

Concept of supportive spreadsheet application in the survey of production departments' satisfaction with services of maintenance departments

Bartosz Szczęśniak

Silesian University of Technology, Institute of Production Engineering
Department of Quality Management of Process and Product
41-800 Zabrze, ul. Roosevelta 26, e-mail: bartosz.szczesniak@polsl.pl

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Abstract

In order to be able to use the method of surveying satisfaction of production departments with the services provided by maintenance departments, one must first acquire and analyse considerable amounts of data. Such an attempt may only be successful if an appropriate information tool is used. This article provides a discussion on the concept of an MS Excel spreadsheet application for the sake of creating such a tool. The author has proposed a specific data structure enabling storage of the data acquired in the course of research. The entities occurring in it have been identified and discussed, and so have the attributes assigned to individual entities. The author has also elaborated on the spreadsheet mechanisms which allow for data processing in accordance with the premises of the aforementioned method.

Introduction

According to the process-based concept of management, an enterprise is regarded as a set of closely linked processes the efficient performance of which should enable a product or a service to be generated to satisfy customers' needs. For an enterprise holistically considered to be a unity, the most important goal is to meet the requirements and ensure satisfaction of a customer perceived in a traditional manner, namely as an external customer. However, in order to be able to accomplish the general goals envisaged, all components of the enterprise must necessarily cooperate in an effective manner. Hence, it is required to ensure proper functioning of the individual processes being implemented. Between separate processes and between their individual stages products, services or information are transferred. Ensuring their sufficient quality is usually the prerequisite of successful completion of downstream actions. The organisational units responsible for provision of products, services or information that are subsequently utilised by other units of the same organisation while performing specific tasks are known as

internal suppliers, whereas the organisational units utilising the resources generated are analogically referred to as internal customers.

The link between maintenance departments and production departments is a typical example of an internal customer / internal supplier relation. In order to improve the collaboration between these types of organisational units, a dedicated method has been proposed, assuming bilateral examining of the existing relation [1, 2, 3]. In accordance with the said method, the quality of services provided by the maintenance department is analysed on the one hand, but on the other hand, the method also envisages assessment of the possibilities the maintenance department employees have in order to perform their tasks well. By collating the results obtained in both analytical areas, one can perceive the problem being investigated from a broader perspective. The method proposed is based on the assumption that regular surveys are conducted among employees of the production and maintenance departments. Two types of surveys are used for this purpose: a survey delivering information on the quality of the services rendered and a survey pertaining to the possibilities of performing one's duties appropriately. As in

every survey, the questionnaire used comprises a certain number of questions regarding specific situations and phenomena which may occur in the sphere of collaboration between the maintenance and production departments. While filling in the questionnaire, an employee is supposed to specify at each question whether the given phenomenon occurs rarely, sometimes or often. In each question, one is also to determine the significance of the problem it relates to. Some of the phenomena referred to in questions are of positive nature, while others are negative. At the data analysis stage, a corrected rating is assigned to questions. For the questions of positive nature, replies of “often” are marked with 3 points, “sometimes” receives the rating of 2 points and “rarely” – 1 point. In the case of negative questions, the points are assigned in an opposite manner. Consequently, the higher the overall number of points is the more positive the situation occurs. Then for each question, average values are calculated for corrected assessment and significance on the basis of which the relation between the assessment and the significance of individual issues is estimated. Additionally, for the area of service quality, as well as the area of working possibilities, weighted average values are calculated based on the ratings obtained where the weight is the significance attributed to individual questions. The calculated weighted averages constitute grounds for establishing which part of the result matrix contains the current area of collaboration between maintenance and production departments. In order to conduct the research successfully and in accordance with the premises of the method

proposed, it is necessary to acquire and process considerable amounts of data. However, the processing of the data acquired can be automated by means of an information tool created using a spreadsheet the concept of which has been discussed in the following sections of the article.

Supporting tool

The method proposed is based on the assumption that independent surveys are conducted simultaneously to examine the quality perceived in the services provided by the maintenance department and the possibilities the employees have in performing their duties. Both problems are surveyed using separate questionnaires. For the sake of simplification and further data processing, it was assumed that data connected with both questionnaires were to be acquired separately. Having analysed the problem in question, the author proposed a set of entities characterised in table 1 to be used in the tool being developed. The relations between individual entities have been illustrated using an ERD model conforming with the CASE*Method approach [4, 5] in figure 1.

Attributes were identified for the individual entities. They have been briefly characterised in table 2 including the names used in the spreadsheet tool discussed.

Most entities identified were represented in the spreadsheet in the form of tables typical of a relational database. Each table was entered into a separate worksheet. A list of individual entities including the worksheets assigned to them in the application has been provided in table 3.

Table 1. General characteristics of the entities proposed

Item	Entity name	Description
1	Questionnaire – quality	Questionnaire survey concerning quality of the service provided by the maintenance department. The information section related to those surveyed comprised education, position, age and production department of the employee filling in the form.
2	Question – quality	Question asked in the questionnaires concerning quality of the service provided by the maintenance department.
3	Response – quality	Response provided to a specific question in the questionnaire concerning quality of the service provided by the maintenance department. Each response consisted of assessment and significance rating assigned using the scale of 1–3.
4	Questionnaire – possibilities	Questionnaire survey concerning the possibilities of performing work at the maintenance department. The information section related to those surveyed comprised education, position, age and maintenance department of the employee filling in the form.
5	Question – possibilities	Question asked in the questionnaires concerning the possibilities of performing work at the maintenance department.
6	Response – possibilities	Response provided to a specific question in the questionnaire concerning the possibilities of performing work by the maintenance department employees. Each response consisted of assessment and significance rating assigned using the scale of 1–3.
7	Education	Employee’s educational level.
8	Position	Working position at the department subject to survey.
9	Production department	Production department subject to survey.
10	Maintenance department	Maintenance department subject to survey.

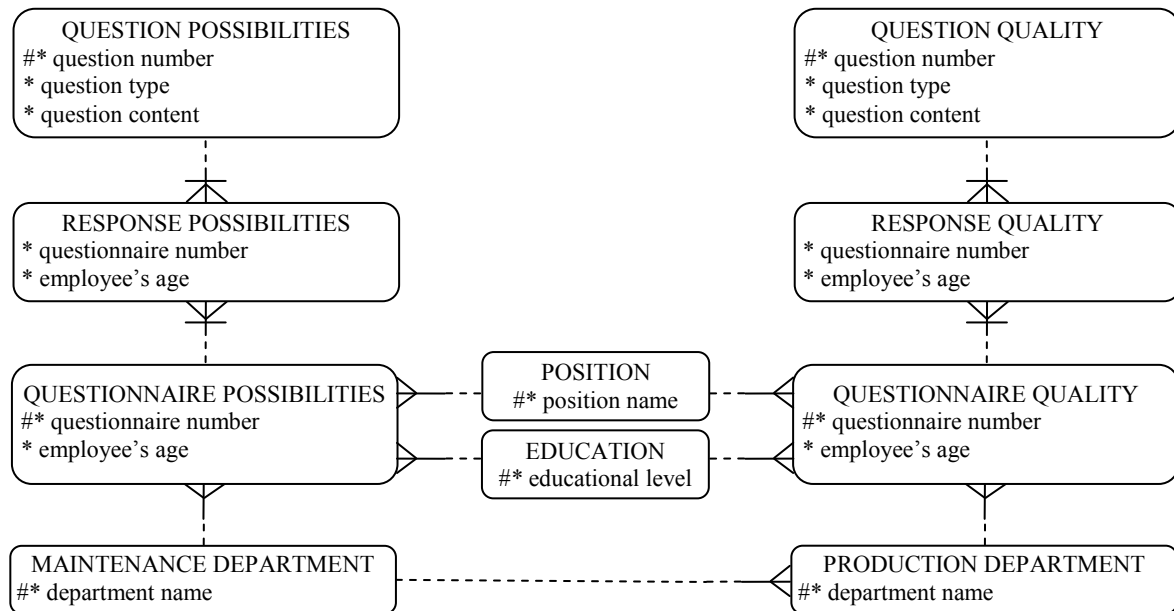


Fig. 1. Entity Relation Diagram (ERD) of the problem analysed

Table 2. General characteristics of attributes of the individual entities

Entity name	Attribute name	Spreadsheet name	Description
Questionnaire – quality	Questionnaire number	Questionnaire	Number identifying each questionnaire in a set of questionnaires used to survey the maintenance department's service quality.
	Employee's age	Age	Age of the employee filling in the questionnaire form.
Question – quality	Question number	No.	Question number explicitly identifying it in a set of questions provided in the questionnaire used to survey the maintenance department's service quality.
	Question type	P/N	Attribute enabling determination whether the given question is positive or negative in nature. This attribute's value was decisive in the analysis of results whether the responses provided to the given question were take into consideration directly or if they required conversion.
	Question content	Content	Full content of a question.
Response – quality	Assessment	Assessment	Assessment rating assigned to the given question while filling in the questionnaire.
	Significance	Significance	Significance rating assigned to the given question while filling in the questionnaire.
Questionnaire – possibilities	Questionnaire number	Questionnaire	Number identifying each questionnaire in a set of questionnaires used to survey the possibilities of performing work by the maintenance department employees.
	Employee's age	Age	Age of the employee filling in the questionnaire form.
Question – possibilities	Question number	No.	Question number explicitly identifying it in a set of questions provided in the questionnaire used to survey the maintenance department's working possibilities.
	Question type	P/N	Attribute enabling determination whether the given question is positive or negative in nature. This attribute's value was decisive in the analysis of results whether the responses provided to the given question were take into consideration directly or if they required conversion.
	Question content	Content	Full content of a question.
Response – possibilities	Assessment	Assessment	Assessment rating assigned to the given question while filling in the questionnaire.
	Significance	Significance	Significance rating assigned to the given question while filling in the questionnaire.
Production department	Department name	Department_P	Abbreviated name of the production department. The name must identify the given production department explicitly.
Maintenance department	Department name	Department_M	Abbreviated name of the maintenance department. The name must identify the given maintenance department explicitly.
Education	Educational level	Education	Generally accepted term corresponding to the given educational level, e.g. higher, secondary, basic vocational, primary education.
Position	Position name	Position	Abbreviated name of the working position at the departments being surveyed.

Table 3. List of Worksheets assigned to the individual entities

Entity name	Worksheet name
“Questionnaire – quality”	“Questionnaire_Q”
“Question – quality “	“Question_Q”
“Response – quality”	“Quality”
“Questionnaire – possibilities”	“Questionnaire_P”
“Question – possibilities”	“Question_P”
“Response – possibilities”	“Possibilities”
“Production department”	“Department_P”

An exception comprised the entities of “education”, “position” and “maintenance department”, since in the case discussed they had no attributes assigned apart from the primary key, and their occurrences formed a set of values that could be entered as attributes of other entities. They were in fact of a data dictionary nature, and hence they were entered into a single worksheet entitled “Dictionary”. The arrangement of fields proposed for individual worksheets has been depicted in figure 2.

“Possibilities”

	A	B	C	D
1	Questionnaire	Question	Assessment	Significance

“Question_P”

	A	B	C
1	No.	P/N	Content

“Questionnaire_P”

	A	B	C	D	E
1	Questionnaire	Education	Position	Age	Department_M

“Department_P”

	A	B
1	Department_P	Department_M

“Quality”

	A	B	C	D
1	Questionnaire	Question	Assessment	Significance

“Question_Q”

	A	B	C
1	No.	P/N	Content

“Questionnaire_Q”

	A	B	C	D	E
1	Questionnaire	Education	Position	Age	Department_P

“Dictionary”

	A	B	C
1	Education	Position	Department_M

Fig. 2. Fields in the worksheets of the tool in question

Integrity of the data provided in the above tables was ensured – as in the cases of other solutions proposed in various publications [6, 7] – by means of a mechanism of data correctness verification. Since the data were entered into different worksheets, and the mechanism of data correctness verification only enables making direct references to cells of the worksheet in which it is used, for the

sake of addressing of the relevant areas, an additional mechanism of area name defining was used.

Having arranged the data acquired into a layout conforming with the structure shown, one could propose to analyse them by means of pivot tables widely elaborated upon in the literature [8, 9, 10]. For that purpose, separately for both areas being analysed, two tables were prepared with the individual lines containing all the responses provided under the questionnaire surveys conducted including all the attributes possible to be assigned. These tables became sources of data for the respective pivot tables. The arrangement of table fields for the area of working possibilities at the maintenance department has been illustrated in figure 3. In order to obtain relevant values, simple formulas based on the VLOOKUP() and IF() functions were applied.

	A	B	C	D	E	F	G	H	I	J	K
	Questionnaire_No	Question_No	Assessment	Significance	P/N	Assessment_c	Education	Position	Age	Department_M	AxS
1											
2	1	1	1	2	N	3	vocational	Pos_A	38	Dep_M_A	6
3	1	2	3	2	P	3	vocational	Pos_A	38	Dep_M_A	6
4	1	3	2	2	N	2	vocational	Pos_A	38	Dep_M_A	4

Fig. 3. Arrangement of fields in a table constituting a source of data for a pivot table for the area of working possibilities at the maintenance department

The arrangement of table fields for the area of quality of the maintenance department’s services was almost identical. There was an additional field of “Department_P” entered, referring to the relevant production department. Besides the attributes obtained directly from the tables provided in figure 2, the “Assessment_c” and “AxS” fields were added. The former contained a corrected assessment rating assigned to the given question. According to the premises of the method assumed, in the course of the final analysis, a higher assessment rating meant a more positive one for the given area being examined, therefore, for the questions of negative nature, the assessment ratings had to be corrected. For instance, if the “Assessment” field contained value “1” and the “P/N” field contained value “N”, then the corrected assessment rating came to “3”. The “AxS” field was a product of the corrected assessment and the significance.

Using the tables prepared which contained source data, pivot tables were developed for each of the areas examined. In each table, average corrected assessment, as well as average significance were provided for all questions. Using the respective attributes as report filters enabled quick analysis of

results for the chosen departments, positions, age and educational levels. Moreover, based on the data entered into pivot tables, a quality map was drawn up for each area to enable quick identification of the issues in need of specific actions. Since the quality map is a dot diagram and the diagram directly linked with a pivot table cannot be one, it was necessary to use indirect cells. In order to acquire the relevant data, the GETPIVOTDATA() function was used in these cells. A part of a sample pivot table used to analyse data for the area of working possibilities of the maintenance department employees, as well as the quality map related to the former have been depicted in figure 4.

Another step in the method of surveying production departments' satisfaction with the service of maintenance departments was establishing weighted average assessments for service quality and working possibilities. The results obtained should be entered into an appropriate result matrix. In order to enable efficient calculation of average assessment ratings for the chosen departments, positions, educational level or employees' age levels, this step consisted in application of two separate pivot tables. In the table related to the data concerning the service quality, an additional computational field was entered under the name of

WMA_Q_el, whereas in the table related to the data concerning the working possibilities, an additional computational field of WMA_P_el was entered. In both cases, the value in the computational field was calculated according to the "AxS/Significance" formula. In the area of significance of each table, there was a sum of the corresponding computational field WMA_Q_el or WMA_P_el. This sum was assigned a specific name in the tables, i.e. WMA_Q and WMA_P accordingly. In pivot tables, the computational field sum is calculated as a result of the formula assigned to the given computational field executed for summed-up values of those table fields that have been used in the formula. Owing to such a sequence of calculations, the aforementioned solution enabled calculations of WMA_Q and WMA_P in accordance with the method proposed. The results obtained have been presented in the result matrix. This effect was attained by means of a dot diagram extracting data from two pivot tables. As in the case of the quality map, it was also necessary to make use of indirect cells containing the GETPIVOTDATA() function. The pivot tables used to calculate WMA_Q and WMA_P, as well as the result matrix connected with them have been provided in figure 5.

Department M	(All)
Age	(All)
Position	(All)
Education	(All)

Question No.	Average	
	Average Assessment_c	Average Significance
1	2,56	1,72
2	1,22	2,67
3	2,50	2,00
4	1,78	1,61
5	2,61	2,06
6	1,39	2,44
7	2,00	1,78
8	1,61	2,00
9	2,39	2,39
10	1,72	2,06
11	2,06	2,11
12	1,56	1,39

1	2,56	1,72
2	1,22	2,67
3	2,50	2,00
4	1,78	1,61
5	2,61	2,06
6	1,39	2,44
7	2,00	1,78
8	1,61	2,00
9	2,39	2,39
10	1,72	2,06
11	2,06	2,11
12	1,56	1,39

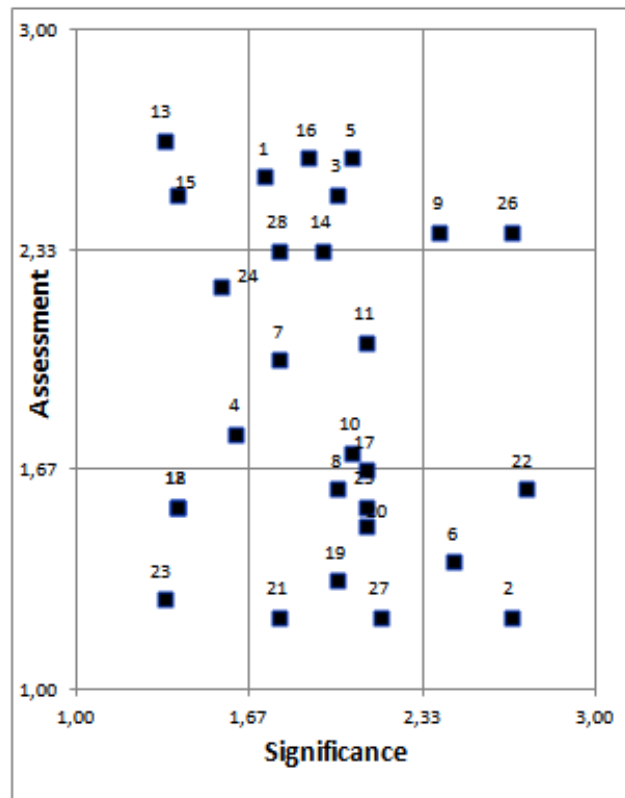


Fig. 4. Part of a pivot table including a quality map and indirect cells used to analyse the maintenance department employees' working possibilities

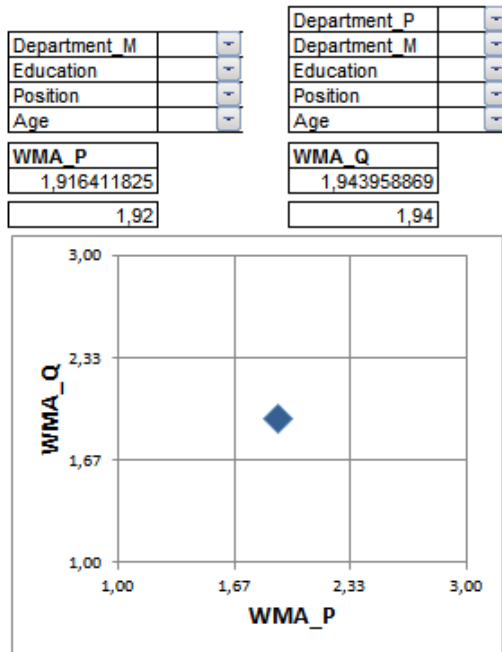


Fig. 5. Pivot tables used to calculate WMA_Q and WMA_P including the result matrix

Conclusions

The concept proposed and described above proves that a spreadsheet can be successfully used to store and process data under the foregoing method of surveying production departments' satisfaction with the services of maintenance departments. Data acquisition and storage may be performed by means of a structure compatible with relational databases, namely in tables identical to those used in standard databases. Ensuring data integrity between individual tables is possible owing to the mechanism of data correctness verification. Based on the arrangement of tables proposed, one may easily create different tables to function as data sources for further analyses. All the calculations required by the method discussed can

be executed using pivot tables, whereas the results obtained can be represented in a graphical form by means of accordingly linked dot diagrams. The solution elaborated above does not require application of the VBA language and may be successfully used by any person intending to investigate the sphere of collaboration between production and maintenance departments according to the method proposed who is familiar with standard functions and mechanisms of the MS Excel spreadsheet.

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