

Exclusion Calculator Pro 2.6: Reference manual

January 2023

Sam Waller, Joy Goodman-Deane, Mike Bradley, P. John Clarkson

Cambridge Engineering Design Centre, University of Cambridge

NB: Excel's functionality to 'undo' is not available while working within Exclusion Calculator Pro.

Explanation: The inability to 'undo' is an unfortunate, but unavoidable, consequence of the custom Visual Basic code that is used within the calculator.

Table of Contents

1. Introduction	2
1.1 Read Me: Important notes on the behaviour of the software related to the licence key	2
1.2 Assumptions for this reference manual.....	2
1.3 Understanding the Ribbon.....	2
1.4 Understanding the Worksheets	3
1.5 Format of each worksheet.....	3
2. Getting started with an assessment	4
2.1 Task analysis.....	6
2.2 Hierarchical task analysis	7
2.3 Demand assessments.....	9
2.4 'Harder than' demand assessments.....	11
2.5 Assessment comments	12
3. Exclusion assessment results	13
3.1 Exclusion results for each task	13
3.2 Vision difficulty for each task.....	13
3.3 Results for task codes	14
3.4 Graphs	15
3.5 Changing the demand ratings	17
Appendix 1: Version history	18
Appendix 2: Original survey questions	20
Appendix 3: Re-profiling the survey data for different time periods and countries	24
Appendix 4: Liability, copyright, usage and distribution.....	25
Appendix 5: Importing audits from old versions of the Exclusion calculator	26
Appendix 6 How the DIGNITY survey data is used within EC Pro	27
Appendix 7 Data Flow Diagram.....	28

1. Introduction

1.1 Read Me: Important notes on the behaviour of the software related to the licence key

- The Excel file may not be distributed outside of the licensed organisation, because the licence key is embedded in this file. Furthermore, the licence key itself may not be distributed outside of the licensed organisation.
- The licence key is stored in each sheet of the Excel file in a cell that is just underneath the cells for specifying the age and gender of the target population. The text colour of this cell has been set to white so that the licence key cannot be seen by a passing observer. If you click on this cell, you will be able to see the licence key in the 'formula bar' at the top of the Excel sheet.

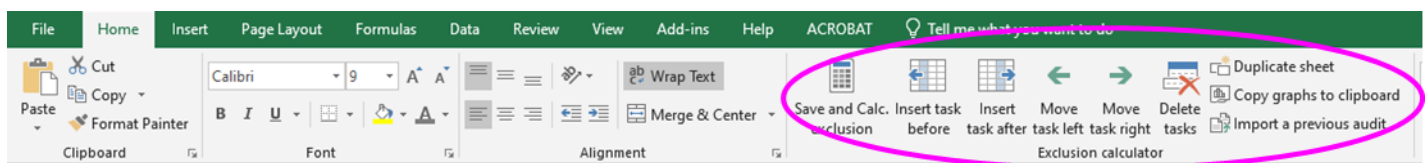
1.2 Assumptions for this reference manual

This reference manual provides detailed instructions on how to use Exclusion Calculator Pro, but does not explain how to perform an exclusion audit. It is assumed that assessors already know how to do this, and are not Microsoft Office novices.

If required, training on performing exclusion audits is available from the Engineering Design Centre, as part of our consultancy services.

1.3 Understanding the Ribbon

The Exclusion Calculator Pro contains extra buttons in the 'Home' tab of the toolbar ribbon, as shown below. These buttons perform specific actions related to exclusion calculations, as described in the rest of this manual.



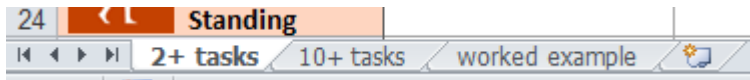
1.4 Understanding the Worksheets

The Excel file contains several worksheets (also called *sheets*). Three are provided to start with:

- 2+ tasks: This sheet contains a blank task analysis with two tasks in it. More tasks can be added if desired.
- 10+ tasks: This sheet contains a blank task analysis with ten tasks in it. More tasks can be added if desired.
- Worked example: This sheet contains a worked example

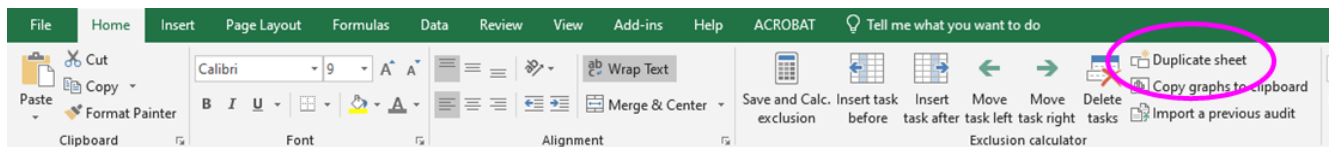
How to:

- **Move between sheets:** Click on the tabs at the bottom of the sheet



- **Rename a worksheet:** Right-click on the tab for the worksheet that you want to rename. Select *Rename* from the menu.

- **Duplicate a sheet:** press the ribbon button labelled *Duplicate sheet*, as shown below.



Alternatively, you can right click on the name of the spreadsheet, and then select 'move or copy', and make sure the box labelled 'create a copy' is ticked.

The new sheet can then be renamed following the instructions above. Using multiple sheets in a single workbook is very convenient for comparing products with each other – we recommend that you use one sheet per product. There is no limit on the number of sheets you can use, apart from the file size and memory implications.

1.5 Format of each worksheet

Colour-coding for cells that the user is expected to modify

As an example, consider the blank sheet named '2+ tasks'. The user is expected to modify all of the cells that are white, and leave all the other cells alone.

These white cells include the demand ratings, and other information about the tasks

Cells for demand ratings change colour once a rating has been entered. Pale grey indicates low demand, and dark grey indicates a high demand. Red indicates a demand assessment that is 'harder than' the available scale points (see Section 2.4).

Colour-coding for cells that the user should not edit



Yellow: Results will be displayed in these cells.



Turquoise: Excel uses these cells for internal calculations, etc. Please do not modify them.



Pale purple: Labels and row headings.

Furthermore, the headings for each of the different capabilities use a colour that matches the colour of the icon for that capability.

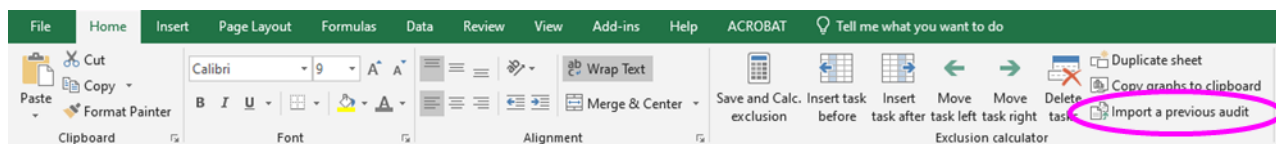
Graphs

Graphs of the results are shown on the right of each worksheet. Please do not modify them or they will not be generated or regenerated properly.

2. Getting started with an assessment

Importing assessments from previous versions of the exclusion calculator

If you want to take a previous exclusion audit, and perform calculations based on country/year combinations that have been added after this audit was performed, you will need to use the button that has been specifically programmed for this purpose, as shown below. Instructions for using this button are provided in Appendix 5.



It is fine to copy and paste cells between different sheets in the same file, or between sheets in different files, provided the files have the same version number. It is fine to move sheets between one file and another, provided the files have the same version number.

HOWEVER, DO NOT MANUALLY COPY AND PASTE CELLS BETWEEN CALCULATOR FILES WITH DIFFERENT VERSION NUMBERS. DO NOT MOVE SPREADSHEETS BETWEEN CALCULATOR FILES WITH DIFFERENT VERSION NUMBERS. The spreadsheet may break if you do this.

Recording overall assumptions

Assessors can enter overall information about each assessment in the table on the right of each worksheet, as shown opposite. In particular, it is important to record the 'user goal being assessed' and the 'user scenario'. The latter includes assumptions about the initial state, location, user's prior experience etc. Use these cells to record assumptions that justify the scope of the tasks that are assessed, so that the analysis can be justified at a later stage.

Please note the following points.

Country and Year of population data

See Appendix 3 for the list of countries that are available, and the years of population data that are available for those countries. If you choose UK 1997, the exclusion calculations will use the dataset from the 1997 Disability Follow-up Survey. If you enter any other country or year, the calculator will adjust the UK 1997 source data so that it matches the age/gender profile (or projected age/gender profile) for the appropriate country and year. See Appendix 3 for more details.

Access to countries other than UK is only possible if your licence key allows it. If it doesn't, then you will get an error message when you attempt to calculate the exclusion.

If you wish to purchase access to any additional territory/year combinations, please contact edc-toolkit@eng.cam.ac.uk

Licence Key

Gender (B=both, M or F)	B
Licence Key (in white)	

A key must be entered in this cell. The colour of the text in this cell has been set to white so that it is invisible, in order to help prevent accidental disclosure of this key. See Appendix 4 for more details on licensing.

- When the button to calculate the exclusion is clicked, exclusion results will be returned, if the licence key is valid and in-date. If the licence key is invalid or expired, the calculator will indicate an error and prompt the user to renew their licence.
- After the licence key has expired, the licensee may keep any exclusion calculations that have been previously performed, but new exclusion calculations cannot be performed. If any changes are made to a spreadsheet that contains exclusion calculations (after the licence key has expired), then all previously calculated results on this sheet results will be lost, and the licence key must be renewed if they need to be recalculated.
- The calculator requires an internet connection in order to check the licence key, and access the underlying population database, which is stored on a University of Cambridge file server. If the

K	L	M	N
	Product name		
	Purpose of assessment		
	User goal being assessed		
	User scenario (including assumptions about: initial state, location, user's prior experience, motivation, general strategy for achieving the goal etc.)		
	Country	UK	
	Year of population data	2017	
	Min. age (16 is lowest)	16	
	Max. age (102 is highest)	102	
	Gender (B=both, M or F)	B	
	Licence Key (in white)		

calculator is not able to access the Internet, or if the University of Cambridge file server is not responding, it will alert the user accordingly.

2.1 Task analysis

A single worksheet assesses a single linear task sequence. If desired, the worksheet can be copied to analyse different task sequences, different ways of achieving the same goal or different products.

We recommend that you describe the tasks on sticky notes first, as a team exercise with a wide group of stakeholders. This helps to ensure that everyone understands and agrees to the scope and purpose of the assessment, before commencing the detailed analysis.

The names of tasks should be entered into row 4 of the sheet, between the turquoise stripes, as shown in the image below.

	A	B	C	D	E	F	G	H
1								
2	Task No.			1	2			
3	Task code							
4	Task name							
5	Task comments e.g. Task details, Rationale, Consequences, Alternatives, Core tasks / Supplementary task, issues / positives found							

Each task is automatically given a task number, and this is automatically updated whenever the custom buttons are used to add, rearrange or delete tasks. If you move or delete tasks using Excel features such as 'delete column', then you may need to correct the task numbers manually.

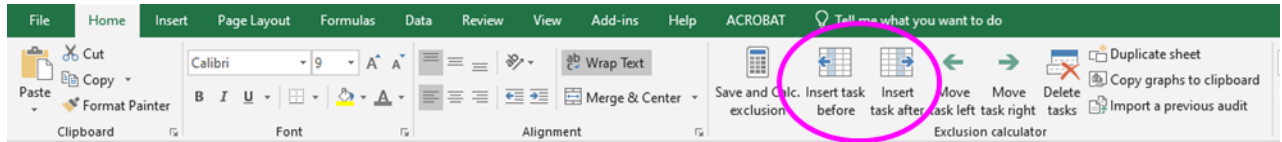
The task codes can be used to support a hierarchical task analysis, as described in Section 2.2.

The exclusion analysis is based on a single user scenario, which comprises a single linear series of tasks, where every task is necessary. The user scenario should be chosen to represent a 'typical' use case that is 'important' for your business. Inclusive design is about improving the design of mainstream products, without the need for special adaptation. Therefore, 'coping strategies' that may be adopted by users with particular limitations should be considered as 'out of scope' for the task analysis.

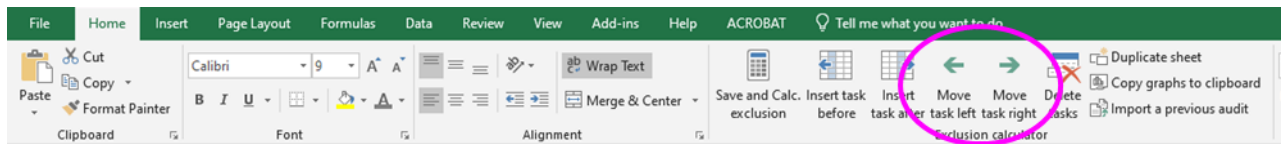
In order to reach a simplified model of a single linear series of tasks, it is necessary to make lots of assumptions and justify why this particular way of achieving the goal has been chosen for analysis. Please use the 'task comments' row to record these assumptions, so that the task analysis can be justified at a later stage. You may also wish to use the task comments to record things such as whether the task is 'core' or 'supplementary', how frequently it occurs, what happens if a user fails to complete the task successfully, other ways the task could be achieved or how the design could be improved.

How to:

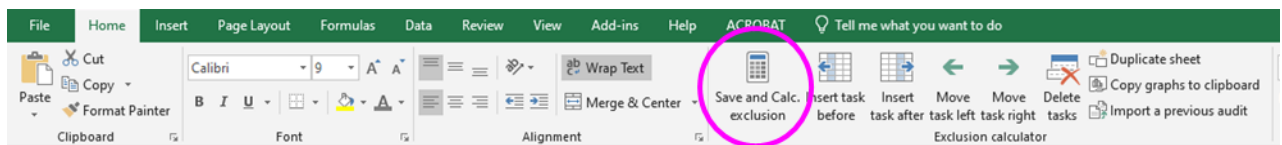
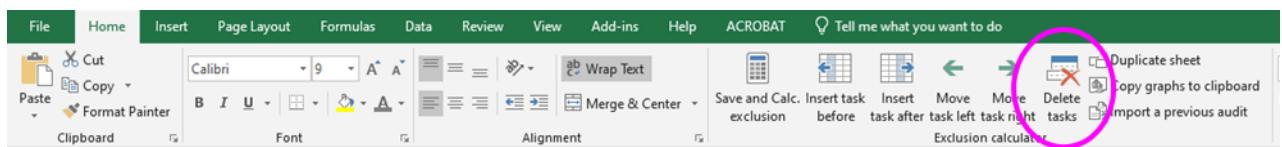
- **Add a new task:** Click on one of the buttons circled in pink below:



- **Move a task:** Click on the column associated with task that you want to move, then click on one of these buttons circled below:



- **Delete one or more tasks:** Click on one or more column(s) associated with task(s) that you want to delete. Click *DELETE TASK*. Note that this action CANNOT be undone.



- **Add a line break to text inside a cell:** When editing text inside a cell, you can press ALT+ENTER to give you a line break. This is particularly useful for describing the 'user scenario', which may involve a lot of text.

2.2 Hierarchical task analysis

Each worksheet is capable of supporting a hierarchical task analysis by using the rows labelled 'task code' and 'task name', as shown below.

	A	B	C	D	E	F	G	H
1								
2		Task No		1	2			
3		Task code						
4		Task name						
5		Task comments						
		e.g. Task details, Rationale, Consequences, Alternatives, Core tasks / Supplementary task, issues / positives found						

Task codes are used to describe top-level tasks, such as *Purchase*, *Setup*, *Main use* and *End of life*. Task names describe lower-level tasks, such as *Go to shop*, *Find item* and *Pick up item*. Each task code is repeated across several columns that describe the lower-level tasks within that task code. For example, the

code '*Purchase*' might be used in the columns for the task names: *Go to shop*, *Find item* and *Pick up item*. The worked example sheet shows how this works in practice.

There is no limit to the number of tasks or the number of task codes that you can use. The calculator has been tested with over 100 tasks.

When the spreadsheet calculates exclusion, it draws together the demand assessments for each of the task codes. For each task code, it chooses the highest demand assessment in any of its constituent tasks. A summary results area is produced on the right of the demands area. This shows the demands and exclusion associated with each separate task code.

There is no single correct task analysis, and no single correct set of task codes. It is rare to complete an assessment without changing your mind several times regarding the appropriate number of tasks and the set of task codes used. A task analysis is a simplified model, and its scope is necessarily limited to avoid information overload.

Furthermore, the level of detail of the analysis should be appropriate for the purpose of the assessment. For example, if the purpose of the assessment is to improve the detailed design of an easy-open packaging feature, you would expect the task analysis to separate out finding this feature, gripping it and releasing it. Each of these tasks would share the task code of *Open pack*. For many other purposes you might consider all of these as a single task: *Open pack*, which might have a task code of *First use*.







The task codes are particularly useful when benchmarking one product against another. Each product may be used in a slightly different way, and so have a different detailed-level task analysis. However, for comparative purposes, the task codes allow you to define a set of codes that are identical for all the products being compared, such as *Purchase*, *Setup*, *First use*, *Main use* and *End of life*.

Alternatively, if you are considering a single product in detail, you might want to use task codes to separate out 'core' user tasks from 'supplementary' or 'optional' user tasks.

2.3 Demand assessments

For each task, assess the demands made on the user's capabilities in rows 7-24 as shown on the right.

We recommend that the assessor considers the demands on every capability in every task, and that ratings are explicitly set to '0' for each capability that is 'not required'. Otherwise, there is no way to tell the difference between 'the assessor decided this capability is not required' and 'the assessor didn't think about this at all'.

6			
7		Vision by glasses	
8		Hearing	
9		Concentration	
10		Memory	
11		Literacy	
12		Speech Comp.	
13		Speaking	
14		Strength	
15		Dexterity	
16	Dominant	Forward/Up	
17		Down	
18		Strength	
19		Dexterity	
20	Non Dominant	Forward/Up	
21		Down	
22		Walking	
23		Stairs	
24		Standing	

Intentionally blank (do not touch!)









Vision assessments

Vision demand assessments are made using Cambridge Simulation Glasses, which are available for sale from the [Inclusive design toolkit](#). Feedback from earlier projects indicated that the previous vision assessment method of comparing against text sizes does not achieve robust and repeatable assessments in many cases. As a result, this assessment method has been removed from the Excel version of the calculator. It is still available in the online version for introductory and workshop purposes where the glasses might not be available. The prompt box opposite guides the assessor through the instructions for the assessments. This box also appears when you click on one of the vision demand assessment cells. Enter the number of glasses directly into Excel, or enter "X" if there is no need to see anything. The meaning of ">" is described in Section 2.4.

The background colour of the cell is shaded so that things that are harder to see have a darker background colour, and "1x glasses" is the darkest grey. Note that features that are hard to see correspond to low numbers of glasses, because they cannot be seen with higher levels of vision impairment simulation.

Vision: Assess by glasses

Wear 6 pairs of Cambridge Simulation Glasses and attempt the task. Maintain a typical viewing distance; do not lean closer. Remove glasses one at a time, until the things needed to complete the task can be seen easily and quickly. Then enter the number of glasses you are wearing:

Rating	Description
X	 No need to see anything
6	 6 x glasses
5	 5 x glasses
4	 4 x glasses
3	 3 x glasses
2	 2 x glasses
1	 1 x glasses
>	 Cannot see it with 1 x glasses, or cannot see it wearing no glasses, or scenario prevents use of visual aids

N.B. The assessor should have good vision, or fully corrected vision wearing glasses or lenses.

6		
7		Vision by glasses

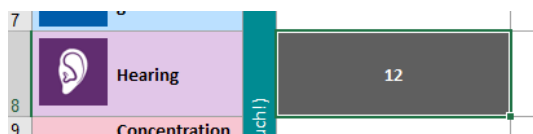
1
x 1 glasses

Hearing, Thinking, Reach, Dexterity and Mobility assessments

By default, when you click on one of the demand assessment cells, a set of *rating tips* will appear. An example is shown on the right. This provides guidance on how to perform the rating and explains what the different possible ratings correspond to.






The assessments are made by entering a number between 0 and 12 or the symbol ">". The meaning of ">" is described in Section 2.4.

The background colour of the cell is shaded according to the severity of the demand, where an assessment of 12 gives the darkest grey.



Hearing

Rate the demand of the task against the scale below

Rating	Description
0	 No need to hear anything
4	 Understand loud speech in a quiet room
8	 Use telephone without special adaptations for hearing impairment
12	 Follow conversation against background noise
>	 Harder than these, or scenario prevents use of hearing aids

2.4 'Harder than' demand assessments

The Disability Follow-up Survey that underpins the exclusion calculator aimed to define a threshold for 'able-bodied' vs 'disabled'. This threshold was set based on the impact of the capability loss on quality of life, and was intended to be equivalent across the different capability categories. The survey only intended to recruit participants whose ability might be below this threshold (about one quarter of the population), and only asked questions relating to ability levels below this threshold.

The survey provides no information on the other three quarters of the population, which are assumed to be fully able. This tool therefore underestimates exclusion, especially for mild or temporary impairments.

When assessing mainstream products, it is often the case that some tasks are 'harder than' the available scale points that are provided. The symbol ">" can be used to record such assessments, and the picture opposite shows an assessment where every single capability has been assessed as 'harder than' the available scale points.






By definition, a demand that is harder than the available scale points means that some unknown proportion of 'fully able' users will be excluded. This should be evidence enough that something needs to be done about it. The corresponding demand assessments are highlighted in red to indicate the importance of this.

In order to show an exclusion number for 'harder than' assessments, the exclusion is calculated for the highest possible demand that is available within the survey. However, by definition, the actual exclusion will be more than the number shown.

For all product audits that have been conducted by the Engineering Design Centre, the first step in prioritising improvements has been to focus on anything that is 'harder than' the available scale points. In order to support this prioritisation, any exclusion values associated with 'harder than' demands are also highlighted in red. A first step towards an inclusively designed product would be a completed exclusion audit without any results in red. Once this first threshold has been achieved, the actual exclusion numbers can help to prioritise the next set of improvements.

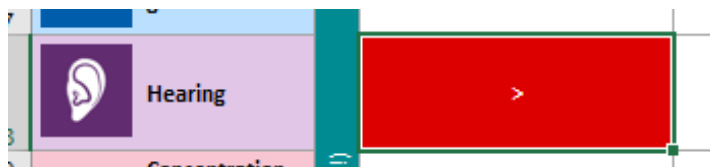
A vision cell is shaded red if the vision demand is "Cannot see it with 1x glasses". This corresponds with the task being 'harder than' the scale point available within the underlying survey (see Section 2.3). By definition, this means the demand is above the level that we would consider to be 'acceptable'. (Note that lower demands may also be unacceptable, depending on the circumstances.)

For other capabilities, a demand cell is shaded red if the assessment is 'harder than' the hardest available scale point. This means that the demand is outside the range covered by the underlying survey. By

		Vision by glasses		> (cannot see it)
		Hearing		>
		Concentration		>
		Memory		>
		Literacy		>
		Speech Comp.		>
		Speaking		>
		Strength		>
		Dexterity		>
		Forward/Up		>
		Down		>
		Strength		>
		Dexterity		>
		Forward/Up		>
		Down		>
		Walking		>
		Stairs		>
		Standing		>

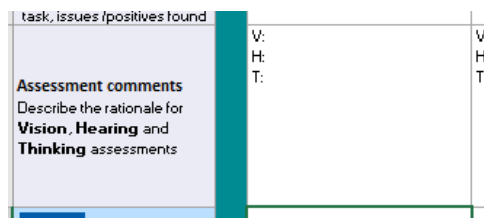
Intentionally blank (do not touch!)

definition, this means the demand is above the level that we would consider to be 'acceptable'. (Note that lower demands may also be unacceptable, depending on the circumstances.)

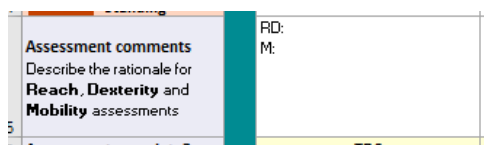


2.5 Assessment comments

It is sometimes necessary to revisit an assessment at a later date, perhaps because the product or scenario has changed and the implications of this need to be considered. In order to facilitate this, assessors should enter a rationale for each of the demand ratings in the rows labelled *Assessment comments*. There are two such rows: the assessment comments for Vision, Hearing and Thinking are placed in cells just above the demand assessment area, as shown below.



Similarly, the comments for Reach, Dexterity and Mobility should be entered in the cells just below the demand assessment area, as shown below.



The comments should describe the exact feature that was assessed and justify the rating given to it.

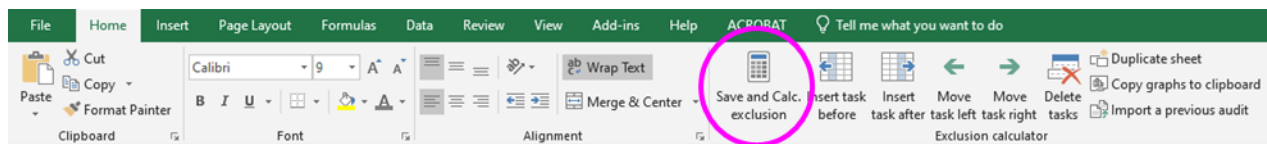
Baseline demands

Some demands apply over the whole task sequence, rather than applying to individual tasks. This is often the case for Thinking demands such as Concentration. In these cases, rate the overall demand for the task sequence, and then enter this value identically for every task. You may find it helpful to use Excel's 'drag-fill' feature for this purpose, which you can access by clicking on the little square in the bottom right-hand corner of the cell. Indicate this in the *Assessment comments* associated with the first task in the sequence, identifying it with the word "BASELINE" so that it can be correctly interpreted at a later stage.

Note that sometimes individual demands are higher than baseline. Care should be taken not to overwrite these demands with baseline demands. Thus it is better if the baseline assessments are done first.

3. Exclusion assessment results

When the demand ratings have been entered, click the button labelled 'Save and calculate exclusion' within the ribbon. This will also automatically save the worksheet, in case Excel crashes while trying to connect to the Internet.



3.1 Exclusion results for each task

For each task, the corresponding exclusion values are shown in the yellow cells at the bottom of each task column, as shown below.

25	Assessment complete?	Y	Y	Y	Y	Y
26	Exclusion (%)	15.6%	7.8%	8.7%	8.6%	5.3%
27	Vision only (%)	4.1%	1.1%	1.1%	0.0%	1.0%
28	Hearing only (%)	7.4%	0.0%	0.0%	2.3%	0.0%
29	Thinking only (%)	4.4%	4.2%	4.4%	4.5%	1.9%
30	Reach & dex only (%)	0.0%	4.1%	5.3%	4.1%	3.3%
31	Mobility only (%)	0.0%	0.0%	0.0%	0.0%	0.0%

For each task, the row titled 'Assessment complete?') indicates whether the assessment for that task is complete. 'Y' means that a rating has been entered for every capability row, 'N' means there are one or more blank rows.

Exclusion values are highlighted red if they correspond with any assessments that are outside the range of the underlying survey. According to the scope of the underlying survey, this means the demand is higher than the level that we would consider acceptable (see Section 2.4). These values therefore represent the highest priority issues.

3.2 Vision difficulty for each task

Additionally, percentages for 'Vision Difficulty' are reported on a separate line, below the exclusion results, as shown below.

31	Reach & dex only (%)	5.8%	4.4%	5.6%
32	Mobility only (%)	0.0%	0.0%	0.0%
33	Vision Difficulty (%)	43.9%	3.6%	3.6%
	see user manual			







These results are calculated from the German version of the DIGNITY survey (2020), which is available from here <https://upcommons.upc.edu/handle/2117/367811>. More details on the results from this survey can be found in this report (<https://www.dignity-project.eu/wp-content/uploads/2022/03/DIGNITY-D1.2-final.pdf>). See Appendix 6 for more detail on how the DIGNITY survey data is used to calculate vision difficulty percentages.

Note that the reported difficulty percentages are considerably higher than all of the exclusion percentages. This is because the German DIGNITY survey:

- Covers the whole range of vision ability, whereas the dataset that is used for exclusion calculations did not include any tasks harder than 'reading ordinary newspaper'.
- Asked people to identify the row that was comfortable for them to see, quickly and with certainty. Therefore, the results give an indication of the number of people who might have difficulty with a particular task, rather than the number of people who cannot do it at all.

3.3 Results for task codes

If any task codes are used in row 3 (see Section 2.2), then a summary is generated of the demands for each code. In each case the highest demand assessment for that code is shown. These summaries are shown in columns to the right of the tasks, as shown in the worked example provided in the spreadsheet, and also below.

5	Task comments e.g. Task details, Rationale, Consequences, Alternatives,	Summary for each task code			Overall demands
	Assessment comments Describe the rationale for Vision, Hearing and Thinking assessments	Prepare	Main use	Finish	
6					
7	 Vision by glasses	1 x L1 glasses	4 x L1 glasses	5 x L1 glasses	1 x L1 glasses
8	 Hearing	0	8	0	8
9	 Concentration Memory Literacy Speech Comp.	12	12	12	12
10		12	12	12	12
11		4	2	0	4
12		0	4	0	4
13	Speaking	0	0	0	0
14	 Strength Dexterity Forward/Up	>	1	0	>
15		0	6	0	6
16		0	4	0	4
17	Down	0	0	0	0
18	 Strength Dexterity Forward/Up	0	4	4	4
19		0	4	6	6
20		0	8	4	8
21	Down	0	0	0	0
22	 Walking Stairs Standing	0	0	0	0
23		0	0	0	0
24		0	0	0	0
25	Assessment comments				not used
26	Assessment complete?	Y	Y	Y	not used
27	Exclusion (%)	10.9%	10.5%	8.3%	12.9%
28	Vision only (%)	4.4%	1.2%	1.1%	4.4%
29	Hearing only (%)	0.0%	2.6%	0.0%	2.6%
30	Thinking only (%)	4.6%	4.7%	4.5%	4.8%
31	Reach & dex only (%)	5.8%	5.6%	4.6%	7.5%
32	Mobility only (%)	0.0%	0.0%	0.0%	0.0%
33	Vision Difficulty (%)	43.9%	3.6%	0.0%	43.9%
	see user manual				

The final column on the right hand side is for 'overall demands'. This picks out the highest demands encountered across the whole task sequence.

All of these summary demand values are shaded in grey or red to indicate their severity, in the same way as the underlying assessments.

The exclusion associated with the task codes, the vision difficulty, and the overall exclusion are provided underneath the corresponding columns. Exclusion values are highlighted in red if they correspond with any assessments that are outside the range of the underlying survey.

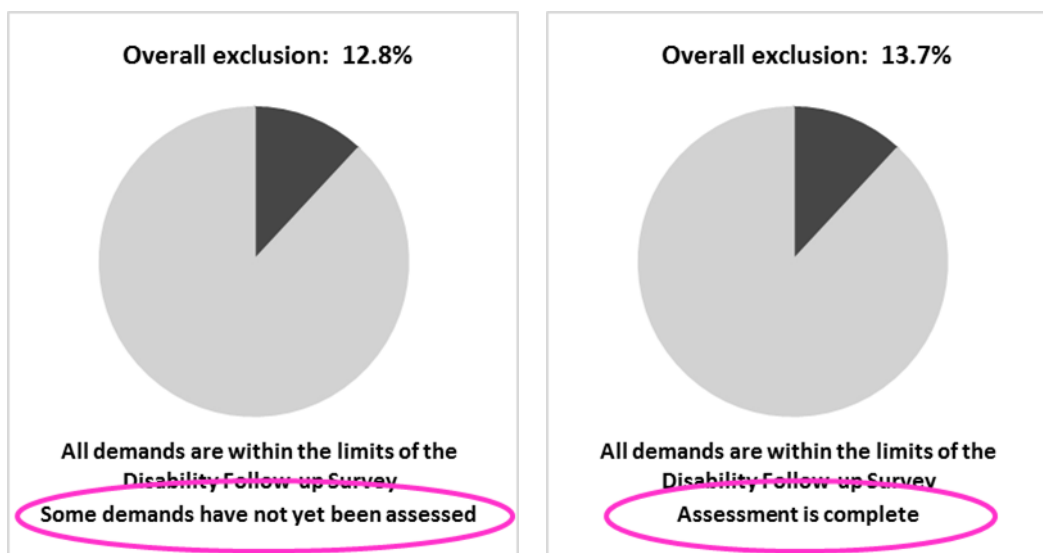
3.4 Graphs

A pie chart and bar graph of the overall exclusion values are shown on the right of the worksheet.

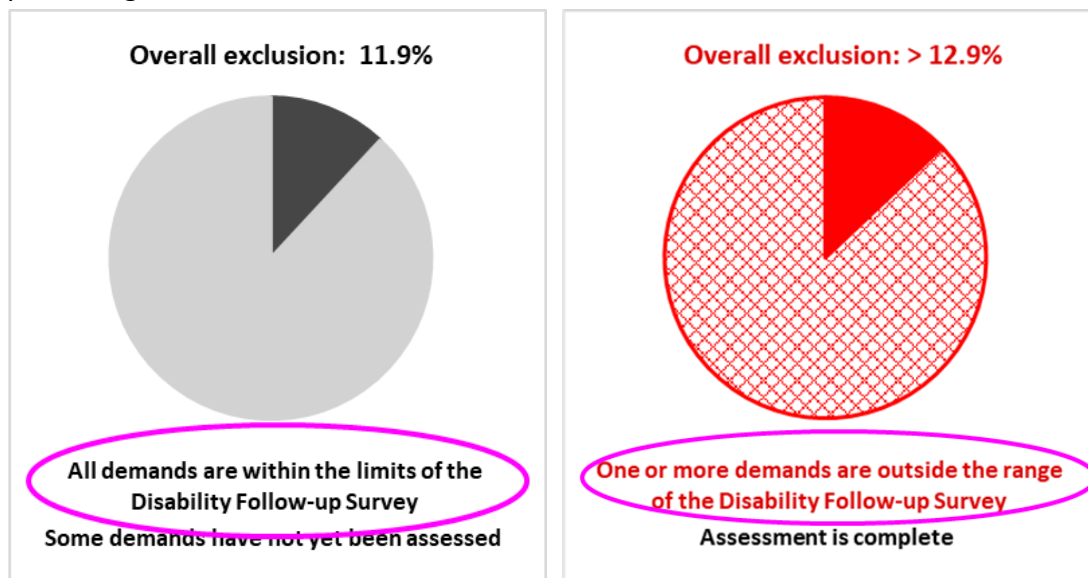
Pie chart

Note that the overall pie chart includes two additional important pieces of information:

1. **Is the overall assessment complete?** This indicates whether every demand has been assessed for every task. The different options are shown below. The ideal situation is that the assessment is complete.

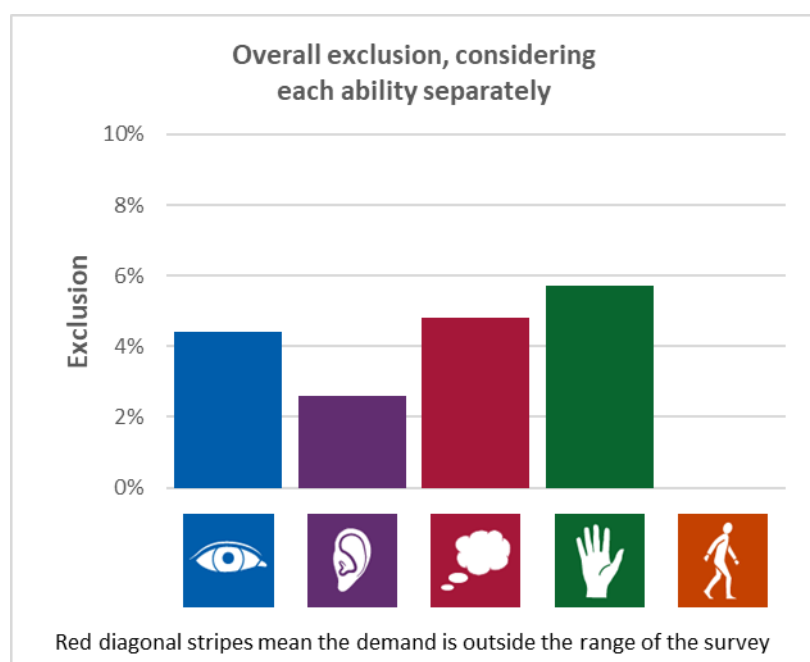


2. **Are all demands within the limits of the Disability Follow-up Survey?** If any of the demands are outside the limits of the survey (see Section 2.4), then both the pie segment and the statements above and below it are displayed in red to indicate the importance of this. The corresponding exclusion values presented elsewhere in the spreadsheet are also highlighted in red. Given that the demand ratings have exceeded the limits of the underlying survey, all exclusion values are underestimates, and should be considered a priority to resolve, regardless of the actual exclusion percentage.

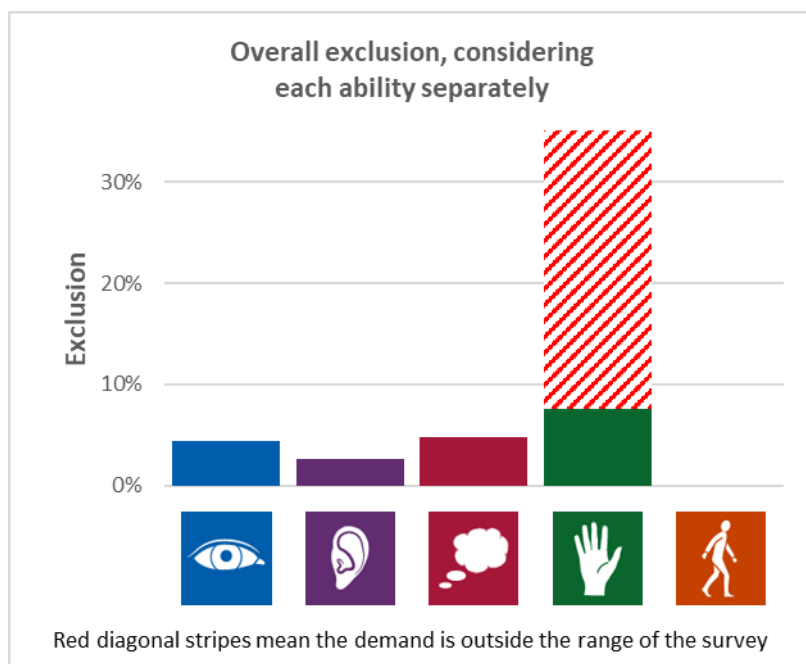


Bar graph: Breakdown of exclusion by capability

A bar graph is produced that shows the exclusion considering each ability separately. Note that the overall exclusion is different from the result that would be obtained by adding up these separate exclusion values. This is because the overall exclusion avoids 'double counting' people who have more than one capability loss.

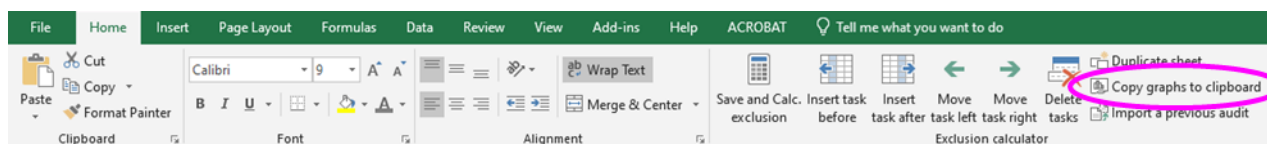


Exclusion values associated with any 'harder than' demand assessments show an expanded area of red diagonal stripes, to indicate that the actual exclusion is somewhere above the known maximum for that capability, as shown below.



Copying the graphs

To copy the graphs to another document, use the button within the ribbon:



Click the button, then switch to your desired application and press Ctrl+V to paste the graphs. Pasting the graphs directly without using the button will omit some of the details on the graphs.

3.5 Changing the demand ratings

If you change any of the demand ratings, the results will all change to TBC (to be calculated). To see the new results, click the button labelled “Calculate exclusion” again.

Appendix 1: Version history

This calculator is constantly being developed. If you spot any other bugs or errors, or would like to request additional functions or features, please e-mail edc-toolkit@eng.cam.ac.uk. Please include a screenshot of the calculator if appropriate.

Improvements made between EC 2.6 and EC 2.5

- Added 2030 datasets for USA, Brazil, UK, South Africa, China, Indonesia, India, Turkey, Kingdom of Saudi Arabia.
- Moved the list of available countries and years to the welcome page
- Updated the interface for selection of country and year, so that the drop-down list only shows entries that the licensee has access to.
- Moved the licence key to the welcome page
- Added a new button in the toolbar that automates the process of importing a previous audit
- Fixed an anomaly in the source data sets that are used to predict exclusion for China, Japan, India and Asia, for the year 2025. Exclusion values are now slightly lower than previously predicted. If vision, thinking, dominant hand and non-dominant hand are set to maximum, the differences are as follows:

Country / year	Exclusion for maximum demand on vision, thinking, dominant and non-dominant hand	
	EC 2.6 onwards	EC 2.1 - EC 2.5
China 2025	13.4%	14.3%
Asia subset 2025	12.1	12.9%
Japan 2025	20.0%	22.1%
India 2025	10.4%	11%

Given that the anomaly had a minimal effect on the exclusion values, the change is unlikely to affect any conclusions that have been drawn from calculations with these datasets. Nevertheless, if you would like to automate the process of updating any previous calculations, see Appendix 5 for details of the toolbar button that has been programmed specifically for this purpose.

Improvements made between EC 2.5 and EC 2.4

- Added welcome page
- Updated error notification messages to include contact email from welcome page
- Added data flow diagram to user manual (Appendix 7)

Improvements made between EC 2.4 (2022 release) and EC 2.1 (March 2017 release)

- Updated graphs so that off scale is presented as diagonal hatching on the capability graph, and crosshatching on the pie chart
- Introduced assessment of 'out of scope', which is treated as equivalent to 0
- Updated citation and disclaimer text
- Fixed a bug that caused graphs to move around and resize
- Fixed a bug that meant exclusion sometimes went over 100%, if the age range was set to be very high
- Fixed a bug that meant demand scale tip boxes got unnecessarily duplicated many times within the sheet, meaning file sizes became unnecessarily large
- Switched to https rather than http for communicating with Cambridge fileservers
- Added some more error checking to give graceful error messages, rather than runtime errors, when the exclusion calculation fails because of corporate firewall issues or HTML redirects.
- Added the capability to assess by vision row numbers of a Test Chart, for those who have been trained to do so
- Added vision difficulty percentages, based on the German version of the DIGNITY survey

Improvements made between EC 2.1 (2021 release) and EC 2.0.3 (March 2017 release)

- Moved calculator buttons into the ribbon
- Fixed a bug associated with the way the calculator reuses values it has already calculated, which should considerably improve the speed of calculations
- Fixed a bug where cell colours didn't necessarily always update properly
- Added extra datasets (China 2025, Japan 2025, India 2025, Asia subset 2025)
- Changed the method for detecting which datasets have been purchased. The available datasets are now embedded within the licence key.
- If any of the demands are off scale, the text box that says 'overall exclusion' now includes a ">", and is coloured red
- Under the bonnet: Changed the code for calculating exclusion, and the target population. The calculated values have not changed as a result.

Improvements made between EC 2.0.3 (March 2017 release) and EC 2.0.2 (February 2017 release)

The "issue where results are unreliable on very small target populations (e.g. small age ranges)" has been solved by limiting the input of age to five-year bands, with a customised start and customised end range. Essentially we rejected any age band where there were less than 20 males or less than 20 females in the underlying survey with any kind of capability loss. This means 16-19 doesn't exist (the minimum possible band at the start is 16-24), and everything over 85 is just 85-100.

Appendix 2: Original survey questions

- The exclusion calculator uses a capability database that was derived from the "Disability Follow-Up to the 1996/97 Family Resources Survey"
- This survey was conducted by the Office of National Statistics on behalf of the UK government.
- It recruited approximately 7500 participants living in private households in Great Britain, between the ages of 16 and 102.
- Uniquely this measured co-occurrence of impairments to vision, hearing, thinking, reach and stretch and mobility.
- More information on this survey is available from the UK Data Service by following this link: <https://discover.ukdataservice.ac.uk/Catalogue/?sn=4090&type=Data%20catalogue>.

The original questions in this survey relate to the demand scales used in this calculator as follows:

Scale name	Original survey questions
Vision	<ul style="list-style-type: none"> • (Wearing glasses or lenses...) Can you see well enough to read a newspaper headline • (Wearing glasses or lenses...) Can you see well enough to read a large print book? • (Wearing glasses or lenses...) Do you have difficulty reading ordinary newspaper print?
Hearing	<ul style="list-style-type: none"> • (Wearing your hearing aid...) Can you hear someone talking in a loud voice in a quiet room without difficulty? • (Wearing your hearing aid...) Can you use an ordinary telephone? • (Wearing your hearing aid...) Do you have great difficulty following a conversation if there is background noise - for example a TV, radio or children playing?
Thinking (Concentration)	Do you often forget what you are supposed to be doing in the middle of something?
Thinking (Memory)	Do you often forget the names of people in your family or friends whom you see regularly?
Thinking (Understanding text)	Could you read a short newspaper article?
Thinking (Speech comprehension)	Do you have any difficulty understanding what other people say or what they mean (exclude language difficulties)?
Thinking (Speaking)	Do other people have any difficulty understanding you (exclude language difficulties)?

Dominant / Non-Dominant Handedness (This question was used in producing the Strength, Dexterity and Reach scales)	<ul style="list-style-type: none"> Are you left-handed, right-handed or ambidextrous?
Dominant hand (Strength)	<ul style="list-style-type: none"> Can you pick up and hold a mug of coffee or tea with your left/right hand? Can you pick up and carry a pint of milk with your left/right hand? Can you pick up and carry a 5lb bag of potatoes with your left/right hand? <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above.</p>
Dominant hand (Dexterity)	<ul style="list-style-type: none"> Can you turn a tap or the control knobs of a cooker with your left/right hand? Can you pick up a small object, like a safety pin with your left/right hand? Can you use a pen or pencil without difficulty? <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above. An exception was the question about using a pen or pencil. This was asked for the dominant hand only.</p>
Dominant hand (Reach forward/up)	<ul style="list-style-type: none"> How difficult is it for you to hold your left/right arm out in front of you to shake hands with someone? (not difficult, difficult, impossible) How difficult is it for you to put your left/right hand up to your head to put a hat on? (not difficult, difficult, impossible) How difficult is it for you to put your left/right hand above your head to reach something above you? (Not difficult, difficult, impossible) <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above. For the purposes of the exclusion calculator, the answers were simplified to 'possible' or 'impossible'.</p>
Dominant hand (Reach down)	<ul style="list-style-type: none"> Can you bend down far enough to touch your knees and straighten up again, holding on if necessary? Can you bend down and pick something up from the floor and straighten up again, holding on if necessary? Can you bend down to sweep something up with a dustpan and brush and straighten up again, holding on if necessary? <p>These questions were combined with the Handedness question above, and with the question about holding your arm out to shake hands, to determine if the dominant hand/arm is functional.</p>

Non-Dominant hand (Strength)	<ul style="list-style-type: none"> • Can you pick up and hold a mug of coffee or tea with your left/right hand? • Can you pick up and carry a pint of milk with your left/right hand? • Can you pick up and carry a 5lb bag of potatoes with your left/right hand? <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above.</p>
Non-Dominant hand (Dexterity)	<ul style="list-style-type: none"> • Can you turn a tap or the control knobs of a cooker with your left/right hand? • Can you pick up a small object, like a safety pin with your left/right hand? <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above.</p>
Non-Dominant hand (Reach forward/up)	<ul style="list-style-type: none"> • How difficult is it for you to hold your left/right arm out in front of you to shake hands with someone? (not difficult, difficult, impossible) • How difficult is it for you to put your left/right hand up to your head to put a hat on? (not difficult, difficult, impossible) • How difficult is it for you to put your left/right hand above your head to reach something above you? (Not difficult, difficult, impossible) <p>The individual questions referred to the left or right hand. To create the scale in the calculator, this was combined with the Handedness question above. For the purposes of the exclusion calculator, the answers were simplified to 'possible' or 'impossible'.</p>
Non-Dominant hand (Reach down)	<ul style="list-style-type: none"> • Can you bend down far enough to touch your knees and straighten up again, holding on if necessary? • Can you bend down and pick something up from the floor and straighten up again, holding on if necessary? • Can you bend down to sweep something up with a dustpan and brush and straighten up again, holding on if necessary? <p>These questions were combined with the Handedness question above, and with the question about holding your arm out to shake hands, to determine if the dominant hand/arm is functional.</p>
Mobility (Walking)	<ul style="list-style-type: none"> • What is the furthest you can walk on your own, without stopping and without severe discomfort (walking with a stick etc. if used)? (At least 200 yards, less than 200 yards but at least 50 yards, less than 50 yards but more than a few steps, only a few steps) • Do you have difficulty walking for a quarter of a mile on the level (include walking with sticks or other walking aids)?
Mobility (Stairs)	<ul style="list-style-type: none"> • Can you walk up and down one step on your own? • Can you walk up and down a flight of 12 stairs on your own? (without holding on and without stopping for a rest, by holding on

	but without stopping for a rest, by holding on AND stopping for a rest, not at all)
Mobility (Standing)	Do you need to hold on to something to keep your balance? (All the time, quite often, only occasionally, not at all)

Appendix 3: Re-profiling the survey data for different time periods and countries

Important notes:

- The capability database that the calculator uses is derived from a survey that was conducted in the UK in 1997 (as described in Appendix 2).
- The Exclusion Calculator Pro 2.1 (onwards) is capable of estimating exclusion estimates for alternative countries and years.
- **However, the calculator does not use data that was actually collected from the target country / year, because the data required for the exclusion calculations only exists for the UK in 1997.**
- For any other country/year, the calculations are done by reprofiling the age and gender distribution of the UK 1997 capability database, so that it matches the age and gender distribution of the target country / year.
- This reprofiling assumes that the percentage of people with capability loss in each age and gender group is the same for the target country / year as it was for UK in 1997.
- Therefore, the reprofiling does not account for differences in capability loss due to different health situations, such as increased prevalence of conditions such as diabetes and obesity, or different healthcare provision. Neither does it account for the changes in the development and availability of assistive technology.

And most importantly

- THE MORE THE HEALTH PROFILE OF THE TARGET COUNTRY / YEAR DIFFERS FROM THE UK IN 1997, THE LESS ACCURATE THESE ESTIMATES ARE LIKELY TO BE.
- Extra caution should be taken in using and interpreting the results for 'Asia subset' as this combines several countries, even though these countries are considerably different, especially with respect to their healthcare provision.
 -

Appendix 4: Liability, copyright, usage and distribution

Liability

The University of Cambridge shall not be liable for any indirect or consequential damage, injury (whether for loss of profit, loss of business, depletion of goodwill or otherwise), costs, expenses or other claims for consequential compensation whatsoever (howsoever caused) which arise out of or in connection with the use of the software.

Copyright

This calculator is © Cambridge Engineering Design Centre, 2021

Permitted Use

- The licensee shall not charge a fee to provide exclusion calculator results to any other 3rd party
- If the Licensee presents the results produced by this tool in any media, the Licensee must include the following citation and disclaimer: "These results were estimated by YOUR COMPANY NAME, using Exclusion Calculator Pro vX.Y, Licenced from the University of Cambridge. However, these results were not checked or endorsed by the University of Cambridge." (X and Y should relate to the actual version number of the exclusion calculator that was used to generate the results)

If you would like the University of Cambridge to confirm your exclusion calculator results, please contact edc-toolkit@eng.cam.ac.uk

Important notes on the distribution of Excel files and Licence Keys

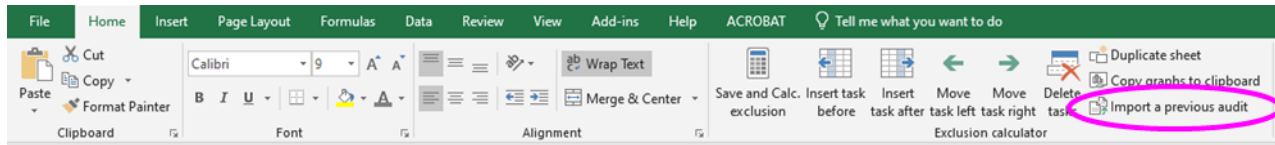
Your Licence Key has been pre-entered into a cell in the "Welcome" sheet that has the named range "licence key" (Usually cell L3). The text colour of this cell has been set so that the text is invisible. However, if you click on this cell, the Licence Key is displayed in the 'formula bar'.

The Licensee shall not share their licence key, or any Excel files that contain the licence key, with anyone who is not an employee of the organisation that purchased the calculator licence.

After the Licence Key has expired, The Licensee may keep any exclusion calculations that have been previously performed. However, if the User attempts to perform any new exclusion calculations, all previous results on the spreadsheet will be cleared.

Appendix 5: Importing audits from old versions of the Exclusion calculator

If you want to take a previous exclusion audit, and perform calculations based on country/year combinations that have been added after this audit was performed, you will need to use the button that has been specifically programmed for this purpose, which is shown below



When you click this button, it will ask you which file you want to copy FROM, and then ask you which sheet in this file you want to copy FROM. Then, it will insert a new sheet into the Excel file you want to copy INTO, and then copy all of the user entered data across from the old file into this newly created sheet. It will also copy across the spreadsheet name, and set the row heights of the new sheet to be the same as those in the old sheet.

Before clicking on this button, you should have opened both the file that you want to copy FROM, and the file that you want to copy INTO. The file that you want to copy INTO should be active (like as though you are about to edit it).

IMPORTANT NOTES:

It is fine to copy and paste cells between different sheets in the same file, or between sheets in different files, provided the files have the same version number. It is fine to move sheets between one file and another, provided the files have the same version number.

HOWEVER, DO NOT MANUALLY COPY AND PASTE CELLS BETWEEN CALCULATOR FILES WITH DIFFERENT VERSION NUMBERS. DO NOT MOVE SPREADSHEETS BETWEEN CALCULATOR FILES WITH DIFFERENT VERSION NUMBERS. The spreadsheet may break if you do this.

Appendix 6 How the DIGNITY survey data is used within EC Pro

The DIGNITY survey gave the participants a handheld chart containing 12 rows of capital letters, the largest of which was 7.4mm high, and smallest was 0.6mm high. The participants were asked to identify the smallest row that was comfortable for them to read (i.e. quickly and with certainty).

The exclusion calculator spreadsheet reprofiles the results from the German DIGNITY survey, to match the country and year that is specified in the calculator spreadsheet (see Section 2, and Appendix 3). The vision demands are specified according to a number of simulation glasses, and these have been approximately calibrated to the equivalent rows on the DIGNITY survey test chart, as follows.

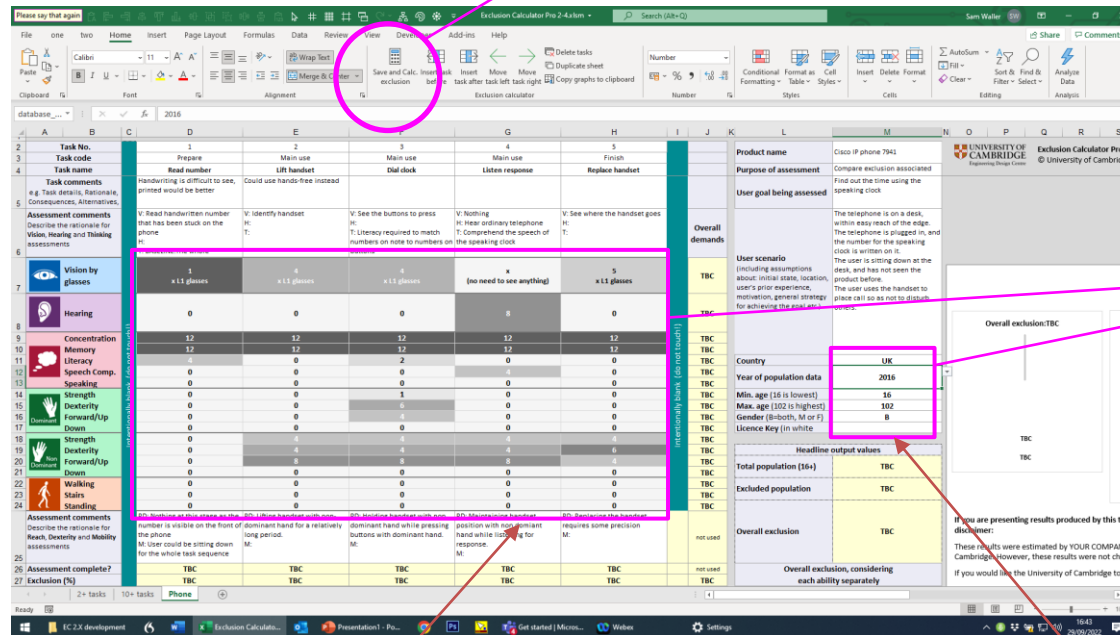
Vision demand, specified by number of simulation glasses for which the task can be performed quickly and with certainty.	If people reported the following DIGNITY survey row numbers, they would be likely to find this task difficult.
4x L1 glasses	Row 1
3x L1 glasses	Rows 1-3
2x L1 glasses	Rows 1-5
1x L1 glasses	Rows 1-7

If the task can be completed wearing 5 or 6 pairs of level 1 glasses, then the percentage of people who would have difficulty completing the task is reported as 0%, because all of the DIGNITY survey participants were able to comfortably read row 1 on the DIGNITY survey test chart.

If the task cannot be completed while wearing 1xL1 glasses, then the demand is 'off scale'. The number of people who might find this task difficult might be up to 100%, but is estimated as those who reported DIGNITY survey rows 1-9. Similar to other 'off scale' demands, the cell is highlighted red to indicate that the true difficulty is likely to be higher than the value reported.

Appendix 7 Data Flow Diagram

1. When this button is clicked, the Excel macro formulates a https POST request. The button sends the data associated with the sheet that is active at the time



2. The macro reads the data entered into these cells (which the VBA accesses via named ranges).

Confidential information cannot normally be entered into the cells, because the VBA includes a WorksheetChange event, which checks these cells and only accepts expected values for them. If the user has macros disabled, or is using a browser-based version of Excel, then it becomes possible for the user to enter text into the cells, although this would still be contrary to the intended purpose of these cells.

Important note: Users of the Exclusion Calculator are likely to enter confidential information into cells that are NOT highlighted within the pink boxes above. This information is NOT transmitted over the Internet at any time. The information is stored in the same way as any other Excel file, which is up to the Licensee to manage.

Confidential information cannot be entered into the cells, because Excel's native 'data validation' functionality will reject any unexpected values. Given that this is native functionality, the user can go into the data validation settings (within the data ribbon) and disable it, but this would require the user to specifically intend to bypass this protection. The user could perhaps put confidential information into the license key, but this would be absurd and would also stop the calculator from working.

