

GenQ

BOQs Auto Generating Revit Tool

By

Mohamed Mahdy

Mohamed Refat

Mo'men Nabil

Abdallah Khaled

Mahmoud Ismail

Under Supervision of

Eng. Ahmed Moheyeldin

BIM Automation Development Department Head



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Chapter 1

Introduction

1.1 Problem Definition

The problem of Bill of Quantities document generation is a time and effort consuming task. Time consuming tasks are a major problem facing the AEC industry specially the tendering team.

1.2 Objective

To create a tool that addresses the problems that face the Tendering Team while preparing BOQs in their project's initiation phase by speeding up the tiring process of gathering up quantities, in addition to the amount of time spent on collecting the required data throughout many phases and platforms and then putting them together and also documenting validated requirements in the form of a specific template.



1.3 Document Organization

Chapter 2: Analysis and Design

This chapter describes the Add-in's functional requirements.

Chapter 3: Implementation

This chapter includes a detailed description of all the functions in the add-in.

Chapter 4: User Manual

This chapter describes in detail how to operate the project along with screen shots of the project representing all steps.

Chapter 5: Conclusions and Future Work

This chapter contains a complete summary of the project and what are new features that can be added in the future.

Chapter 2

Analysis and Design

2.1 System Overview

2.1.1 Functional Requirements

1. List all types and categories from Revit model:

Description: The Add-in should display all Revit model categories and types in the form of a tree-view with check-boxes.

Input: Revit model.

Processing: Extracting all Categories and types from Revit Model.

Preconditions: - The user needs firstly to provide well-defined Revit models, i.e. inputting the right wanted types with the right names and assigned materials, in order to detect the right data.

Output: A tree-view with check-boxes for all Revit model categories and types.

2. Include linked Revit models:

Description: The Add-in allows the user to include linked Revit models' categories and types.

Input: Revit Linked model.

Processing: Extracting all Categories and types from Revit Linked Model.

Preconditions: - The user needs firstly to provide well-defined Revit models, i.e. inputting the right wanted types with the right names and assigned materials, in order to detect the right data.

Output: A tree-view with check-boxes for all Revit model and Revit linked model categories and types.

3. Filter by level or multiple levels:

Description: The Add-in allows the user filter categories and types by one level or multiple levels.

Input: Selected level(s).

Processing: Filtering categories and types by one level or multiple levels.

Preconditions: In case of filtering by levels in Revit linked models, the levels in the Revit linked models should have to same name to its corresponding level in the main Revit model.

Output: A tree-view with check-boxes for all Revit model categories and types included in the selected levels.

4. Display and allow editing the selected types and categories in a grid-view:

Description: The Add-in should display all selected Revit model categories and types in the form of a grid-view. Each category and type should have:

- A drop-down list to select measurement unit.
- A drop-down list to select MasterFormat division.
- A drop-down list to select MasterFormat section.
- A text-box list to enter the cost of the item.
- A text-box list to enter the description of the item.

Input: Selected items from the tree-view.

Processing: Collecting the data entered by the user and adding them to the items.

Preconditions: A MasterFormat.xlsx file should be provided to be displayed in the division and section drop-down lists.

Output: Selected types and all their collected data. Each type and its data are a separate object.

5. Save data to Revit model:

Description: The Add-in allows the user to save the data entered by the user of each type back to the Revit model.

Input: The data entered by the user in the grid-view.

Processing: saving the data entered by the user of each type back to the Revit model.

Output: Revit types holding all the entered data.

6. Import data from Revit:

Description: The Add-in allows the user to import the data of each type and display them in the grid-view.

Input: Revit types including the needed data.

Processing: Importing the needed data of each type and adding them to the items.

Preconditions: Type parameters in Revit to be filled with the needed data.

Output: Selected types and all their collected data. Each type and its data are a separate object.

7. Export Excel:

Description: The Add-in allows the user to export all the collected data to excel in the BOQ format.

Input: Selected types and all their collected data. Each type and its data are a separate object.

Processing: Extracting all collected data of the types and puts the data in the BOQ format and save the excel file.

Preconditions: The collected data of each type must be validated.

Output: Excel file.



8. Preview PDF:

Description: The Add-in allows the user to preview a ready to print PDF file of all the collected data in the BOQ format.

Input: Selected types and all their collected data. Each type and its data are a separate object.

Processing: Extracting all collected data of the types and puts the data in the BOQ format and preview the ready to print PDF file.

Preconditions: - The collected data of each type must be validated.
- The user needs to install Adobe Reader.

Output: A preview window that shows the PDF to be exported.

9. Export PDF:

Description: The Add-in allows the user to export all the collected data to PDF in the BOQ format.

Input: Selected types and all their collected data. Each type and its data are a separate object.

Processing: Extracting all collected data of the types and puts the data in the BOQ format and save the PDF file.

Preconditions: The collected data of each type must be validated.

Output: A ready to print PDF file.



2.1.2 System Users

A. Intended Users:

The intended user for this tool is the Tendering Engineers that typically work on construction projects. The tool would serve best the less experienced Tendering Engineers who need assistance with the course of their work.

B. User Characteristics

The user is expected to be qualified as a “Tendering Engineer” that knows how to gather wanted data and know how to use the BIM software like Revit.



Chapter 3

Implementation

3.1 Displaying the data

Our first step is to show the required data from the Revit model to the WPF in a usable fashion.

3.1.1 Tree View

In this view, the user can see all categories in the model inside each one is the types for each category. The tree view allows the user to filter categories and types according to levels and the user have the option to include linked models.

Approach

1. Start by establishing a connection between Revit and the WPF.
2. Displaying each category name in the parents' tree views.
3. Displaying the types' names in the children tree views.
4. Enable choosing for the required types or categories by checking the adjacent check box.
5. The user is able to choose to include other linked Revit links to the tree view.
6. In case of checking "include links" checkbox the tree view displays the model's and the linked models' categories and types.
7. In case of filtering by one level or many, the tree view only displays categories and types in those levels.



3.1.2 Grid View

In the code behind, the selected categories and type are collected in lists and then used to create a grid view, in which the user can choose the suitable unit of measurement, the division, section, and write a description.

The collected lists are sent back to the Revit model, to collect important data like the count, length, area, or volume.

Approach

1. Displaying each type so the user can choose the suitable unit of measurement, the division, section, and write a description.
2. Units' dropdown list is fixed including Length, Area, Volume, Perimeter and Count.
3. Divisions and Sections dropdown lists are imported from MasterFormat Excel file.

3.1.3 Export Excel

Generating a well-organized Excel file in which selected types are ordered according to CSI Master-Format. Creating a summary page and a separate worksheet for each division including headers for fixed titles, headers for each section and numbering its items. Adding measurement unit, rate, quantity and description for each item. Calculating totals for each division and for all divisions in the summary page.

Approach

1. Creating a summary page including project information and divisions totals.
2. Creating a separate worksheet for each division including fixed headers.
3. Sorting types according to section number, adding a header for each section, numbering each item included in the section.
4. Adding measurement unit, rate, quantity and description for each item.
5. Multiplying rate and quantity to generate total. Addition of each item total to create division total.
6. Linking divisions totals with the summary page.



3.1.4 Export PDF

Generating a ready to print PDF file in which selected types are ordered according to CSI Master-Format. Creating cover page including project name and address, summary page and a separate document section for each division including transition page, headers for fixed titles, headers for each section and numbering its items. Adding measurement unit, rate, quantity and description for each item. Calculating totals for each division and for all divisions in the summary page. Each page includes headers with project name and address, and footers with page number and creation date. Adjusting print settings including page layout, orientation and margins.

Approach

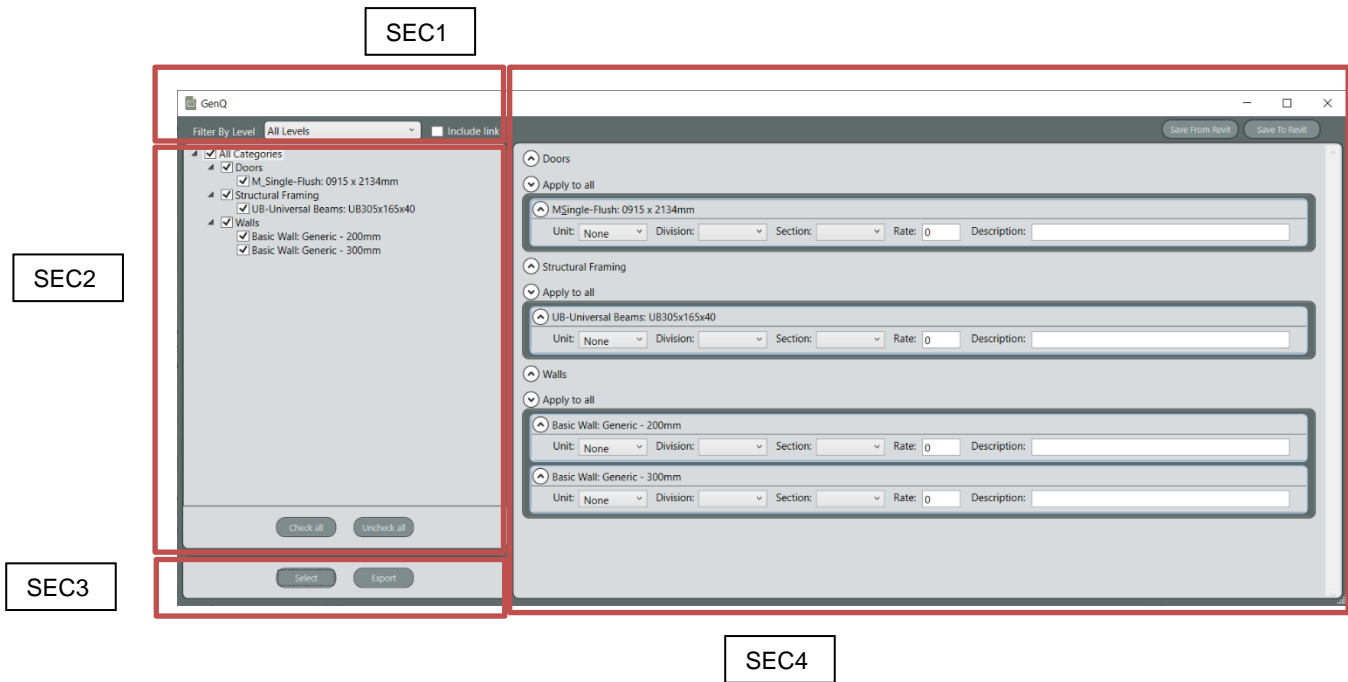
1. Using generated Excel package.
2. Creating a cover page including project name and address.
3. Creating headers for each page including project name and address.
4. Creating footer including page number and creation date.
5. Adding transition page between division including division name and number.
6. Adding print settings including page layout, orientation and margins.



Chapter 4

User Manual

4.1 Main UI





Filter By Level

All Levels

☐ Include link

2

1

- In SEC 1:

- 1: The user can include or exclude the linked Revit models in the filtration Process.
- 2: The user can filter by a specific level or more.

- In SEC 2:

- 1: The user can see a tree-view of filtered elements' types and can check all what's wanted.
- 2: The User can check/Uncheck all filtered elements' types.

1

☒ All Categories

☒ Doors

☒ M_Single-Flush: 0915 x 2134mm

☒ Structural Framing

☒ UB-Universal Beams: UB305x165x40

☒ Walls

☒ Basic Wall: Generic - 200mm

☒ Basic Wall: Generic - 300mm

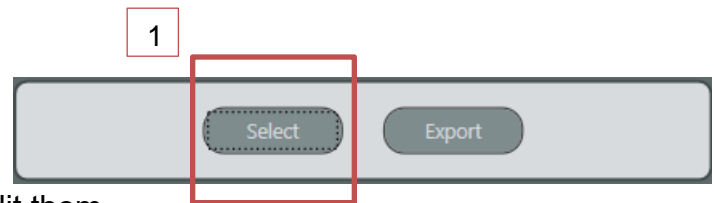
2

Check all

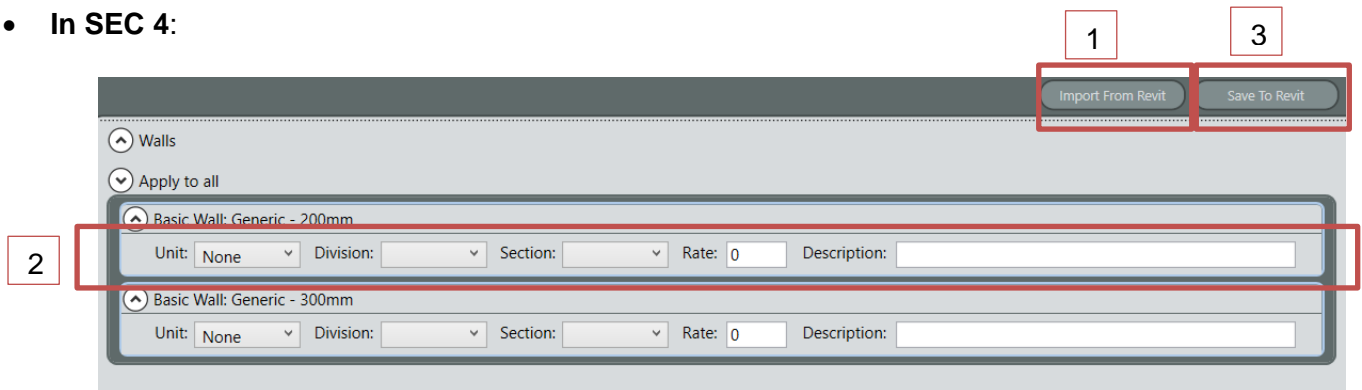
Uncheck all

- In **SEC 3**:

- 1: The User need to click on “Select” to view the checked elements’ types and then edit can edit them.



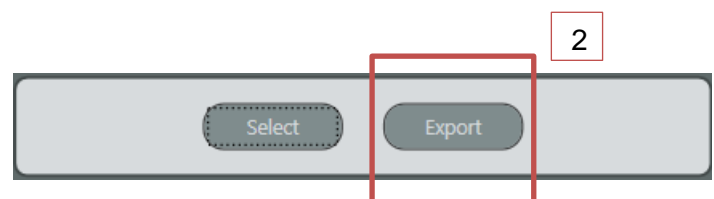
- In **SEC 4**:



- 1: The User can import saved data as Rate and Description for each type as they’re saved on the Revit Model.
- 2: The User need to input the following for each type:
 - Measurement Unit.
 - Destination Division.
 - Corresponding Section.
 - Rate.
 - Description.
- 3: The User can save the inserted Rate and Description data in the UI to its parameters in Revit Model.

- Back to **SEC 3**:

- 2: The User need to click on “Export” to open the export options window.





- **Export Options Window:**

The screenshot shows a web application window titled "GenQ | Export Options". The window is divided into two main sections. The left section contains a form with the following elements: two upload buttons labeled "Add Client Logo" and "Add Creator Logo" (callout 1); two text input fields labeled "Project Name" and "Project Location" (callout 2); and three buttons labeled "PDF Preview", "Export to PDF", and "Export to Excel" (callout 3). The right section is a large, empty white area with a vertical scrollbar (callout 4).

- 1: The User need to upload the Client/Creator Logos.
- 2: The User need to type the Project's name and location.
- 3: The User can preview the created BOQ's PDF before exporting, export the created BOQ's PDF, and export the created BOQ's xlsx file.
- The PDF Previewer.



Chapter 5

Conclusions and Future Work

5.1 Conclusions

Automation has become one of the most important technologies nowadays. Thus, GenQ is created, which is a fully-automated tool that facilitates the Tendering Engineers' work.

5.2 Future Work

Many different adaptations, tests, and experiments could be further studied to enhance the concept that has been proven throughout this paper. Future work concerns deeper analysis of particular mechanisms, new proposals to try different methods, or simply curiosity.

There are also some ideas that we would have liked to add as extra functionalities in our system other than those that are mentioned in Chapter 2. Those following functionalities could be:

- Providing Invoices Generating service.
- Generate BOQs regarding Model's Elements Materials not only Types.
- Including other international specification systems.