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AUTODESK.
UNIVERSITY , Middle East 2019

Creating Room Data/ Layout Sheets & Manuals Are Getting Easier With BIM

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Learning Objectives:

- Understand how building design data represented in BIM objects and connected to a database.
- Using Revit®, Microsoft Access ®, and dynamo instrumentally together will enhance the project deliverables.
- In-depth workflow in using a data-centric approach for creating, validating, and delivering the project documents (room data sheets, room layout sheets, and specs booklets).
- Taking advantage of using the augmented reality, in creating immersive room data/layout sheets.

About the Speaker

A senior Electrical Engineer & BIM specialist at Dar Al Handasah, with extensive experience in AEC's digital industries and construction, responsible for BIM adoption, standards, strategy, vision, and direction for the use of technologies that support the multidisciplinary practice of a global consulting and engineering firm.

Abdul Kareem also develops digital workflows and solutions for key projects and advises design teams with the best practice workflows and technologies especially for healthcare facilities and research labs. While at Dar Al Handasah, Abdul Kareem contributes to vision, teamwork, and leadership in presenting BIM at dar and many innovations that help to improve the design results.

Accredit as LEED AP in Building Design + Construction and holds a Bsc. degree in electrical engineering from the Hashemite University.

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Table of Contents

1.   Class Summary

This class will cover the steps required to create **Room Data Sheet (RDS), Room Layout Sheet (RLS)** and **Specification Manuals** using BIM models in Revit®, which are linked to an imported dataset in Microsoft Access® that builds the relations between objects and their embedded attributes.

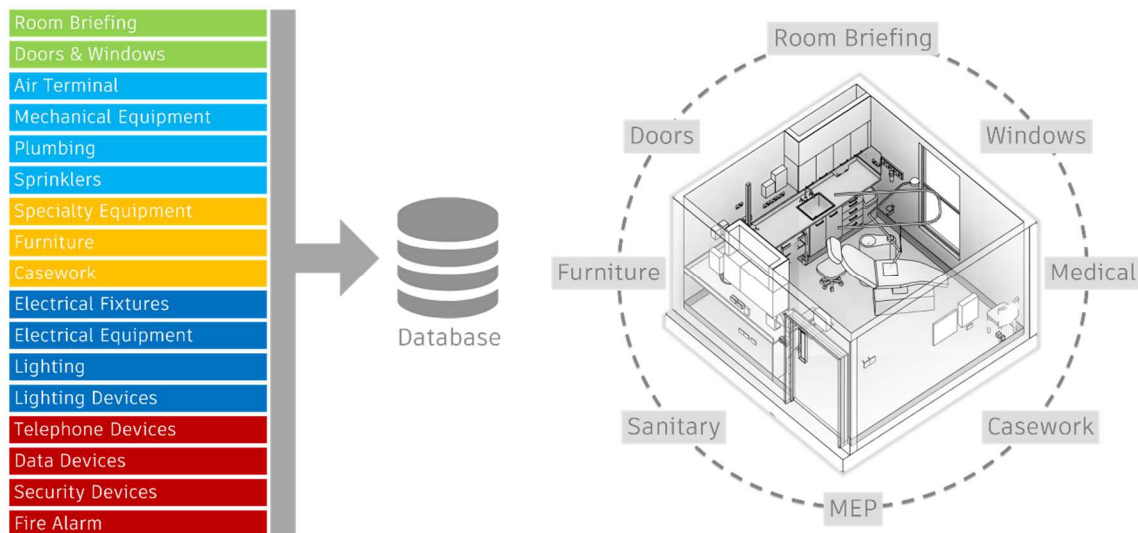The derivables of this class will be:

- Room Data Sheets
- Room Data/Layout Sheets
- Specification Manuals

2.   BIM Data

BIM projects deal with rich data from different disciplines and systems, and we face the challenge of how to process, render this data, share and deliver outrageous formatted documents.
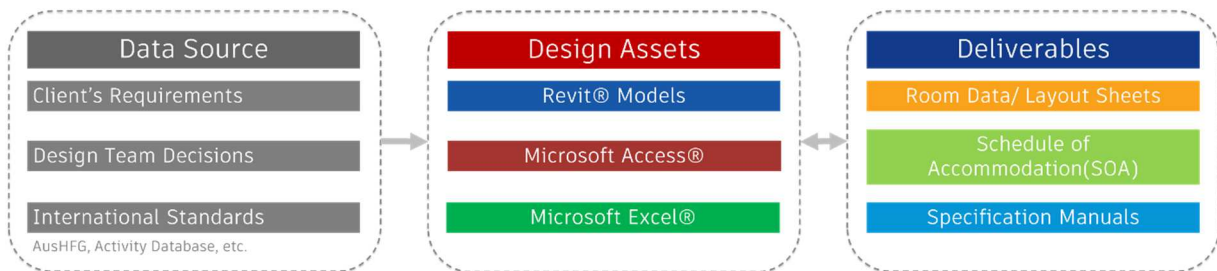
The data are accumulated from various sources, starting the client requirements, and the design team's previous experience, and keep growing while design input come from different categories within different disciplines.

BIM models are the main source of information, and this does not mean that all data shall be in the BIM models, some information can be live in a database for several considerations, for example, to secure the sensitive information such as cost, or the manufacturer at some point, where we are asked to deliver the BIM models at all stages of design.
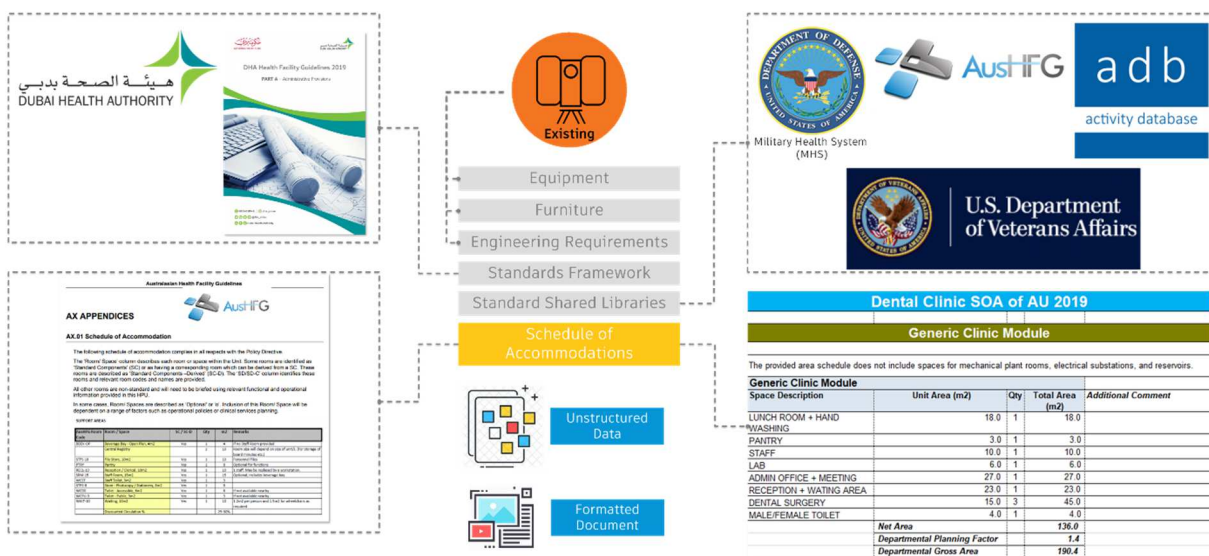
3.   Data Flow

The data source starts with the client space requirements, which our discussion in this class is presented in a paper most likely will be formatted as the client used to see. In order to use this data as design info, we need to convert it into structured tables, then use it to create placeholders rooms in Revit®. It will be detailed in section 8, and then at some point, we need to validate and compare room design vs. planned using PowerBI®.

There is other information sources that also feeds the design, such as (equipment, furniture, engineering requirements, standard framework, reports, and other data), that also need to be organized within the database.

The key is to understand the data from the early stages of the project, examining the data, and build the relationship based on the model division specified to in the BIM implementation plan, otherwise, we need to remember the data sequence, in order to process the required deliverables which in this cases might be not achievable.

4.   Revit Objects

Most of the terms used to identify objects in Revit are common, industry-standard terms. However, some terms are unique to Revit. Understanding the following terms is crucial to understanding the software.

Source: http://help.autodesk.com/view/RVT/2014/ENU/?guid=GUID-2480CA33-C0B9-46FD-9BDD-FDE75B513727

4.1.   Category

A category is a group of elements that you use to model or document a building design.

4.2.   Family

Families are classes of elements in a category. A family groups elements with a common set of parameters (properties), identical use, and similar graphical representation. Different elements in a family may have different values for some or all properties, but the set of properties—their names and meaning—is the same.
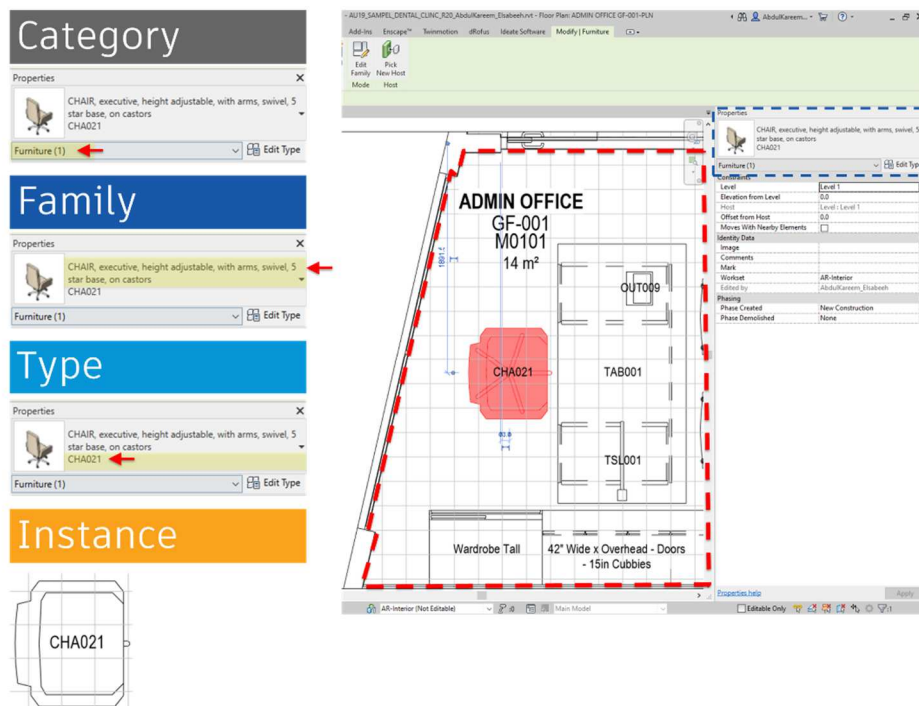
- **Loadable families** can be loaded into a project and created from family templates. You can determine the set of properties and the graphical representation of the family.
- **System families** are not available for loading or creating as separate files, which is not part of our discussion, as we focus on discrete loaded families within the rooms.

4.3.   Type

Each family can have several types. A type can be a specific size of a family.

4.4.   Instance

Instances are the actual items (individual elements) that are placed in the project and have specific locations in the building (model instances) or on a drawing sheet (annotation instances).

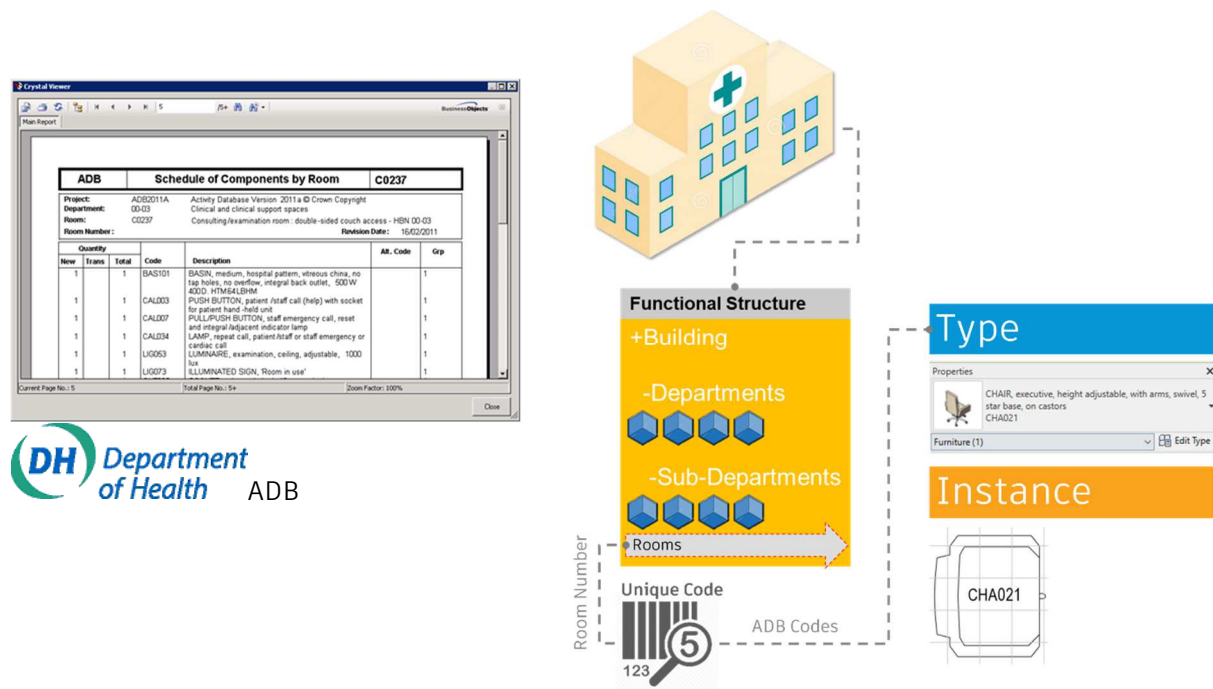## 4.5.   Inheriting Data (Parent to child)

Revit objects are able to inherit information such as (Hosting, Properties, and its Location in Room or Space).

In Revit, objects or families, which is in the database language called the child and the room where this occurrence is located called parent, this relation is built in Revit and will be exported to the database tables.

4.6.   Parent (Rooms) Functional Structure

The rooms are organized within the BIM models based on clear functional groups, aligned with the schedule of accommodation design for the project, it starts from the facility code, and going down until reaching the room occurrences within each sub-departments.

The occurrences which are based on predefined families and types, also connected to a standardized database similar to **activity database (ADB),** which gives each type a unique code across the facility.

ADB

5.   Database Basic Relations

The database consists of tables and their relationships. This simple structure is used for a wide range of data, as we understood our data and their relationship, some of which are built-in Revit and others need to be configured in the database.

Each table must contain a key code that is used to build the relationship, for this example the code is the room number that should be treated to avoid "Null Values" and "duplicates".

The main table should be normalized, which means the key code should not null and should be unique, while the other corresponding table which contains some of the item lists, may have null or duplicate values as much item occurrences detected within the room.

There are different relationships that can be used in the database, which are called "Join Properties", depending on how you want to process the information from the relational tables.

- (**One: One**): Only includes rows where the joined fields from both tables are equal.
- (**One: Many**): Include all records from the Main table and only those records from the sub-table where the joined fields are equal.
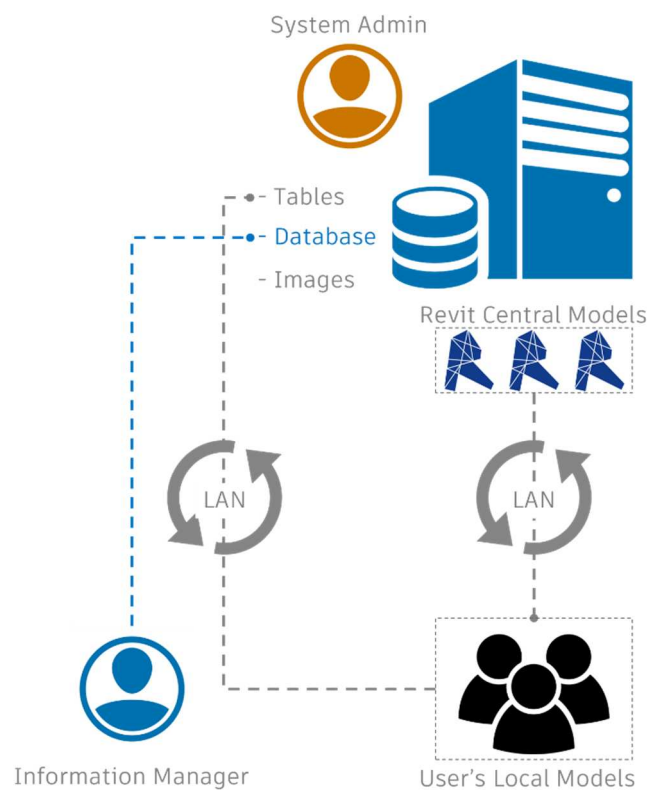
6.   System Structure

The proposed system structure is working within the company LAN network, where the information (BIM models) and database tables are made accessible and stored in a common server.

Revit allows for Work-sharing as a design method that allows multiple team members to work on the same project model at the same time. This can be enabled by creating a central model so that team members can simultaneously make design changes to a local copy of the central model.

The schedules which contains the room based items can also be synchronized from different users, depending on their specialties, as illustrated below.

Database are designed to be a single user type, which means that it can only be accessed by one user at a time, in this example it is the information manager.

7.   Used Tools

7.1.   Revit

Revit is the authoring tool, where all interdisciplinary models are created based on the model division strategy defined in the project implementation plan, the Revit models house all rooms and the items placed in each which are synchronized with the database.

7.2.   Whitefeet

Is a free add-in runs within Revit, and can be used for different purposes, in this example, we will use whitefeet to create room's views and export them as images.

7.3.   Dynamo

Dynamo is a graphical programming interface that lets you customize your building information workflow. Dynamo is an open-source visual programming platform for designers. It is installed as part of Revit, and it will be used to export the database tables to a common location within the company network.
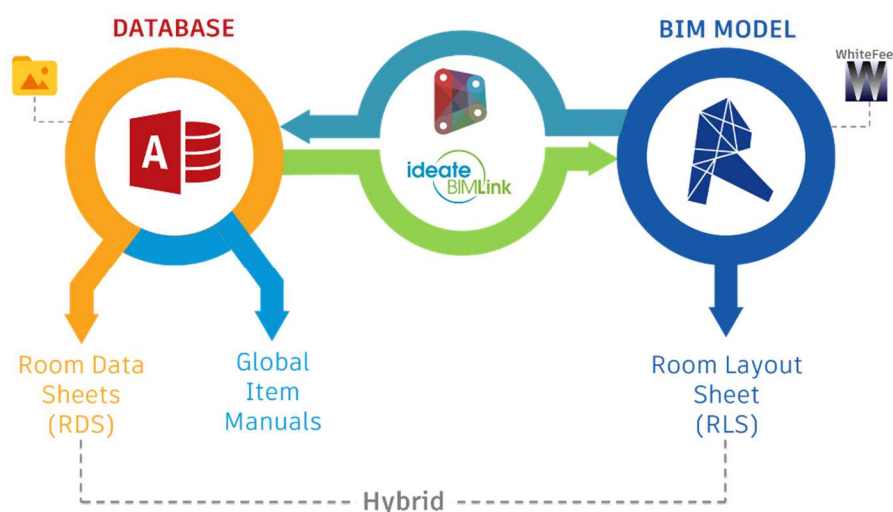
7.4.   Ideate BIMlink

Is a commercial add-in runs within Revit, allows users to pull information from the model into Microsoft Excel and push volumes of precise, consequential BIM data back into Revit model with speed, ease and accuracy, this tool will be used to create the rooms based on defined schedule of accommodation as will be detailed in section 8.

7.5.   Microsoft Excel

Microsoft Excel is a spreadsheet program. That means it is used to create grids of text, numbers and formulas specifying calculations. That's extremely valuable in BIM.
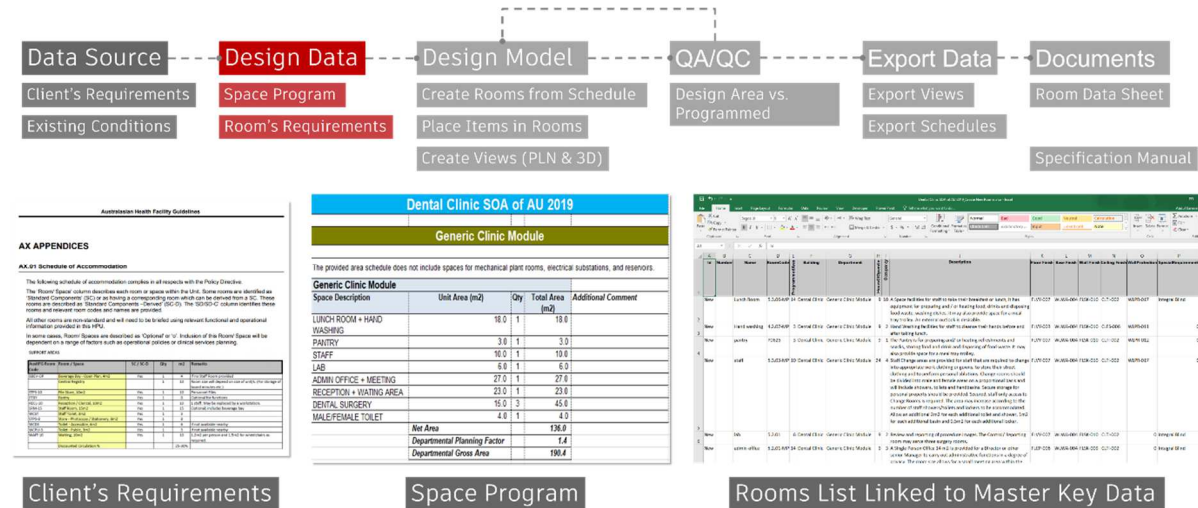
7.6.   MS Access

Part of the Microsoft office tools, Microsoft Access is an information management tool that helps you store information for reference, reporting, and analysis. Using Microsoft access we will be able to export room data/layout sheets and specification manuals.
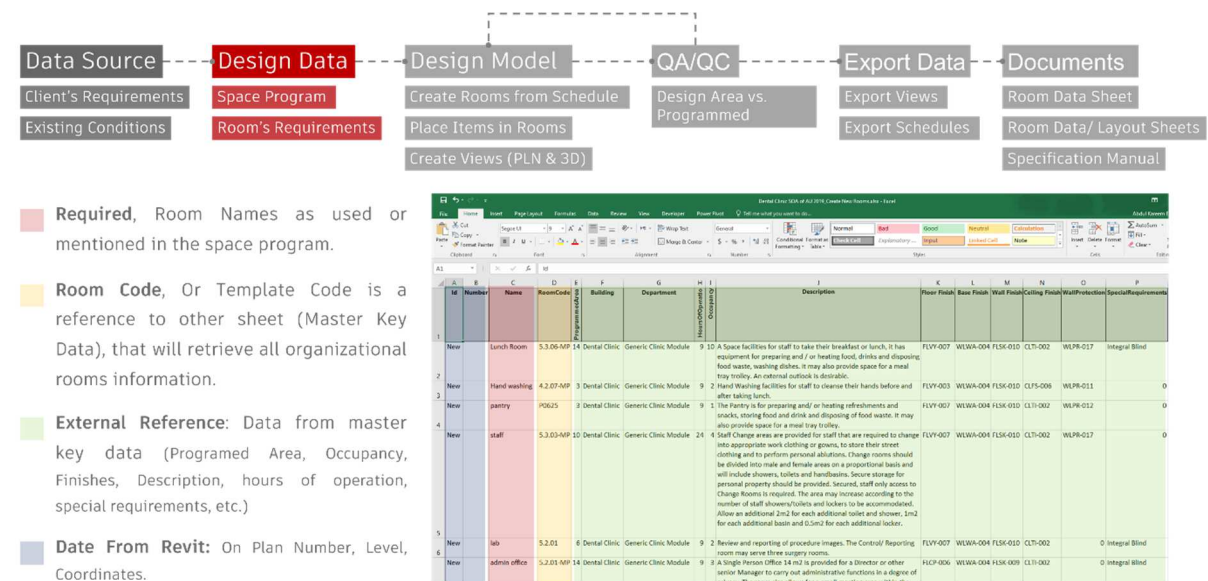
8.   Design Workflow

8.1.   Data Source

Starting with customer requirements, which as described earlier may be in the format used for reading, they must be converted into what we know as space program or schedule of accommodation, so then the normalization process will be to convert the SOA in a format that can be used to create rooms in Revit.
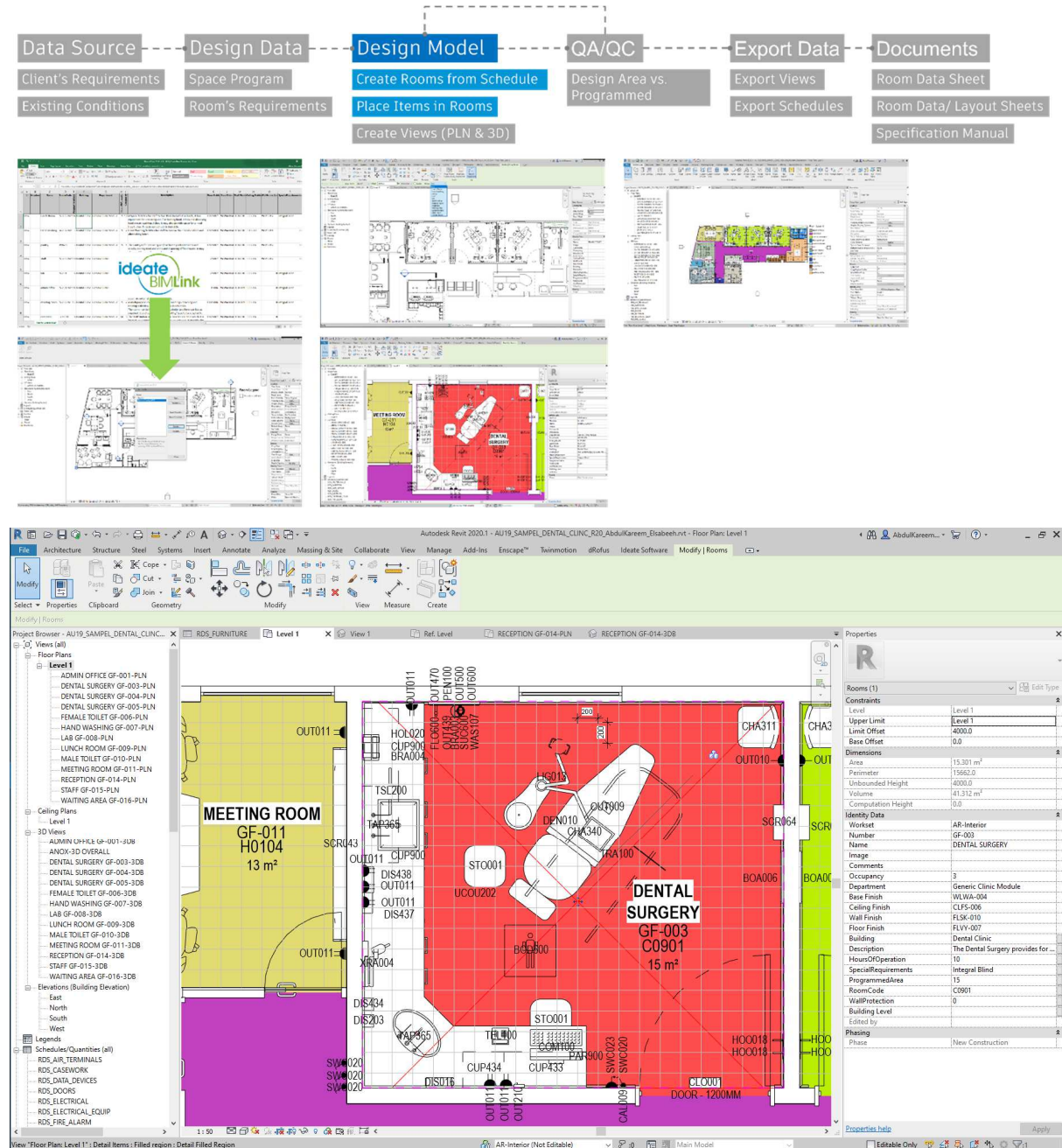

8.2.   Design Data

The normalized table has fields that require manual input, and other linked to external reference "Master data" using a key value, in this example we are using the room code used in the UK activity database which is (ADB), and other data derived back from Revit such as (room number, level, and Area).
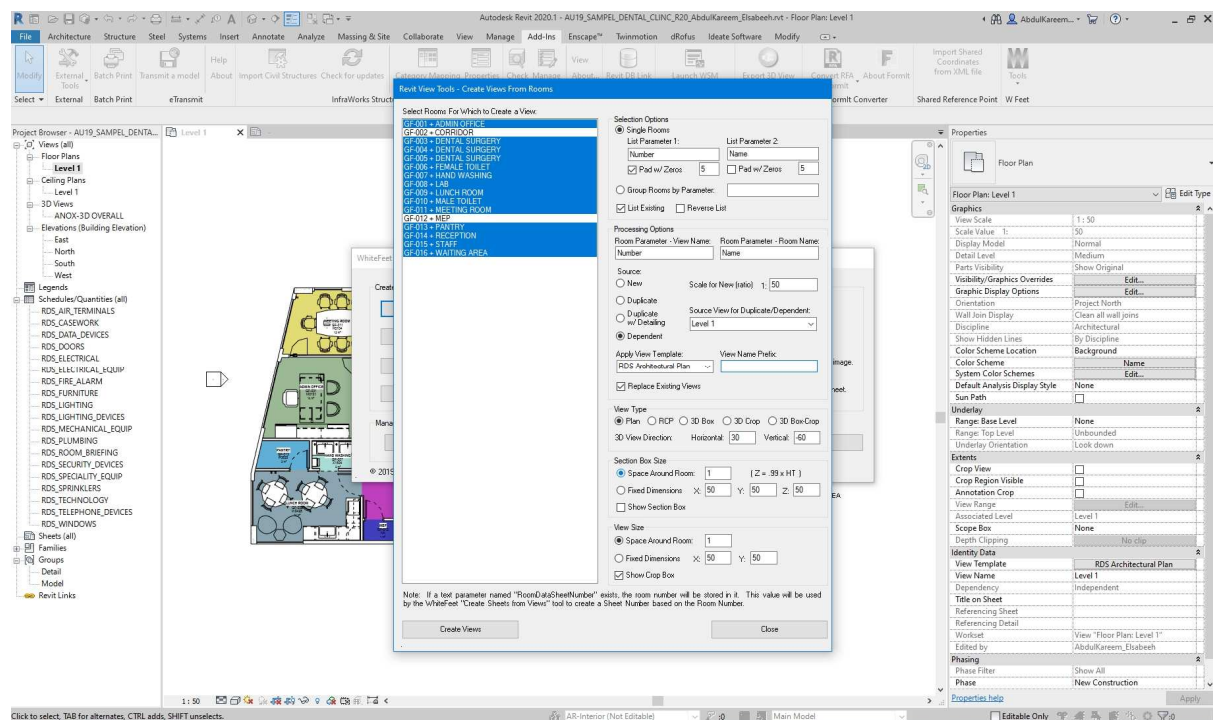
8.3.   Design Model

The room schedule created in the previous step is now ready to be created in Revit as this "place holder rooms" using the ideate BIM link. Then plan these rooms at each architectural bounding walls, while all corresponding data will be available for audit within Revit rooms.

The next step is to create rooms' 3D views and Plan Views based on each boundary, this achievable using WhiteFeet, which detects each room's boundaries and create the required views, which will be used later in the room data/layout sheets.

8.4. QA/QC Process

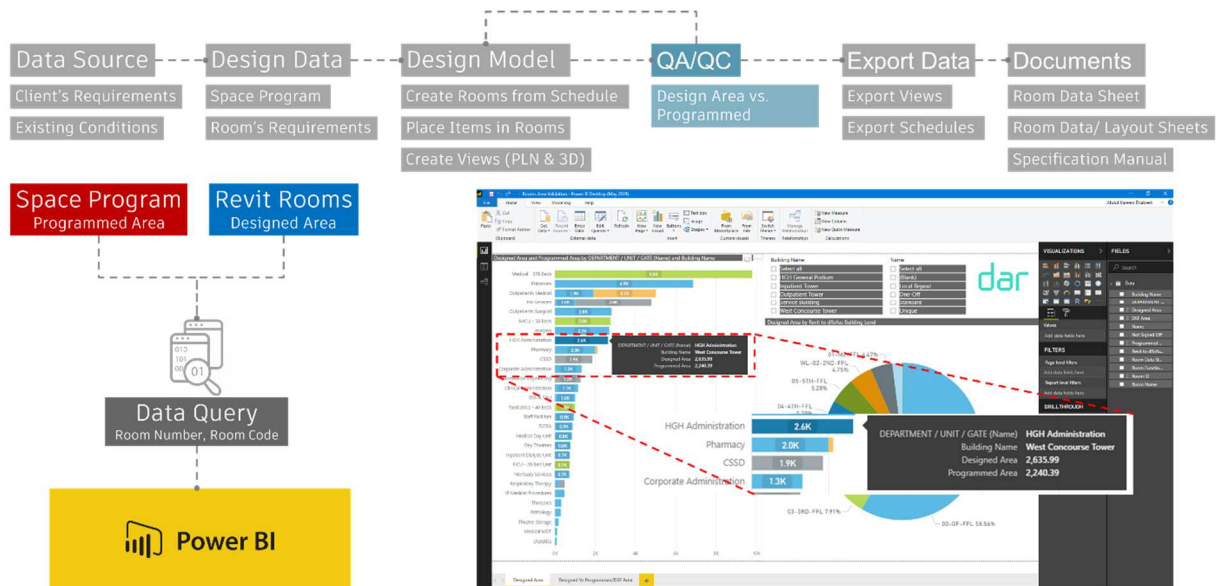At a certain stage of the project, we need to check the room areas (designed versus planned), while the planned room areas are listed in the schedule of accommodation (SOA) and the as drawn room areas live in Revit. It is crucial to keep compare them together dynamically to make sure that the design intent and the client requirement has been maintained.

This example is from one of our projects where Power BI was used to build an intelligent interactive dashboard, which dynamically changes as the design progresses. This is necessary to ensure that the client's requirements are maintained.
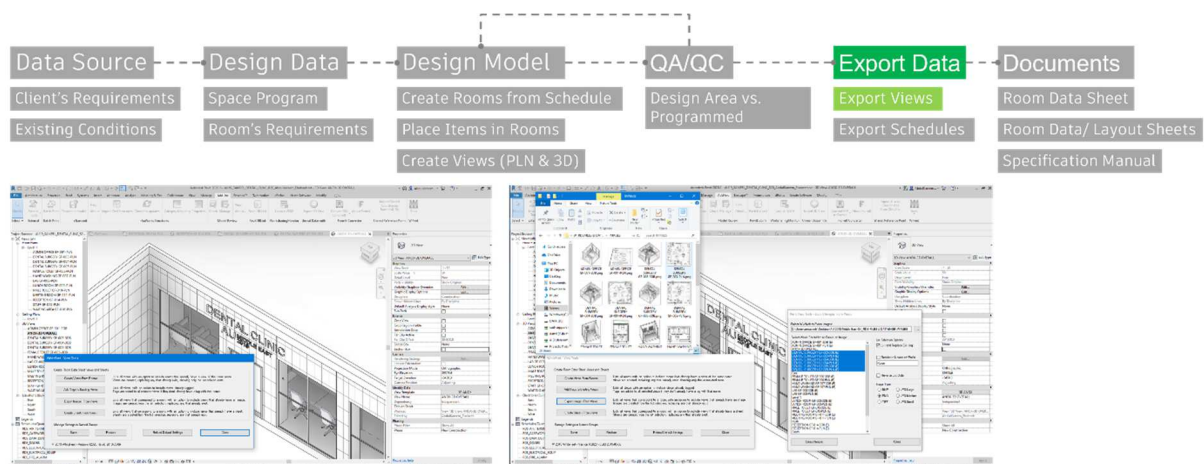

8.5. Export Data
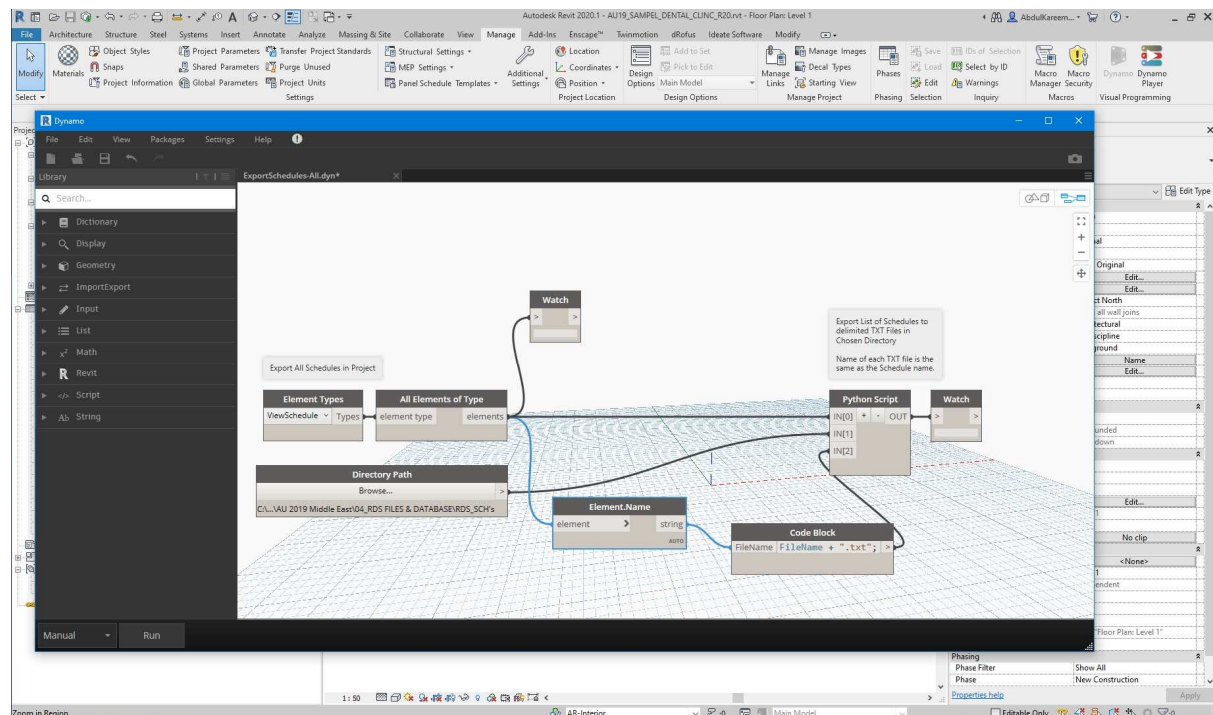
8.5.1. Export Views

Using whitefeet, we can export all created views in section 8.3 (Plan & 3D), as images, linked to their respective server location in the database.

If the design is changed, you can export the images again and write over the existing ones, or export only the affected rooms.

8.5.2. Export Schedules

Predefined tables based on item lists are created in the Revit template and can be transferred to any project as required. Tables will count the room based items designed for each discipline that will be exported from Revit using dynamo, all together in a specific location on the server as described in section 6. The data will remain synchronized each time you click Run in dynamo which will overwrite the tables located on the server.

8.6.   Documents

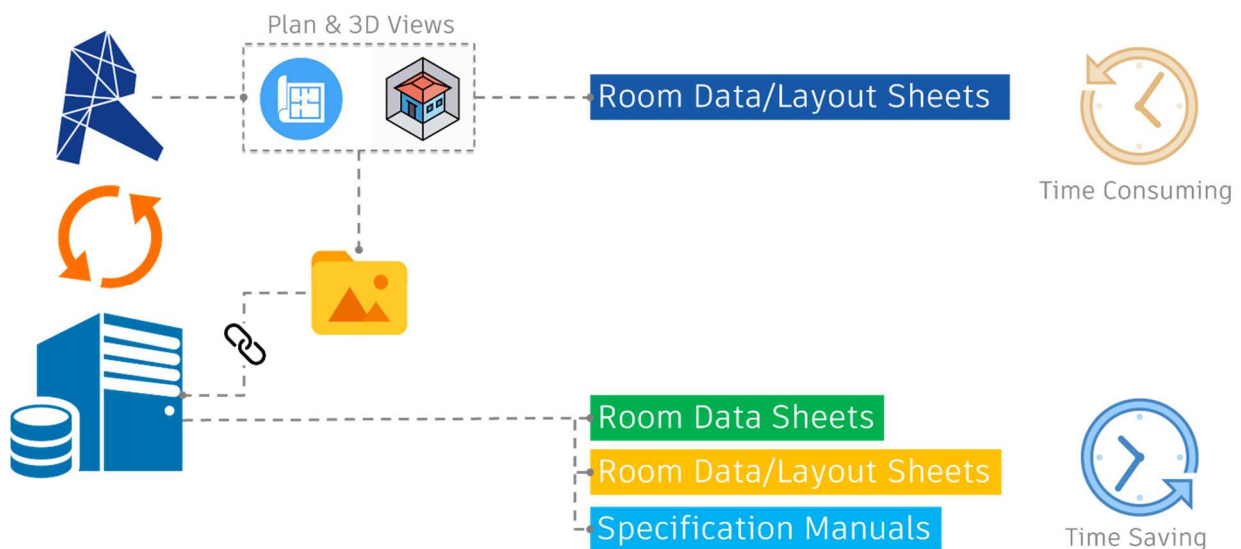There are two approaches for creating room data/layout sheets, first one is using Revit where they are created entirely as Revit sheets, and second one in Access which uses images exported from Revit and attaches them with all relevant information in an Access report.

Both approaches are valid; the approach in Revit retains the view scale and may result in better vector print quality. The upper hand in this class is for Access reports, where it can be included more data types and have more formatting capabilities, it rated as more efficient, while saves time.

Both approaches include creating separate views for each room, (plan and 3D) views cropped at a fixed distance around the room, which are described in section 8.3.

8.6.1. Revit Room Data/Layout Sheet

Views created using WhiteFeet will be placed on a sheet of paper, including a schedule of items within each single room.

Although most tasks can be automated, some tasks still have to be done manually and will take more time, makes this approach is **NOT recommended.**

8.6.2. Access Room Data/Layout Sheet

Revit views are being exported to a defined location using Whitefeet, this a batch process while images are named based on their numbers and names with an indicator for PLN or 3D so that they can be linked to the access report based on a composite path created in Revit rooms schedule.

Dental Clinic, AU Middle East 2019
ROOM NAME: DENTAL SURGERY   ROOM NUMBER: GF-003

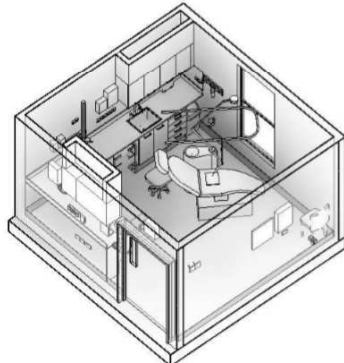ROOM BRIEFING:
The Dental Surgery provides for dental consultation, examination and treatment for patients. An external outlook is desirable. The 14m2 room provides for two door access if required. Additional Design Considerations: Radiation shielding to be advised by Radiation Consultant. Services will be required for the dental chair unit which will be dependant on the chair model and supplier and will include dental air, dental suction, filtered water, power and drainage.
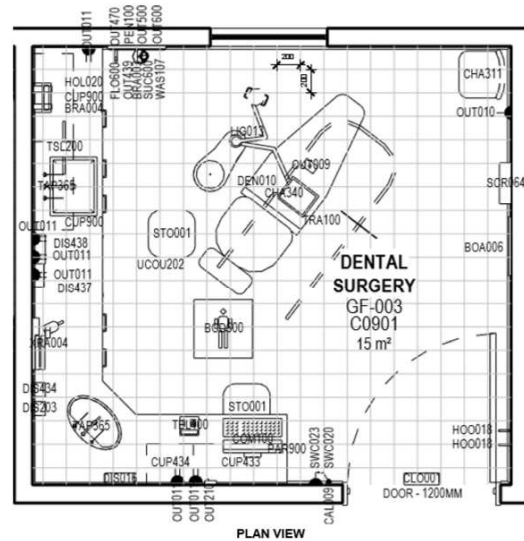
ROOM LOCATION:		FINISHES:	
BUILDING:	Dental Clinic	FLOOR:	FLVY-007
LEVEL:	Level 1	WALL:	FLSK-010
DEPARTMENT:	Generic Clinic Module	BASE:	WLWA-004
ROOM CODE:	C0901	CEILING:	CLFS-006
CAPACITY	3	SPECIAL REQUIREMENTS:	
DESIGN ROOM SIZE:		WINDOW BLIND	Integral Blind
AREA (M2):	15 m²		
VOLUME (M3):	41.31 m²		
PERIMETER (M):	15662		

3D VIEW

PLAN VIEW

DENTAL SURGERY
GF-003
C0901
15 m²

DOOR - 1200MM

ISSUE DATE: 11/5/2019
ROOM DATA SHEET
Page 5 of 32

Dental Clinic, AU Middle East 2019
ROOM NAME: DENTAL SURGERY   ROOM NUMBER: GF-003

FURNITURE:

ITEM #	NAME	QUANTITY
STO001	STOOL, height adjustable - gas lift, 450H 355 dia.	2
CHA311	SOFA CHAIR, 2 seater, easy, with arms, fully upholstered, wipeable	1
BOA006	BOARD, marker, whiteboard, dry-wipe, with pen holder, wall mounted, 1200H1800W	1

ELECTRICAL:

ITEM #	NAME	QUANTITY
SWC023	SWITCH 15amp ac single pole, intermediate, wall mounted	1
OUT131	SOCKET outlet data/voice, double.	1
OUT056	SOCKET outlet, switched, 13 amp, single	2
OUT011	SOCKET outlet switched 13amp twin, pilot light	7
OUT010	SOCKET outlet, switched, 13 amp, twin	1
OUT009	SOCKET outlet switched 13 amp twin, floor mounted	1
OUT005	SOCKET outlet, switched, 13 amp, single	1

LIGHTING:

ITEM #	NAME	QUANTITY
XRA004	X-RAY GENERATOR for dental tube, wall mounted	1
TSL200	SPECIAL TASK LIGHT	1
LIG013	LUMINAIRE dental adjustable, ceiling mounted	1
Not Shown	FLUORESCENT DIFFUSED RECESSED COLOUR CORRECTED, DIMMABLE	4

LIGHTING DEVICES:

ITEM #	NAME	QUANTITY
SWC020	SWITCH 15amp ac single pole, 1 way, wall mounted	1

PLUMBING:

ITEM #	NAME	QUANTITY
WAS110	BASIN VANITY OVAL	1
TAP365	TAP pillar, mixer, double lever action, hose outlet, spray gun	2
LSU001	SINK laboratory, 150H 350W 300D, HTM67/S1	1

SPCIALITY EQUIP:

ITEM #	NAME	QUANTITY
HOL020	HOLDER, sharps box, up to 7 litre capacity, rail/trolley hang or wall mounted, 170H 125W 100D	1
BRA004	BRACKET - SHARPS	1
BRA003	BRACKET, holder, suction unit.	1
CLO001	CLOCK battery, wall mounted	1
DIS016	DISPENSER, soap, wall mounted - anti-ligature	1
DIS203	DISPENSER, soap, wall mounted - anti-ligature	1
DIS434	DISPENSER, soap, wall mounted - anti-ligature	1

DIS437	DISPENSER, soap, wall mounted - anti-ligature	1
BOD600	BODY PROTECTED	1
FLO600	FLOWMETER	1
WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in. .	1
HOO018	HOOK, coat, single	2
PEN100	MEDICAL SERVICE PANEL	1
SCR064	SCREEN, x-ray radiation protection, lead rubber, mobile, 900H 700L, lead equivalent 0.5mm Pb.	1
SUC600	SUCTION BOTTLE	1
TRA100	TRACK, curtain, one sided, 800mm length	1
WAS107	TRAP, bottle, 1.1/4 in, plastic resealing.	1
MST003	TROLLEY, small, single, with handle and extended worktop, 5 sets of runners, 600mm facing, 850H 1050W 450D nominal	1
DIS438	DISPENSER, soap, wall mounted - anti-ligature	1

CASEWORK:

ITEM #	NAME	QUANTITY
PAR900	PARTITION - LAMINATE	1
CUP900	LAMINATED OVERHEAD CUPBOARD	2
CUP359	CUPBOARD/DRAWER UNIT, 1 drawer, 1 shelf, on plinth, 850H 500W 500D	1
CUP021	CUPBOARD, 1 shelf, lockable, on plinth, 750H 600W 500D	2
CUP434	CUPBOARD - OVERHEAD - SINGLE	1
CUP433	CUPBOARD - OVERHEAD - DOUBLE	1
UCOU202	BENCH - CORNER UNIT	1

TECHNOLOGY:

ITEM #	NAME	QUANTITY
TEL100	TELEPHONE handset coin/card operated with connection	1
OUT210	SOCKET outlet two-way communication system (intercom).	1
COM100	COMPUTER PRINTER, SCANNER, PHOTOCOPIER, Desktop A4	1

ISSUE DATE: 11/5/2019
ROOM DATA SHEET
Page 6 of 32

8.6.3. Room Data Sheet (RDS)

For a specific projects, we are required to export a formatted room datasheet separate than the room layout sheets, which lists the room environment and the schedule of. In which case the design data exported from Revit is linked to the master data, which usually the room environments and can be from an international source such as (Activity Database-ADB), AusHFG, DHA, etc.
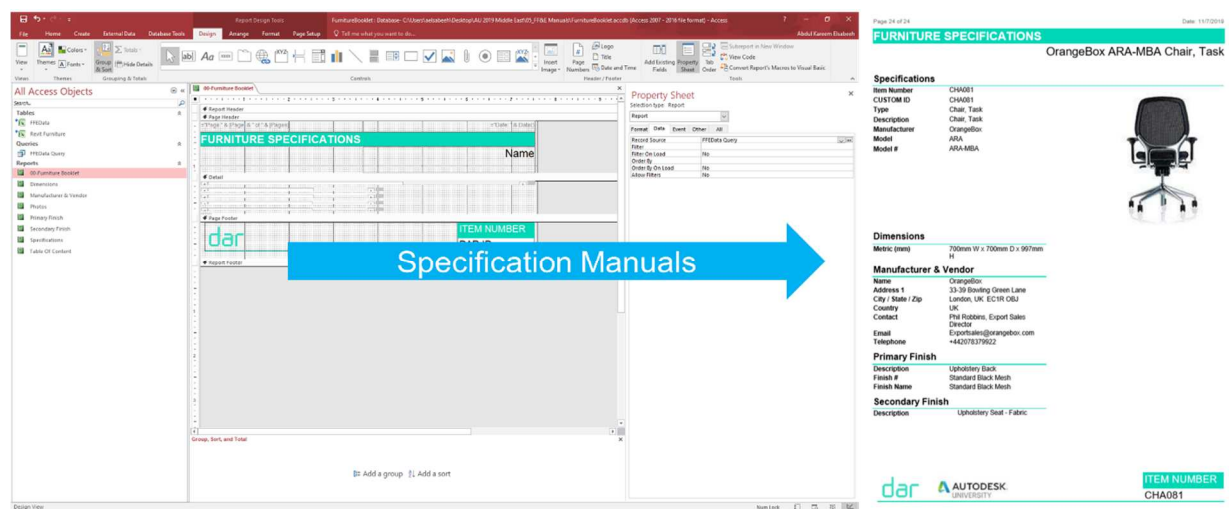
Project Name
XX18000-0100D
dar

Function Number: 01.03.01.01.011   Room Code: 12 05 01

ED Exam Triage

Function Location:	MAIN HOSPITAL / DIAGNOSTIC + TREATMENT / EMERGENCY UNIT / RECEPTION & TRIAGE
Room Code:	12 05 01
Designed Area:	13.94
Building Level:	LEVEL GR
Plan Name:	ED EXAM TRIAGE
Room Activities:	Patient may be ambulant, in a wheelchair or on a trolley or bed Patient to undress/dress in privacy. Clinical examination and assessment in privacy. Treatment for patient with simple injuries or illnesses. Clinical procedures and dressings. Small items of equipment and sundries are stored. Non-controlled medicines and pharmaceuticals are stored securely. Disposal of contaminated dressings. Clinical hand washing may be undertaken. Electronic patient records (EPRs) may be accessed and updated. Use of visual display terminal(s). Telephone(s) may be used.

Equipment Utilities

Item Number	O2	N2O	N2O/O2	Med Air	Surg Air	Med Vac	AGSS	CO2	N2	Slide	Normal Single	Emerg Single	UPS Single	Earth Outlet	Light Switch	Data Port	Pat Monitor Port	Phone Jack	Bed Data Port	Total Back Boxes	Pat Station (PS)	Staff Assist (SA)
PU02.038	2	0	0	1	0	2	0	0	0	2	10	6	0	0	0	4	1	1	0	0	1	1

Medical

Item Number	Item Name	Quantity
MEDEQ00.261	Stool, Exam, Cushion-Seat	1
MEDEQ00.094	Disposal, Sharps, Wall Mount	1
MEDEQ00.110	Flowmeter, Oxygen	1
MEDEQ00.113	Flowmeter, Air	1
MEDEQ00.121	Hamper, Linen	1
MEDEQ00.123	Headwall, Rail System, 1 Patient	1
MEDEQ00.186	Oto/Ophthalmoscope Set, Wall Mount, w/Sphyg	1
MEDEQ00.039	Bracket, Monitor, Wall	1
MEDEQ00.230	Scale, Clinical, Adult, Digital, Floor	1
MEDEQ00.475	Cart, Procedure, General	1
MEDEQ00.262	Stool, Step	1
MEDEQ00.273	Stretcher, Procedure / Recovery	1
MEDEQ00.281	Thermometer, Tympanic, Digital	1

08-Feb-18   12 05 01 ED Exam Triage

Project Name
XX18000-0100D
dar

Medical

Item Number	Item Name	Quantity
MEDEQ00.318	Waste Can, Bio-Hazardous	1
MEDEQ00.371	Waste Can, Step-On	1
MEDEQ00.396	Monitor, Physiologic, Vital Signs	1
MEDEQ00.226	Regulator, Suction, Intermittent/Continuous	1

Furniture

Item Number	Item Name	Quantity
FNCG.004	Allermuir A765 Side Armchair	1

Doors

Item Number	Item Name	Quantity
DR.042	N_SINGLE_NARROW_LITE_DOOR: 950X2150	1
DR.042	N_SINGLE_NARROW_LITE_DOOR: 950X2150	1

Electrical

Item Number	Item Name	Quantity
EL02.02.005	Lighting Switch: One Gang	2
EL00.03.007	Socket Outlet 13A: Single	5
EL00.02.001	Electrical Outlet: Single Phase-20A	3

Technology

Item Number	Item Name	Quantity
LCEN.078	Nurse Call System Type F	1
LCEN.060	Enhanced Patient Station	1
LCEN.053	Corridor Light	1
LCEN.050	Call Cancel Station	1
LCED.01.066	HeadWall/Bed Locator Mounted Data Outlet-4D	1
LCED.01.058	HeadWall/Bed Locator Mounted Data Outlet-1T	1
LCED.01.037	Wall Data Outlet-1D	2

Mechanical

08-Feb-18   12 05 01 ED Exam Triage

8.6.4. Specification Manuals

As part of the supplementary documents delivered in the projects, we need to create the specification manuals for interior design FF&E items (sanitary fittings, furniture, finishes, etc.), to show the details of the selections each in a separate sheet.

A master library database must be available for all items that are likely to be used at the corporate standards level and contain all kinds of various FF&E items, all organized with a unique code available at the item type level within Revit.

The modelled items will be exported as a Revit type schedule, and then a query will recall all other information from the company library including the item image, as they are linked using the unique codes, after which, Access will be able to export a project specification manual for the only used items.

9.   Useful links

- **Whitefeet:**
  http://www.whitefeet.com/Tools/
- **Department of Health and Social Care – GOV.UK (DOH):**
  https://www.gov.uk/government/organisations/department-of-health-and-social-care
- **AusHFG:**
  https://www.healthfacilityguidelines.com.au/
- **DHA:**
  https://www.dha.gov.ae/en/pages/dhahome.aspx