact spread sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Email	CreatedBy	CreatedOn	Category	Company	Phone	External System	External Object	External Identifier	Department	OrganizationCode	GivenName	FamilyName	Street	PostalBox	Town	StateRegion	PostalCode	Country
2	j.celnikier@celnikier-g	j.celnikier@celnikie	2009-01-19T12:27:24	Ar 01 : Architectural Design	Celnikier-Grabli	33140139923	Revit	Ifc	johnston@	Architectural	Ar	Jacob	Celnikier	4, rue Sair	n/a	Paris	Paris	75002	Fr
3	batiment@setec.fr	batiment@setec.fr	2009-01-20T09:46:33	Pm 01 : Project management	SETEC	33140046304	Revit	Ifc	johnston@	Management	Pm	Thomas	Bousteman	58, quai d	n/a	Paris	Paris	75583	Fr
4	contact@apor-amo.fr	contact@apor-amo	2009-02-15T16:03:03	Pr 01 : Programming	APOR	33149889038	Revit	Ifc	johnston@	Programming	Pr	Noelia	Bitar	66/72, rue	n/a	MONTREU	MONTREU	93558	Fr
5	abdelraouf kassem@y	abdelraouf kassem	2009-02-15T16:03:03	St 01 : Structural Consultations	EG consultants	1001202299	Revit	Ifc	johnston@	Structural	St	Abdelraouf	Kassem	292 Faisal	n/a	Giza	Giza	12521	EG
6																			

Table 2. Floor spread sheet

	A	B	C	D	E	F	G	H	I	J
1	Name	CreatedBy	CreatedOn	Category	ExtSystem	ExtObject	ExtIdentifier	Description	Elevation	Height
2	Level -2	j.celnikie	26/03/2009 14:27:24	Floor	Revit	IfcBuildingStorey	-2TB8MXxlf6BAI7EOCcoVP	Level -2	-5.05	3
3	Level -1	j.celnikie	26/03/2009 14:27:25	Floor	Revit	IfcBuildingStorey	-1TB8MXxlf6BAI7EOCcoVP	Level -1	-2.05	3.03
4	Level 00	j.celnikie	26/03/2009 14:27:28	Floor	Revit	IfcBuildingStorey	0TB8MXxlf6BAI7EOCcoVPF	Level 0	0.98	4.52
5	Level 01	j.celnikie	26/03/2009 14:27:35	Floor	Revit	IfcBuildingStorey	1TB8MXxlf6BAI7EOCcoVPF	Level 1	5.5	3.4
6	Level 02	j.celnikie	26/03/2009 14:27:37	Floor	Revit	IfcBuildingStorey	2TB8MXxlf6BAI7EOCcoVPF	Level 2	8.9	3.8
7	Level 03	j.celnikie	26/03/2009 14:27:38	Floor	Revit	IfcBuildingStorey	3TB8MXxlf6BAI7EOCcoVPF	Level 3	12.7	3
8	Level 04	j.celnikie	26/03/2009 14:27:38	Floor	Revit	IfcBuildingStorey	4TB8MXxlf6BAI7EOCcoVPF	Level 4	15.7	3.4
9	Level 05	j.celnikie	26/03/2009 14:27:39	Floor	Revit	IfcBuildingStorey	5TB8MXxlf6BAI7EOCcoVPF	Level 5	19.1	3.4
10	Level 06	j.celnikie	26/03/2009 14:27:50	Floor	Revit	IfcBuildingStorey	6TB8MXxlf6BAI7EOCcoVPF	Level 6	22.5	3.45
11	Level 07	j.celnikie	26/03/2009 14:27:55	Floor	Revit	IfcBuildingStorey	7TB8MXxlf6BAI7EOCcoVPF	Level 7	25.95	2.9
12										

Table 3. Space spread sheet

Name	CreatedBy	CreatedOn	Category	FloorName	Description	ExtSystem	ExtObject	ExtIdentifier	RoomTag	UsableHeight	GrossArea	NetArea
A1	j.celnikier@celnikier-grabli.com	2009-04-13T12:27:24	Central lobby	Level 0	N.A.	Revit	IfcSpace	N.A.	A1	7	154	154
A2	j.celnikier@celnikier-grabli.com	16/04/2009 16:36:14 PM	Front office (Admitting / Billng department)	Level 0	N.A.	Revit	IfcSpace	N.A.	A2	7	111	111
A3	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Security department	Level 0	N.A.	Revit	IfcSpace	N.A.	A3	3.2	39	39
A4.1	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Customer service - patients account	Level -1	N.A.	Revit	IfcSpace	N.A.	A4.1	3.2	85	85
A4.2	j.celnikier@celnikier-grabli.com	22/04/2009 13:10:11 PM	Customer service - patients account	Level 0	N.A.	Revit	IfcSpace	N.A.	A4.2	3.2	40	40
A5	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Conferences /meeting room	Level 0	N.A.	Revit	IfcSpace	N.A.	A5	7	800	800
B1	j.celnikier@celnikier-grabli.com	16/04/2009 16:36:14 PM	Out patients clinics	Level 1	N.A.	Revit	IfcSpace	N.A.	B1	3.2	559	559
B2	j.celnikier@celnikier-grabli.com	2009-04-14T00:43:44	Day hospit. Dept	Level 2	N.A.	Revit	IfcSpace	N.A.	B2	3.2	475	475
B3	j.celnikier@celnikier-grabli.com	2009-04-14T10:11:22	Cardiovascular Rehabilitation	Level 4	N.A.	Revit	IfcSpace	N.A.	B3	3.2	170	170
B4	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	Orthopedic Rehabilitation	Level 1	N.A.	Revit	IfcSpace	N.A.	B4	3.2	139	139
B5	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Day hospit. Dept	Level 1	N.A.	Revit	IfcSpace	N.A.	B5	3.2	108	108
C1	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Adults Emergency (20 000/year)	Level 0	N.A.	Revit	IfcSpace	N.A.	C1	3.2	616	616
D1	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Radiology and MRI/CT's reception	Level 0	N.A.	Revit	IfcSpace	N.A.	D1	4.5	93	93
D2	j.celnikier@celnikier-grabli.com	2009-04-14T10:11:22	Radiology / echography and mammography area	Level 0	N.A.	Revit	IfcSpace	N.A.	D2	4.5	328	328
D3	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	MRI / CT - Programmed patients	Level 0	N.A.	Revit	IfcSpace	N.A.	D3	4.5	262	262
D4	j.celnikier@celnikier-grabli.com	2009-04-14T00:43:44	CT / emergencies and multislice coronary	Level 0	N.A.	Revit	IfcSpace	N.A.	D4	4.5	53	53
D5	j.celnikier@celnikier-grabli.com	2009-04-13T12:27:24	Utility for radiology and MRI/CT	Level 0	N.A.	Revit	IfcSpace	N.A.	D5	3.2	36	36
D6	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Nuclear medicine (scientigraphy + Pet Scan)	Level 1	N.A.	Revit	IfcSpace	N.A.	D6	3.2	427	427
E1	j.celnikier@celnikier-grabli.com	22/04/2009 13:10:11 PM	Operating rooms	Level 2	N.A.	Revit	IfcSpace	N.A.	E1	4	1162	1162
E2	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	Recovery area	Level 2	N.A.	Revit	IfcSpace	N.A.	E2	3.2	303	303
E3	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Cardiology and interventional radiology	Level 4	N.A.	Revit	IfcSpace	N.A.	E3	4	235	235
E4	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Endoscopy Department	Level 2	N.A.	Revit	IfcSpace	N.A.	E4	3.2	200	200
F1	j.celnikier@celnikier-grabli.com	16/04/2009 16:36:14 PM	ICU	Level 1	N.A.	Revit	IfcSpace	N.A.	F1	3.2	871	871
F2	j.celnikier@celnikier-grabli.com	2009-04-14T10:11:22	CCU	Level 4	N.A.	Revit	IfcSpace	N.A.	F2	3.2	449	449
F3	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Heart and Neuro ICU	Level 2	N.A.	Revit	IfcSpace	N.A.	F3	3.2	184	184

G4	j.celnikier@celnikier-grabli.com	22/04/2009 13:10:11 PM	Hospitalization level	Level 4	N.A.	Revit	IfcSpace	N.A.	G4	2.9	887	887
Name	**CreatedBy**	**CreatedOn**	**Category**	**FloorName**	**Description**	**ExtSystem**	**ExtObject**	**ExtIdentifier**	**RoomTag**	**UsableHeight**	**GrossArea**	**NetArea**
G5	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Hospitalization level	Level 5	N.A.	Revit	IfcSpace	N.A.	G5	2.9	1829	1829
G6	j.celnikier@celnikier-grabli.com	2009-04-14T00:43:44	Hospitalization level	Level 6	N.A.	Revit	IfcSpace	N.A.	G6	2.9	1445	1445
H1	j.celnikier@celnikier-grabli.com	2009-04-14T10:11:22	Pharmacy	Level 3	N.A.	Revit	IfcSpace	N.A.	H1	2.9	331	331
H2	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Cytostatic production area	Level 3	N.A.	Revit	IfcSpace	N.A.	H2	3.2	68	68
H3	j.celnikier@celnikier-grabli.com	2009-04-13T12:27:24	Sterilization	Level 3	N.A.	Revit	IfcSpace	N.A.	H3	2.9	277	277
H4	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	Laboratories	Level 3	N.A.	Revit	IfcSpace	N.A.	H4	2.9	500	500
H5	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Mortuary	Level -1	N.A.	Revit	IfcSpace	N.A.	H5	3.2	80	80
H6	j.celnikier@celnikier-grabli.com	22/04/2009 13:10:11 PM	Biomedical Maintenance workshop	Level 3	N.A.	Revit	IfcSpace	N.A.	H6	3.2	83	83
I1	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Administriv archive	Level 0	N.A.	Revit	IfcSpace	N.A.	I1	3.2	70	70
I2	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Administriv and medical archive of the patient	Level 0	N.A.	Revit	IfcSpace	N.A.	I2	3.2	205	205
I3	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	IT (Information Technology) service	Level 3	N.A.	Revit	IfcSpace	N.A.	I3	2.9	111	111
J1.1	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	Head Dpt	Level 3	N.A.	Revit	IfcSpace	N.A.	J1.1	2.9	162	162
J1.2	j.celnikier@celnikier-grabli.com	2009-04-14T00:43:44	Human ressources Dpt	Level 4	N.A.	Revit	IfcSpace	N.A.	J1.2	2.9	103	103
J1.3	j.celnikier@celnikier-grabli.com	16/04/2009 16:36:14 PM	Direction	Level 6	N.A.	Revit	IfcSpace	N.A.	J1.3	2.9	45	45
K	j.celnikier@celnikier-grabli.com	2009-04-14T10:11:22	Employees locker room	Level -1	N.A.	Revit	IfcSpace	N.A.	K	3.2	536	536
K2	j.celnikier@celnikier-grabli.com	29/04/2009 16:12:35 PM	Employees and visitors cafeteria	Level -1	N.A.	Revit	IfcSpace	N.A.	K2	3.2	277	277
K3	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Guarding medical	Level 3	N.A.	Revit	IfcSpace	N.A.	K3	2.9	24	24
L1	j.celnikier@celnikier-grabli.com	22/04/2009 13:10:11 PM	Reception / shipping	Level -1	N.A.	Revit	IfcSpace	N.A.	L1	3.2	84	84
L2	j.celnikier@celnikier-grabli.com	2009-04-28T10:12:44	Stocks	Level -1	N.A.	Revit	IfcSpace	N.A.	L2	3.2	356	356
L3	j.celnikier@celnikier-grabli.com	16/04/2009 16:36:14 PM	Kitchen	Level -1	N.A.	Revit	IfcSpace	N.A.	L3	3.2	518	518
L4)	j.celnikier@celnikier-grabli.com	2009-04-21T11:17:11	Waste room (infectious risk)	Level -1	N.A.	Revit	IfcSpace	N.A.	L4)	3.2	105	105
L5	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Premises' hygiene	Level -1	N.A.	Revit	IfcSpace	N.A.	L5	3.2	118	118
L6	j.celnikier@celnikier-grabli.com	2009-04-13T12:27:24	Laundry room	Level -1	N.A.	Revit	IfcSpace	N.A.	L6	3.2	424	424
L7	j.celnikier@celnikier-grabli.com	15/04/2009 13:14:52 PM	Maintenance	Level -1	N.A.	Revit	IfcSpace	N.A.	L7	3.2	240	240

7. Conclusion

1) The proposed framework proved its reliability in information sharing.

2) The framework minimized loss of data through conversion from a form to another during design and construction stage.

3) The framework decreased required time for design implementation, by efficiently sharing data and decreasing inquires.

4) COBie forms could be applied within the design stage, even before beginning of construction activities.

5) The proposed framework could bring BIM and non-BIM participants to the same platform.

6) The frame work could be implemented in environments, where BIM is still a new culture.

References

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