

ONLINE FORMS AND SPREADSHEET AS MEANS TO SUPPORT THE ABCD METHOD

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Purpose: The main purpose of the study was to develop and demonstrate a concept enabling application of popular and commonly available online forms combined with a spreadsheet to support data collection and processing under the ABCD (Suzuki) method.

Design/methodology/approach: The factors which determine the various ways in which the method in question is applied were first identified, and then it was established which of them affected the manner in which the form to be filled by experts is designed. Different variants of the method were identified on such a basis. For individual variants, the possibility of using different types of questions was discussed by considering the features available in the most popular and free-of-charge solutions enabling online forms to be developed. Diverse data layouts were also identified to establish the frameworks in which data are represented in spreadsheet files. Solutions which make it possible to automatically produce the consolidated reports required for purposes of the ABCD method were identified for each of the data layouts originally defined.

Findings: When combined with a spreadsheet, popular online forms enable highly efficient data collection and processing with the ABCD method in use. Where the said method is applied according to the variant in which every cause is rated, an adequate data collection form can be created using both the online form solutions subject to analysis. If the method is applied according to the variant in which every rating must be used precisely once, developing a useful tool becomes significantly more complicated. Where this is the case, one can create a suitable form to validate the input data only by using the solution delivered by Google. Additionally, the layout of such a form must be reversed compared to the traditional form functioning under the ABCD method. Considering the diverse variants of the ABCD method linked with various kinds of questions used to build the form, 3 different layouts of the data collected by means of a spreadsheet were identified. With respect to each of them, one can devise a solution to ensure automated generation of the consolidated reports typical of the method in question.

Practical implications: The solution proposed in the paper can be applied in practice while using the ABCD (Suzuki) method.

Originality/value: The concept described in the paper is the author's signature solution.

Keywords: spreadsheet, quality management, data processing.

Category of the paper: Conceptual and technical paper.

1. Introduction

Functioning in the era of information, each contemporary organisation processes growing amounts of data in virtually every operational sphere. The increasingly complex and advanced integrated information systems, which are becoming more and more common, are greatly supportive to the implementation of information processes. Application of highly specialised tools which are continuously improving to support clearly defined and limited operational areas of organisations has also become common. Irrespective of the growing availability and popularity of such solutions, there are many cases in which data can be processed using conventional and widespread office tools, among which spreadsheets deserve special attention. Their high flexibility makes them suitable for both ongoing processing of the data set in disposal and for designing dedicated tools to automate such a processing operation. The literature on the subject provides numerous suggestions as to the way of using spreadsheets to support diverse operational areas in organisations. These include investment decision making, finance management, controlling, marketing analyses, sales planning, or pricing (Kusztelak, 2020; Winston, 2019; Próchnicki, 2012) as well as work time planning (Szczęśniak, 2010a; Zasadzień et al., 2017). Many of the solutions proposed also entail quality management. The literature refers to diverse concepts of using spreadsheets as means to support statistical process control (Knight, 2009; Szczęśniak, Molenda, 2013), nonconformity analysis (Szczęśniak, 2017), the ABC method (Szczęśniak, 2010b), work quality assessment (Szczęśniak, 2012), and service quality measurement by the SERVQUAL method (Szczęśniak, 2021). Also the ABCD method, also known as the Suzuki method, belongs to the quality management sphere. Known from the literature is a concept of using spreadsheets to support one of eight identified variants of this method (Szczęśniak, 2020). The solution in question is based on an assumption that a spreadsheet is used both to collect and to process data. However, what seems to be a more convenient data collection solution is using online forms, continuously growing in popularity, once they have been combined with a spreadsheet tool enabling the data previously acquired to be processed. The concept underlying such a comprehensive solution has been discussed further on in this paper.

2. Collecting data for the ABCD method using online forms

ABCD is a relatively straightforward method. It is aimed at defining the most relevant causes underlying a specific problem or phenomenon. The method is based on opinions obtained from experts familiar with the sphere being analysed. Step one of this approach

requires identification of the causes subject to assessment. Once they have been defined, a form is designed according to the general layout shown in Figure 1.

Cause	The rank of the cause					
	0	1	2	3	4	5
Cause_01						
Cause_02						
Cause_03						
...						
Cause_nn						

Figure 1. General form layout according to the ABCD method.

Using this form, each expert participating in the analysis provides their subjective assessment of the relevance of every cause by giving it a specific number of points. The points are assigned by crossing adequate fields in the form. Even though the method in question is really simple, one can come across its variants characterised by different ways in which experts evaluate causes. One of the factors which make them dissimilar is the rating system applied. It is not pre-defined in the literature, which is why there are different perspectives of this matter. The most popular assessment scheme is a ten-point rating scale (Łańcucki, 2003; Łuczak, 2007) where individual causes are assigned numbers ranging from 1 to 10. A six-point scale can also be encountered (Cholewa-Wójcik, 2014). Where it is applied, the relevance is assessed using integers ranging from 0 to 5. This is precisely the scale illustrated in the general form shown in Figure 1. Another differentiating factor is the manner of highlighting the causes of the lowest and highest relevance. Some concepts assume that the most relevant causes are indicated by assigning them the highest score, while low ratings indicate the least relevant ones (Miller, 2011). A reverse procedure is also proposed, where the lowest score is given to the most relevant causes (Łuczak, 2007).

The third and final factor differentiating the manner in which causes can be assessed by experts is the number of ratings which individual causes should receive while a form is filled by an individual expert. The first of the foregoing potential concepts assumes that each expert must rate each cause accordingly. Consequently, the number of ratings assigned in this case corresponds to the number of causes assessed. As per the second approach, an expert can use an individual rating exactly once. Where this is the case, some causes may remain unrated in a form being filled, while the total number of ratings assigned will equal the number of ratings envisaged in a given scale.

The first two of the aforementioned factors which determine the differences between the cause relevance assessment methods do not have any significant effect on how a data collection form is designed. Regardless of whether a six- or a ten-point scale is used, and if the lowest rating is assigned to a cause considered the most or the least relevant, the form layout will be very similar, differing only in terms of the set of available ratings to be used. Nevertheless, how a form is designed depends on the latter of the foregoing factors which determine the

difference between individual cause assessment procedures. Depending on whether or not the experts participating in the survey are expected to rate all or just a selected number of causes, what the form must surely contain is adequate questions. The approaches differentiated by considering the third factor are referred to as variant *a* and variant *b* of the ABCD method further on in this paper.

The most popular free-of-charge solutions used to create online forms are undoubtedly those provided by Microsoft and Google. The manner in which they can be used to develop forms for data collection for purposes of the ABCD method has been discussed below. These solutions, on the other hand, are referred to as variant *I* and variant *II* of online forms in this study.

Where variant *a* of the ABCD method is used, one should build a form in such a manner that assigning a rating to each of the identified causes is obligatory and verified. This can be achieved by means of many of the available diverse types of questions. Many of the analysed question types can accurately determine the set of available answers, and each of them can define whether providing answers within an entire question is optional or not.

In this respect, two options are available when a form is being built. Option *1* assumes that each cause is addressed in a separate question and is represented as the main phrase of this question. As per option *2*, all the causes are addressed in one question and are represented as the text of the consecutive components of this question. When building a form according to option *1* combined with variant *I* of the forms, one can pose type *choice* or *rating* questions. Where questions of the *choice* type are used, the available answers are displayed in vertical arrangement or, if the *dropdown* option has been additionally selected, they can be chosen from a drop-down list. Thus created, the form makes it possible to collect the assumed data, yet in terms of appearance, it varies considerably from the layout shown in Figure 1. A form with a layout similar to the foregoing would be created using questions of the *rating* type, where the available ratings are displayed horizontally arranged. With this question type in use, the rating scale must start with 1, and so in the case of a six-point scale, one must use ratings ranging from 1 to 6 instead of the 0-5 scale, as proposed in the literature on the subject. Where option *1* is combined with variant *II* of the forms, one can make use of the following question types: *multiple choice*, *checkboxes*, *dropdown*, or *linear scale*. Using the first three of the aforementioned question types triggers a deviation from the layout shown in Figure 1, similarly to the case where the *choice* type question is used under variant *I*. One can aim at higher conformity with the model pattern by using the *linear scale* type questions where – much like with the *rating* type questions – the available answers displayed are arranged horizontally. However, full conformity is not an option with both these question types, since consecutive answers are placed in separate paragraphs, and the available answers are to be found below them.

When a form is built according to option *2* combined with variant *I*, questions of the *Likert* type can be used. In the main phrase of this question, one should provide some general information about the survey; the identified causes should be displayed as successive *statement*

elements, while the available ratings – as successive *option* elements. If option 2 is combined with variant II, one of the available question types is *multiple-choice grid*. Where this is the case, the main phrase of the question should also contain the general information, the relevant causes should be provided using the *row* elements, and the ratings to choose from – using the *column* elements. Option 2 makes the form being created most similar to the layout shown in Figure 1. With either variant I or II in place, the successive causes are presented in a compact format, one below another, and the available ratings are displayed next to them, arranged horizontally. A disadvantage of this solution is the form’s reduced transparency in a case where cause descriptions are longer. Facing this problem, one can make the form more legible using option I, even though the layout departs from that depicted in Figure 1.

The data collected can be stored in a spreadsheet file. Where variant I is used, both under option I and 2, the data are entered in a table corresponding to the one shown in Figure 2.

	A	B	C	D	E	F	G	H	O
1	ID	Start time	Completion time	Email	Name	Cause_01	Cause_02	...	Cause_10
2	4	6.24.22 13:35:26	6.24.22 13:37:15	anonymous		0	1	...	2

Figure 2. Data layout in a spreadsheet for variant a I.

The table contains five technical columns as well as columns with ratings of individual causes. Headers of the rating columns match the main phrase of the questions formulated for option I or the content of the *statement* type elements for option 2. Where questions of the *choice* or *Likert* type are used, the collected ratings are stored in a text format, while they are stored in a numerical format if the *rating* type questions are asked. A table of almost identical layout contains the data acquired by applying variant II combined with option I. In this case, there is but a single technical column, and all the ratings are stored as numerical values.

If variant II is applied in combination with option 2, the data thus collected are stored in a table which matches the layout depicted in Figure 3.

	A	B	C	D	E
1	Timestamp	Main phrase [Cause_01]	Main phrase [Cause_02]	...	Main phrase [Cause_10]
2	25.06.2022 11:17	0	1	...	2

Figure 3. Data layout in a spreadsheet for variant a II and option 2.

This table features one technical column, while the remaining columns contain the ratings of individual causes. The header text in these columns represents a combination of the question’s main phrase and the text of the *row* type element to be found in square brackets.

Where variant *b* of the ABCD method is used, one should build a form in such a manner that, as the form is being filled, the action of rating exactly the number of causes which matches the number of available ratings in the scale applied is obligatory and verified, and that every rating has been assigned precisely once. On account of the fact that the validation mechanisms available in both the online form solutions analysed comprise only verification of the correctness of the answers provided against a single question, the only question types which can be used are those which assume that all causes are covered by a single question. With variant *I* in place, it is the *Likert* type question, while in variant *II* – the *multiple-choice grid* type question. It seems natural to make use of these questions similarly to the way in which they are used under variant *a* of the ABCD method, meaning that consecutive causes are presented in consecutive rows, and the available ratings are placed next to them in horizontal arrangement. However, it appears that the available validation options are insufficient in both cases to ensure complete correctness of the data collected for variant *b*. The only option for the *Likert* type question is *Required*, which assumes that it is possible to define optionality for the entire question. If this option has been chosen, the expert filling the form must assign ratings to all the causes stated in the form. If it is inactive, a form can actually be submitted even without any of them rated. Unfortunately, it is not possible to define a specific number of ratings which should be assigned. Neither is it possible to impose an obligation that each rating is used precisely once. The *multiple-choice grid* type question improves this situation only a little. Using the *Limit to one response per column* option, one can prevent each rating form being assigned multiple times. Unfortunately, the other option available in this case, i.e. *Require a response in each row*, actually makes it possible only to define optionality for the entire question. Analogically to the *Likert* type question, one cannot pre-set an exact number of ratings that must be assigned in this case. However, it should be noted that the options available for the *multiple-choice grid* type question make it possible to define form filling rules ensuring that correct data are obtained in a situation where causes and ratings have switched places in the form. Where this is the case, the *row* type elements correspond to consecutive ratings, while the *column* type elements are used to represent consecutive causes. In such a layout, activating the *Require a response in each row* option imposes the obligation to assign each rating, and where the *Limit to one response per column* option has been enabled, it becomes certain that no cause will be assigned to more than one rating. According to this approach, the data layout in the spreadsheet table matches Figure 4.

	A	B	C	D	E
1	Timestamp	Main phrase [0]	Main phrase [1]	...	Main phrase [5]
2	29/06/2022 09:17:46	Cause_09	Cause_08	...	Cause_05

Figure 4. Data layout in a spreadsheet for variant *b II*.

This table features one technical column of *Timestamp*, while the remaining columns provide references to the ratings being assigned. The header of each column within this range is composed of the question's main phrase and the rating provided in square brackets. The successive rows in a given column contain names of the causes assigned to a given rating by consecutive experts.

3. Spreadsheet-based data processing

Once data have been collected, the ABCD method assumes them to be presented in a consolidated report whose overall layout matches that shown in Figure 5.

Cause	The rank of the cause						Corrected sum	Number of undeleted responses	Rank indicator	Overall rank
	0	1	2	3	4	5				
Cause_01										
Cause_02										
Cause_03										
...										
Cause_nn										

Figure 5. General consolidated report layout according to the ABCD method.

In this report, information appears next to each cause to identify how many times a given rating has been given in the forms filled by experts. Next, a corrected sum of ratings is calculated. This sum disregards one bottom and one top rating. What the next column contains is the number of ratings summed up. A quotient of the pre-established sum of ratings and the number of ratings summed up is referred to a rank indicator. Based on the rank indicator, the overall rank of each cause is determined. The last step in the procedure involves compiling a report whose layout matches that shown in Figure 5, where all the causes are sequenced from the most to the least relevant ones, judging by the overall rank.

The assumption made for the data processing tool in question is that it contains three worksheets. The first one is worksheet *Data* where raw data are stored. Depending on the variants and options envisaged, the data layout in this worksheet is consistent with Figures 2, 3, or 4. What was also assumed is that data are manually copied from the master worksheet, generated automatically with reference to the form, to the tool's *Data* worksheet. Further worksheets are *Results* and *Results_O*, containing the consolidated reports whose layout matches that shown in Figure 5, the only difference being that the latter of these worksheets stores the causes arranged on the basis of the *Overall rank*. The layout of columns and the formulas they contain in worksheet *Results* for the input data in worksheet *Data* in a layout matching Figure 2 have all been provided in Figure 6. In this worksheet, formula *FAI* is used

to determine the number of ratings of all types which have been assigned. In the next step, table formula *FA2* in auxiliary column *C1* determines the maximum rating a given cause has received. A similar table formula of *FA3* in auxiliary column *C2* determines the minimum rating for each cause. Based on the number of individual ratings, as well as the minimum and maximum number, formula *FA4* calculates the corrected sum, while formula *FA5* calculates the number of undeleted answers for a given cause. Using these values, formula *FA6* calculates the *rank indicator* value. In the final step, formula *FA7* establishes the ranking of causes with reference to the *rank indicator*.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1		FA1 Rank							FA2	FA3	FA4	FA5	FA6	FA7		
2	Cause	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	2	5	0	0	0	0		0	1		4	5	0,80	8	
4	Cause_02	3	2	2	0	0	0		0	2		4	5	0,80	8	
5	Cause_03	4	1	2	0	0	0		0	2		3	5	0,60	10	

FA1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);B\$2);"")
FA2	{=IF(\$A3<>"";MIN(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}
FA3	{=IF(\$A3<>"";MAX(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}
FA4	=IF(A3<>"";SUMPRODUCT(\$B\$2:\$G\$2;B3:G3)-I3-J3;"")
FA5	=IF(A3<>"";SUM(B3:G3)-2;"")
FA6	=IF(A3<>"";L3/M3;"")
FA7	=IF(A3<>"";RANK(N3;\$N\$3:\$N\$32;0);"")

Figure 6. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 2.

The mechanism which creates the sequenced report in worksheet *Results_O* can be exactly the same in this case as the one envisaged in the concept of using spreadsheets alone to support the ABCD method (Szczeńsiak, 2020), and it is not discussed in this article.

Where the input data layout is consistent with the arrangement shown in Figure 3, one must modify the formulas which determine the number of assigned ratings of a given type as well as the maximum and minimum rating. The formulas adjusted accordingly have been provided in Figure 7.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1		Rank														
2	Cause	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	2	5	0	0	0	0		0	1		4	5	0,80	8	
4	Cause_02	3	2	2	0	0	0		0	2		4	5	0,80	8	
5	Cause_03	4	1	2	0	0	0		0	2		3	5	0,60	10	

FB1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);B\$2);"")
FB2	{=IF(\$A3<>"";MIN(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}
FB3	{=IF(\$A3<>"";MAX(VALUE(OFFSET(Data!\$A\$1;1;MATCH(\$A3;Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1)));"")}

Figure 7. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 3.

With regard to variant *b* of the ABCD method, the literature on the subject does not mention any particular procedure of data processing. Where this is the case, using an approach which would be fully consistent with the one defined for variant *a* may actually produce incorrect results. For instance, assuming that higher ratings in the scale of 0–5 denote more relevant causes, in the event that the assessment is conducted by 20 experts, if the cause designated as *Cause_01* is given the rating of 1 by every person, and that marked as *Cause_02* is rated 2 by three experts while all the remaining persons do not give it any rating, then a more preferable *rank indicator* value will be calculated for *Cause_02*. Although as many as 17 experts have decided that it does not even deserve to receive the rating of 0, it will still be recognised as more relevant. In order to eliminate this inconvenience, it was assumed that the fact that a given cause has not been assigned any rating by a given expert means that it is assigned a rating which denotes relevance lower than the lowest value envisaged in the rating scale applied. For instance, with the scale of 0–5 in place, where 0 indicates the least relevant cause, the lack of rating means that a rating of -1 has been assigned. Where 5 indicates the least relevant cause, no rating means that a given cause has been rated 6. With regard to the foregoing, the consolidated report will feature a scale that contains one rating more than the scale envisaged in the form provided to experts. The consolidated report’s layout along with the auxiliary columns and the formulas they contain has been depicted in Figure 8.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
1			FC2	FC1	Rank						FC3	FC4					
2	Cause	-1	0	1	2	3	4	5		C1	C2		CS	NR	RI	R	
3	Cause_01	6	1	0	0	0	0	0		-1	0		-5	5	-1,00	8	
4	Cause_02	6	0	1	0	0	0	0		-1	1		-5	5	-1,00	8	
5	Cause_03	7	0	0	0	0	0	0		-1	-1		-5	5	-1,00	8	
6	Cause_04	0	0	0	2	2	2	1		2	5		16	5	3,20	3	
FC1	=IF(\$A3<>"";COUNTIF(OFFSET(Data!\$A\$1;1;MATCH(CONCAT("Main phrase [";C\$2;""]);Data!\$1:\$1;0)-1;COUNTA(Data!\$A:\$A)-1;1);\$A3);""))																
FC2	=IF(\$A3<>"";COUNTA(Data!\$A:\$A)-1-SUM(C3:H3);""))																
FC3	=IF(\$A3<>"";MIN(IF(B3:H3>0;\$B\$2:\$H\$2;""));""))																
FC4	=IF(\$A3<>"";MAX(IF(B3:H3>0;\$B\$2:\$H\$2;""));""))																

Figure 8. Setup of columns and formulas in worksheet *Results* for the input data provided in Figure 4.

Formula *FC1* determines the number of individual ratings assigned to a given cause by experts. Formula *FC2* calculates how many experts have not rated a given cause at all. This value represents the number of additional ratings exceeding the scale provided to the experts and assigned to a given cause. Table formulas *FC3* and *FC4* determine the lowest and the highest rating assigned to a given cause, respectively. Found in the remaining columns, the values of the adjusted sum, the number of the ratings taken into account, the rank indicator, and the established position are determined using formulas matching those provided in Figure 6.

4. Conclusions

The solutions proposed in the paper imply that, when combined with a spreadsheet, popular online forms enable highly efficient data collection and processing with the ABCD method in use. There are several variants to the method that one can identify. The factors which make them different from one another are the range of the scale in use, the manner in which the most and the least relevant causes are established, as well as whether experts are assumed to rate all or just a number of causes they choose. Only the latter of the differentiating factors has a significant effect on how a data collection form is built. In terms of the potential for creating such a form, two most popular free-of-charge solutions, i.e. those provided by Microsoft and Google, have been analysed. In the event that one has applied the method's variant assuming that ratings are assigned to all the identified causes, both solutions make it possible to create forms which enable collection of correct data. When using the variant in which every rating must be used exactly once, a form which provides correct data can only be generated by means of Google's solution. Moreover, the layout of this form must be reversed compared to a standard general form used under the ABCD method. For the diverse variants of the ABCD method

linked with various kinds of questions used to build the form, 3 different data layouts have been identified, enabling the data one has obtained to be collected in a spreadsheet. With respect to each of these layouts, the paper provides solutions ensuring automated generation of the consolidated reports typical of the method in question. The solutions devised by the author make use of only standard built-in spreadsheet features, and they require no code to be developed in any programming language. Currently, the presented solution is of a conceptual nature. Further research will include the possibility of its use to support specific cases of the application of the ABCD method.

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