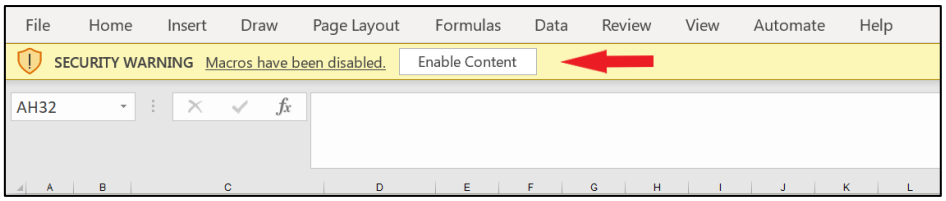
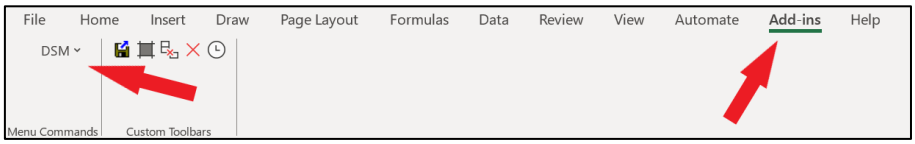
Initial Setup:

When opening the file, we need to allow the system to enable macros. This security feature safeguards against potential corrupted files and prevents damage to the PC. To enable macros, press the "Enable Content" button as shown in the figure:



After enabling macros, a new tab will appear in the top toolbar, providing access to DSM functionalities, as illustrated. The Add-ins tab includes Menu Commands and Custom Toolbar.



Now all sheets with their respective macros are functional.

Important Warnings:

1) Macros in the "Activities-Parameters" worksheet rely on specific cell references. Manually altering the relative positions of tables is strongly discouraged.

2) Formatting elements inserted are part of the VBA code and should not be modified manually.

3) Any changes must be made through the designated macro buttons.

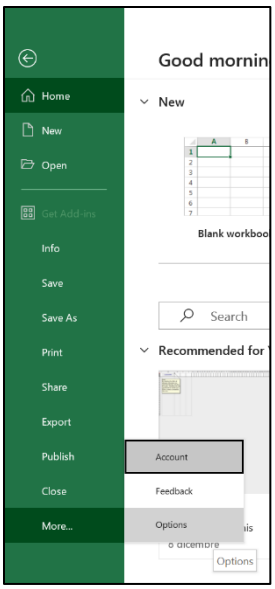
4) Manual changes are allowed only where explicitly indicated.

5) It is possible to make manual changes only where explicitly indicated.

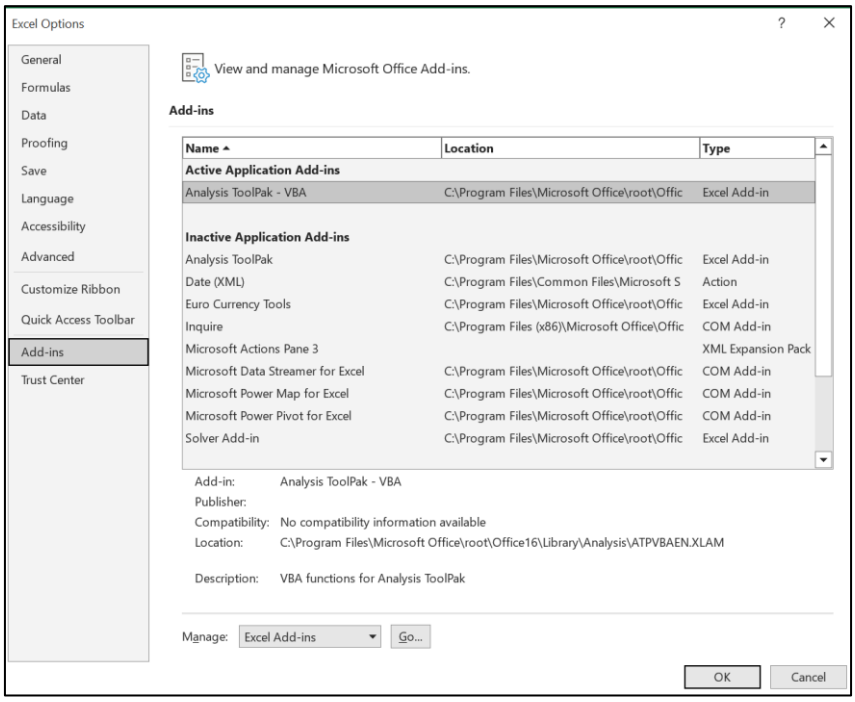
For any change or update the user wishes to make, in the “Activities-Parameters” worksheet, access to the control panel for macros and VBA programming is activated by pressing ALT+F11 key combination, and the module named “moduleDG” should be selected.

Excel File Update:

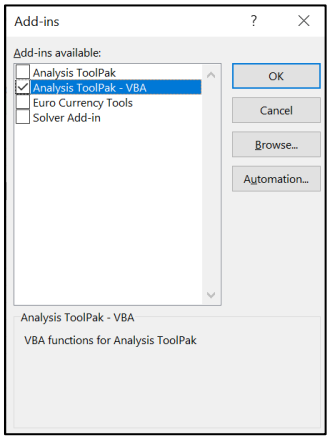
Before using the worksheet, ensure that macros are active (as indicated in the previous section) and update the VBA analysis tools for the entire file to function correctly. Follow these instructions: go to File> More... > Options.



From the Excel Options page, select > Add-Ins.

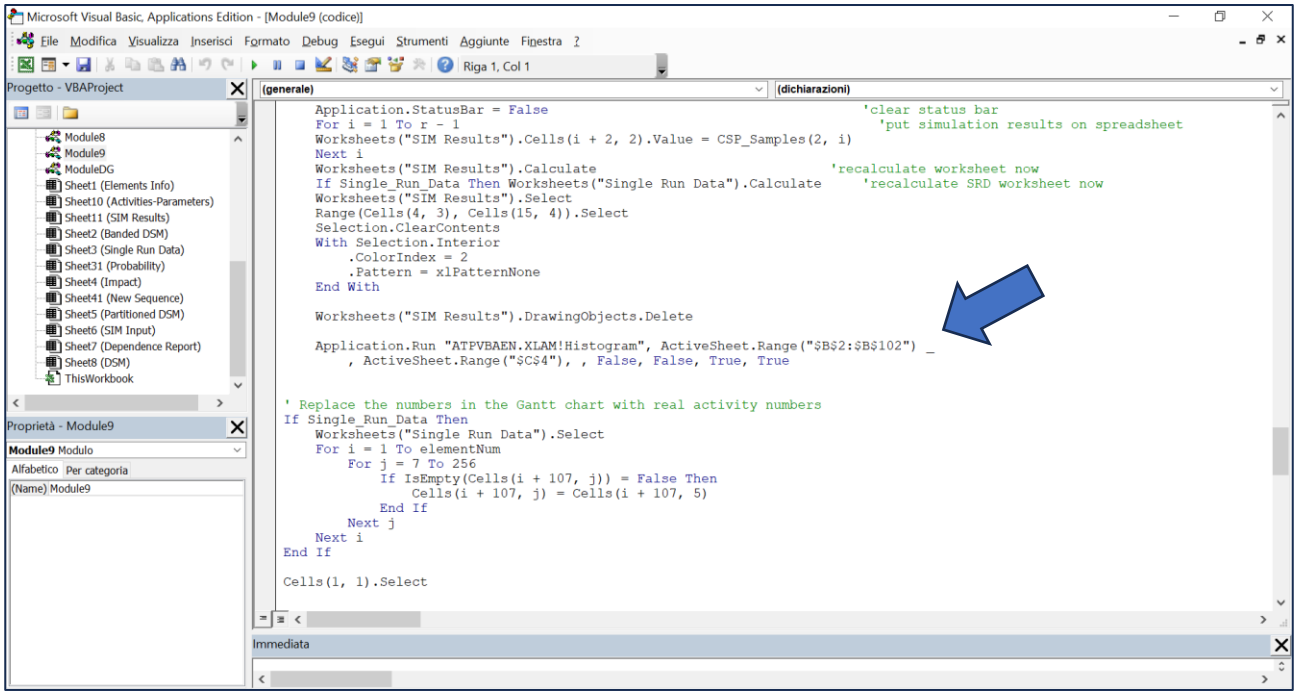


From the Inactive Application Add-Ins page, choose > Analysis ToolPak – VBA and click Go….



From the Add-Ins window, select > Analysis ToolPak – VBA with a checkmark and press OK.

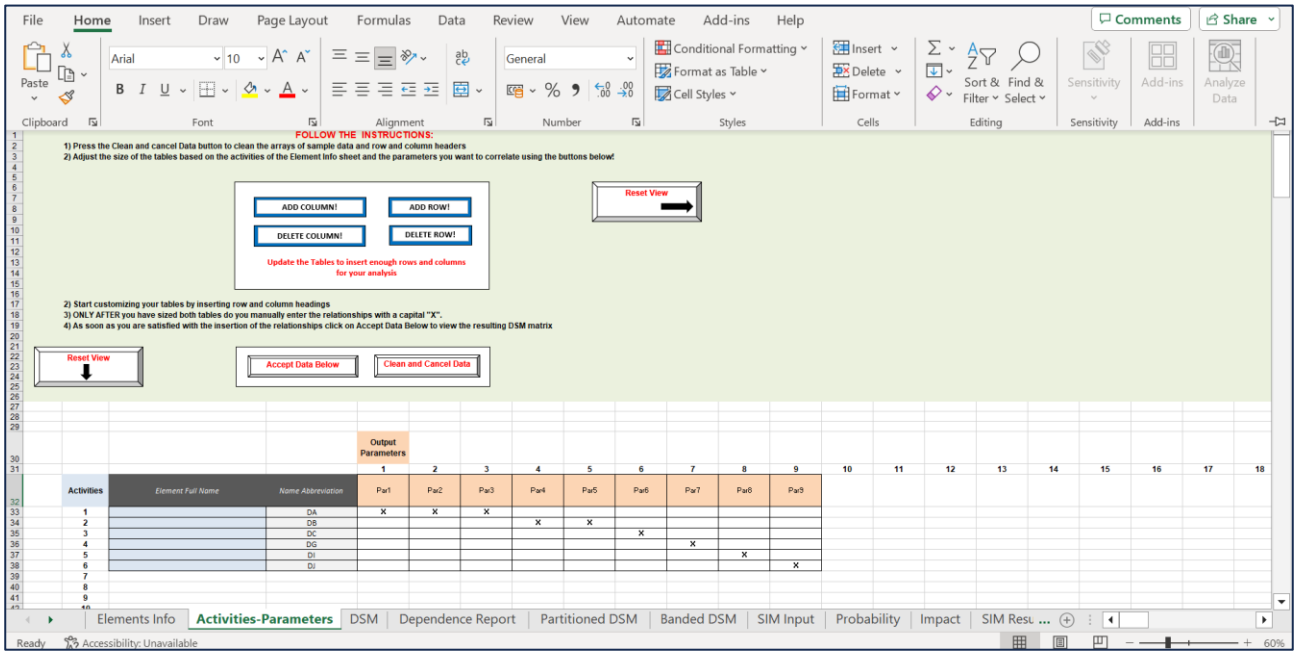
Now, the ATPVBAEN.XLA!Histogram functionality, in an obsolete format, has been replaced with ATPVBAEN.XLAM!Histogram with the XLAM extension, and the Sim Input page works correctly. Verify this if possible on the specific VBA programming module, which is Module 9.



Instructions for Using the "Activities-Parameters" sheet:

There are 12 worksheets in the Boston MIT file, with the highlighted sheet being the one implemented.

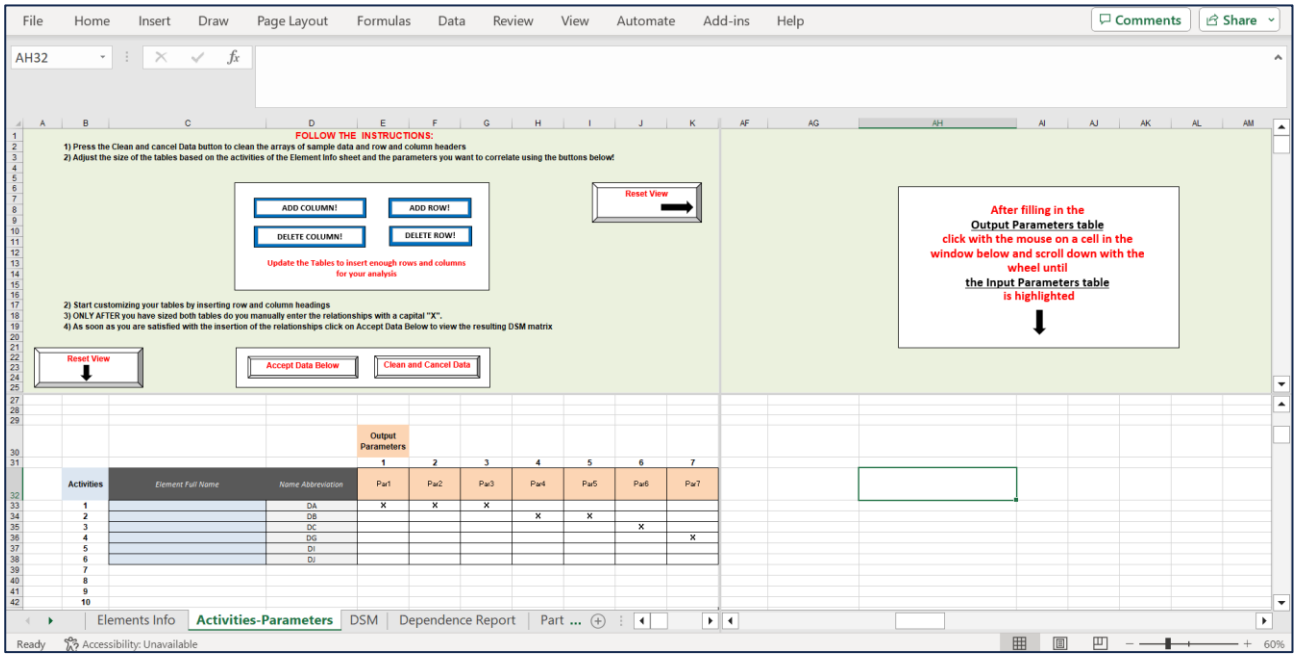
Follow the instructions closely to avoid rendering the macros unusable. After clicking on the "Activities-Parameters" worksheet, this is what should appear:



This worksheet generates a DSM matrix with a maximum size of 50x50 from two DMM matrices of maximum dimensions 50x20, where 20 is the maximum number of implementable parameters.

Set the zoom to 13% to highlight the working areas. There are three zones: the Output Parameters Activity table zone, the Input Parameters Activity table zone, and the DSM matrix zone. To better navigate within the sheet, set the zoom to 60%, position the cursor on cell L43 where it says DO NOT DELETE, go to the View menu, and select Split. Now, the sheet is divided into four sections that can be scrolled using both sidebars and the mouse wheel after clicking a cell within the area. Manually move the horizontal division until it is between row 25 and row 26. The vertical division should be positioned between column K and column L. Click a cell in the bottom-left box and then click the Reset View button with the downward arrow. Repeat this process for the top-right box: click a cell, then click the Reset View button with the right arrow, as shown.

The page is now set up correctly for data entry and should appear as follows:



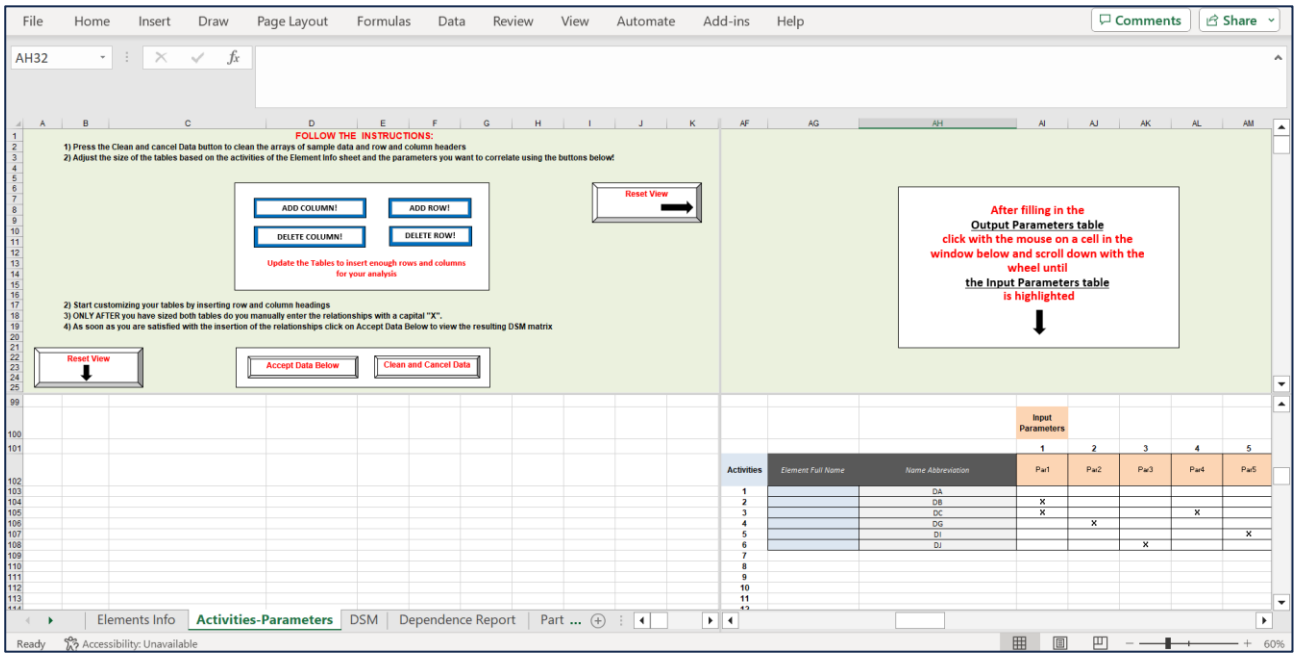
The data entry occurs initially by populating the table appearing in the bottom-left box. However, even before addressing the entry of relationships, we must correctly size the table according to your needs using the buttons in the central box: it is possible to add or delete a row or delete a column. It is not possible to delete all rows or columns, as attempting to do so will trigger an error message from the system. Press the Clean and Cancel Data button to clear the tables of sample data.

Formatting should not be manually changed, as it contributes to VBA code functionality.

As table dimensions change, the second table, still invisible, and the DSM matrix table change accordingly. Therefore, changes should only be made to the first table and are automatically transmitted to the rest of the tables in the sheet. After sizing the table, customize the study by entering row and column headers and abbreviations if necessary. Relationships can now be entered by placing "X" in uppercase. The first table is completed. Move the cursor to the bottom-right box and scroll down to highlight the second table, ready to be customized with necessary information. This mode is indicated in the top-right box with instructions to follow.

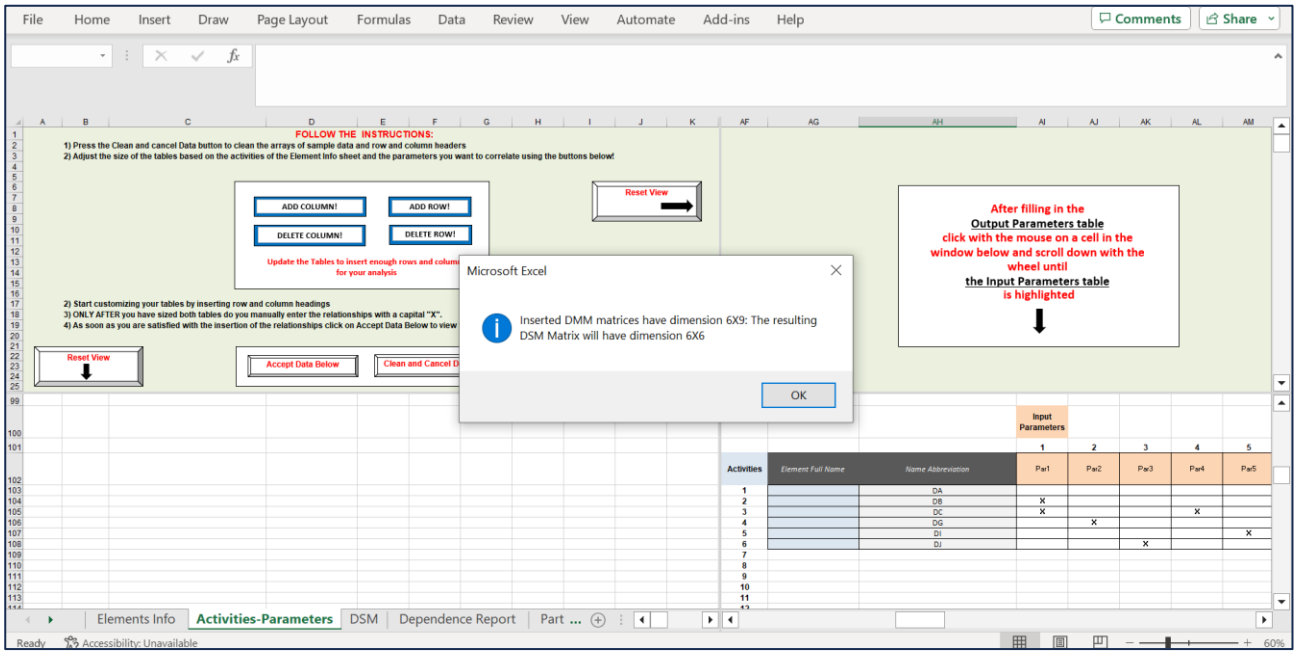
It is crucial to emphasize that relationships should be described by entering uppercase "X"!

This is the screen with the second table ready:



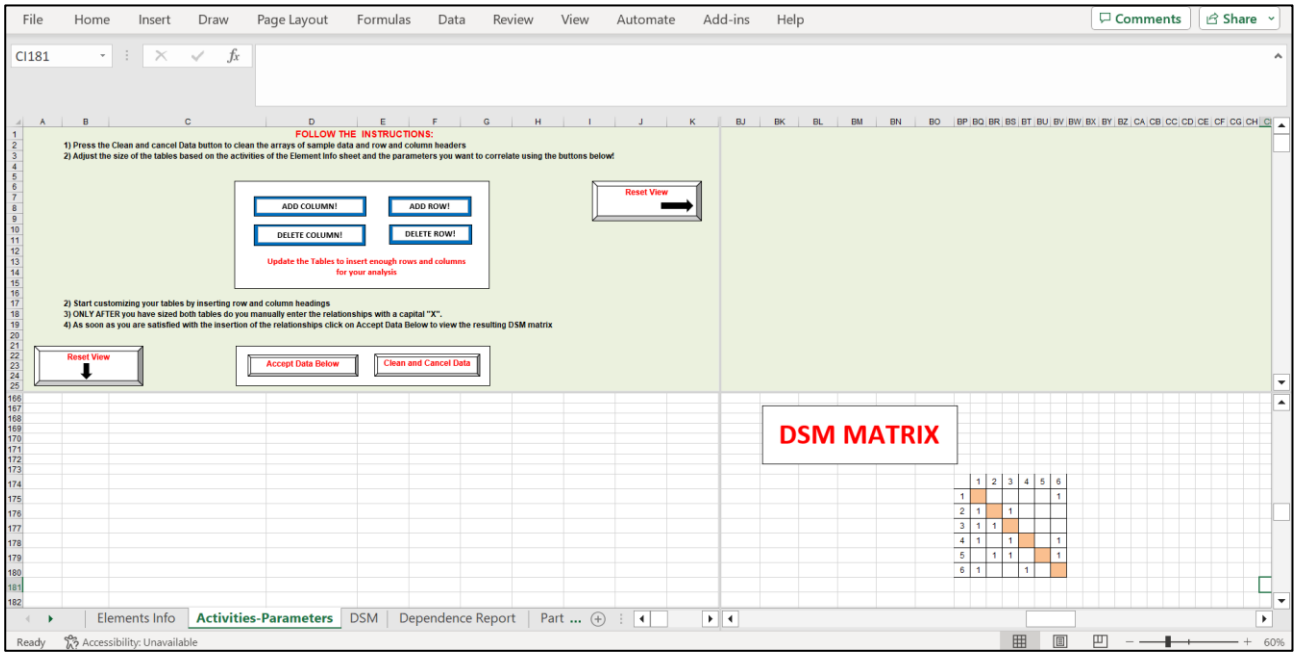
Now, we are ready to accept the entered data and generate the DSM matrix by pressing the Accept Data Below button.

This is what will appear:



The box displays information about the dimensions of the just-filled data tables and the size of the DSM matrix to be generated. Once the OK button is pressed, the DSM matrix with the entered relationships between activities is shown in the bottom-right box. The relationship is highlighted by the presence of the number 1.

This is what will appear on the screen:



At this point, it will be possible to copy and paste the obtained result into the DSM worksheet and, after updating the data, proceed with the study of the production process.

Any changes should not be made to the matrix manually but by pressing the Clean and Cancel Data button and starting over with modifications to the Output table. This button clears the DSM matrix and erases the data entered in the two tables.

Click a cell in the bottom-left box, press the Reset View button with the downward arrow to return to viewing the Output table, then click a cell in the top-right box, and press the Reset View button with the right arrow to return to viewing the box with instructions. We are now ready to restart with modification operations. If you are more comfortable with full-screen mode, you can navigate the page using zoom and side-scroll bars. For this reason, I provide the coordinates of the cells identifying the tables to make them easily locatable in the ways you deem appropriate. Refer to the Important Reference Cells section.

Important Reference Cells:

Output Parameters Activity Table: Cell reference B30

			Output Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA	x	x	x						
2		DB				x	x				
3		DC						x			
4		DG							x		
5		DI								x	
6		DJ									x

Input Parameters Activity Table: Cell reference AF100

			Input Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA									x
2		DB	x					x			
3		DC	x			x					
4		DG		x				x			x
5		DI					x	x			x
6		DJ			x				x		

DSM Matrix: Cell reference BP174

	DA	DB	DC	DG	DI	DJ
DA						1
DB	1		1			
DC	1	1				
DG	1		1			1
DI		1	1			1
DJ	1			1		

Explanation of the Algorithm for DSM Matrix Formation:

Calculate the first column of the DSM matrix so that the construction logic becomes clear. The DSM matrix convention adopted is the IR convention (Input in Row), the same as that used in calculations in the Excel worksheet. The method involves scanning all relationships in the first row of the Output Parameters Activity table (first column of the DSM matrix) and finding all relationships that match through "X" signs in the second table, as shown.

Step 1:

			Output Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA	x	x	x						
2		DB				x	x				
3		DC						x			
4		DG							x		
5		DI								x	
6		DJ									x

			Input Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA									x
2		DB	x					x			
3		DC	x			x					
4		DG		x				x			x
5		DI					x	x			x
6		DJ			x				x		

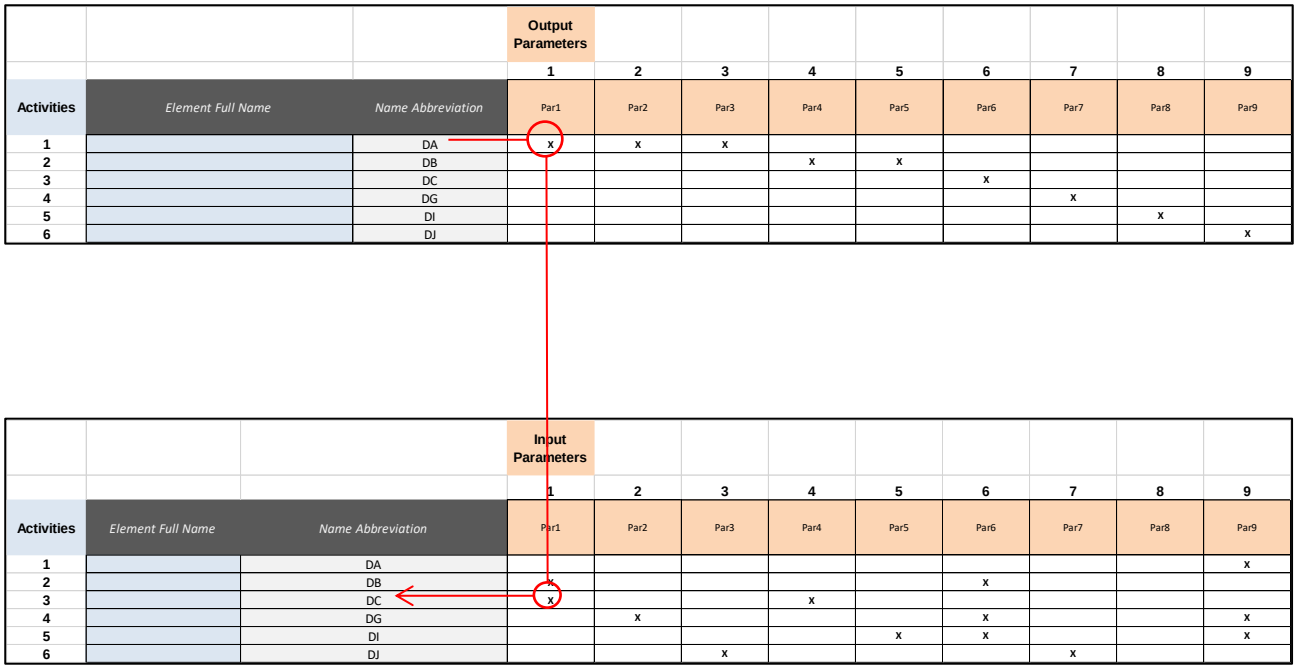
Data entry starts from the first column DA and places the relationship on row DB through the insertion of the number 1.

	DA	DB	DC	DG	DI	DJ
DA						
DB	1					
DC						
DG						
DI						
DJ						

The element has been positioned correctly in the DSM matrix.

Step 2:

The first column of the second table presents another relationship that needs to be considered as shown.



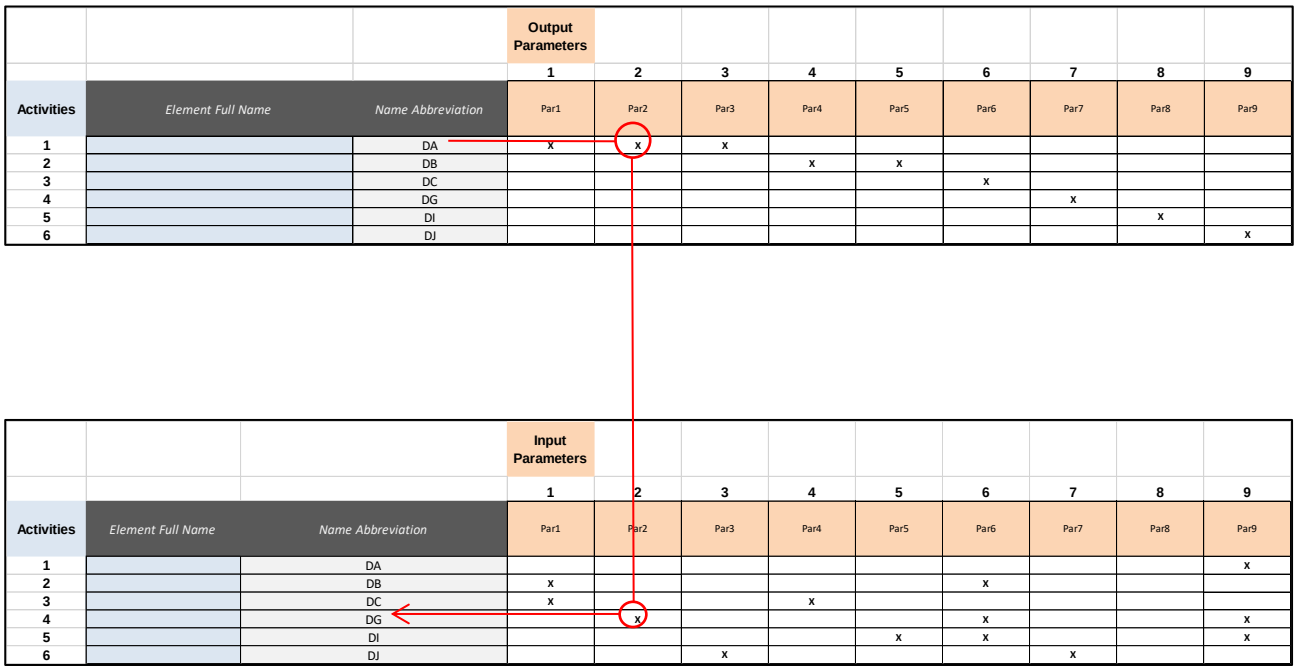
			Output Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA	x	x	x						
2		DB				x	x				
3		DC						x			
4		DG							x		
5		DI								x	
6		DJ									x

			Input Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA									x
2		DB	x					x			
3		DC	x			x					
4		DG		x				x			x
5		DI					x	x			x
6		DJ			x				x		

Data entry into the DSM matrix starts again from the first column DA and places the relationship 1 on row DC.

	DA	DB	DC	DG	DI	DJ
DA						
DB	1					
DC	1					
DG						
DI						
DJ						

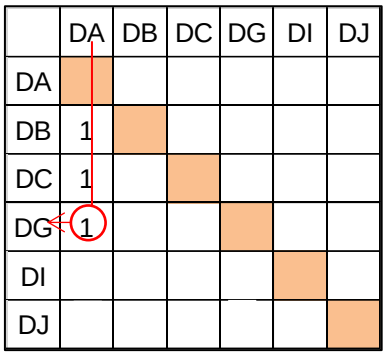
Step 3:



			Output Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA	x	x	x						
2		DB				x	x				
3		DC						x			
4		DG							x		
5		DI								x	
6		DJ									x

			Input Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA									x
2		DB	x					x			
3		DC	x			x					
4		DG		x				x			x
5		DI					x	x			x
6		DJ			x				x		

Data entry starts again from the first column DA, placing the relationship 1 on row DG.



	DA	DB	DC	DG	DI	DJ
DA						
DB	1					
DC	1					
DG	1					
DI						
DJ						

Step 4:

			Output Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA	x	x	x						
2		DB				x	x				
3		DC						x			
4		DG							x		
5		DI								x	
6		DJ									x

			Input Parameters								
			1	2	3	4	5	6	7	8	9
Activities	*Element Full Name*	*Name Abbreviation*	Par1	Par2	Par3	Par4	Par5	Par6	Par7	Par8	Par9
1		DA									x
2		DB	x					x			
3		DC	x			x					
4		DG		x				x			x
5		DI					x	x			x
6		DJ			x				x		

Insert the last relationship of column DA, placing 1 on row DJ.

	DA	DB	DC	DG	DI	DJ
DA						
DB	1					
DC	1					
DG	1					
DI						
DJ	1					

The first column is completed, and we move to the second column, i.e., we consider row DB of the Output Parameters Activity table and proceed in the same way as before. At the end of the process, the DSM matrix is populated with all relationships, and this is the final result.

	DA	DB	DC	DG	DI	DJ
DA						1
DB	1		1			
DC	1	1				
DG	1		1			1
DI		1	1			1
DJ	1			1		

Acknowledgments:

This work does not claim to be exhaustive or capable of solving all problems. It is a project that can be improved and expanded in its functionalities, and, above all, it can be adapted to the needs of those who will use it in their studies. Its goal is to provide an additional working tool that can enhance the approach to constructing a DSM matrix for a production process. The inspiration to include this functionality came from a careful reading of scientific articles and numerous practical examples that I have reviewed. According to these readings, deriving the DSM matrix from the "product" of two DMM matrices simplifies the work for experts in the field to delve into the various stages of the production process under study. I successfully applied this approach in my experimental thesis, gaining direct experience.

I would like to express my gratitude to Uninettuno University (https://www.uninettunouniversity.net/) and, in particular, to my advisor Prof. Andrea Falegnami, for giving me the opportunity to engage in this work, rich in insights and useful from a theoretical, computational, and practical perspective. I hope that, with this effort, I have added a small piece to an operational tool of the highest value crafted by professionals and scholars in the field, coming from a place that, in my opinion, represents a global excellence: the Massachusetts Institute of Technology in Boston (https://www.mit.edu/).

I extend my thanks to Prof. Tyson Browning (https://www.tysonbrowning.com/), who generously allowed me to exchange ideas with him, providing material of great interest for a deeper understanding of the DSM. I am particularly grateful for his interest in my experimental thesis work; this fills me with pride and satisfaction.

Useful links for a better understanding of the DSM tool:

- [DSM Web](https://dsmweb.org/)

- [DSM Conference](https://dsm-conference.org/)