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The use of "Check Alert" technique in data quality management and business analysis within the company

Abstract

The value of business analysis is directly related to the quality of data acquired to their preparation. The Business Data Management (BDM) process is extremely difficult both from internal and external perspective and it is exposed to different type of risk. The objective of this project is to evaluate the usefulness of the authorial "Check Alert" method in area of BI reports reliability verification performed by key users / business data owners. The paper consists of: Business

Data Quality Management accordingly to 8R principle; Business Data Management process and Risk Management; Characteristics of Simulation Modelling method; The "Check Alert" and SAP Analytics Cloud software implementation project – case study. The last part of the paper presents final conclusions and recommendations.

Introduction

The usefulness of business analyses is directly proportional to the quality of the data used to prepare the discussed analyses. The process of managing business data, both internally and externally, is extremely difficult and involves various types of risks. It usually proceeds in a standardized manner, within the framework of pre-defined and approved procedures or system algorithms operating within Business Intelligence software. However, an important problem is not the mere fact of efficient delivery of the report in an appropriate manner and within the required time, but also the reliability of the results of such a report, which have an extremely significant impact on the quality of decisions made within the company. Like any other process, the data (business information) management process also requires the use of appropriate methods and tools. The effectiveness in ensuring high quality data through planned and implemented system solutions finally determines the quality of the entire information management system in every company.

The objective of this paper is to assess the usefulness of our own "Check Alert" technique in supporting the key user/data owner in the process of verifying the reliability of the analysed reports, generated in BI class systems. The paper is an attempt to answer the following questions: 1) How is the data quality management process carried out in the company according to the 8R and 5 SDR principles? 2) What are the so-called "Data defects" of business information stored in the databases? 3) What is simulation modelling and why is it useful in improving the business data management process? 4) What is the proprietary diagnostic technique "Check Alert"?, and 5) How to use SAP Analytics Cloud software in the qualitative assessment of business data from the perspective of assessing the reliability of the generated reports?

In order to answer the above questions, the analytical and the synthetic method applied in scientific and industry-related literature was used, together with simulation modelling carried out using BI SAP Analytics Cloud software and the "Check Alert" technique.

The summary of the analysis and simulation, based on the financial data of the listed companies, becomes a summary of conclusions and recommendations prepared in the form of synthesis.

1. A company's business information management system in the company in accordance with the 8R and 5 SDR principle — towards the integration of logistic and information flows

The issues of data quality management, including business analyses, are discussed in the subject-matter literature, along with the context of analysing information disability ("information disease"). The above pathological behaviours have been presented from the point of view of both: the product as an effect of the information and communication management process implemented in the company, and the process that leads to the production of the above-mentioned products, such as reports and business analyses[1]. Data malfunction with regard to information as product includes the following[2]:

- Information overloads – providing an excess of information and business data, which is manifested in an extended analysis time, higher costs, risk of inconsistency and lower motivation and commitment of a decision-maker;
- Information ambiguity – development of a report, analysis that leads to contradictory, ambiguous conclusions;
- Information anaemia or weakening of the "field of view" – a set of incomplete data, out of date data or an excess of data inadequate to the decision problem solved;
- Information distortion – incorrect association of data categories with their content, or two different contents or data sets are provided for the same category;
- Incorrectly structured forms as carriers of unreadable information – complicated structures, no logical connection of individual tables and fields, excess of manually entered text and data, chaotic editorial work.

As regards the qualitative assessment of the information management process, particular attention should be paid to the following[3]:

- Backlog of information – the so-called "Bottlenecks" in the process of creating and transferring data, business analysis;
- Information "distortion" – the ambiguity of information and data resulting from various formulas, standards for its input, processing and analysis;

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1 Z. Martyniak, *Podstawy diagnozowania informacji jako produktu i procesu*, [in:] Z. Martyniak (ed.), *Zarządzanie informacją i komunikacją. Zagadnienia wybrane w świetle studiów i badań empirycznych*, Wydawnictwo Akademii Ekonomicznej w Krakowie, Kraków 2000, p. 11.

2 Ibid., pp. 12–17.

3 Ibid., pp. 18–20.

- Information collapse – lack of data, lack of information in the system caused by lack of required resources, efficient procedures or lack of integration of goods and financial flows with information flows.

An extremely important element of preventing the so-called "Information failures" in the information management process is to ensure proper integration. Both in commodity flows (logistic perspective) and in information flows (decision perspective) the basic determinant of success is the implementation of an integrated system, for example based on the concept of eight conditions, requirements (8R) and 5 principles of rational management (5 SDR).

In the first case, the 8R concept (*8 Right*) indicates a need to provide the following information and communication management system in the company: 1) appropriate information (*right information*); 2) in the right amount (*right quantity*); 3) of adequate quality (*right quality*); 4) to the right place (*right place*); 5) in good time (*right time*); 6) to the right recipient, decision maker, employee (*right customer*); 7) at an appropriate level of costs (*right cost*) and 8) in a responsible manner from the point of view of the social and natural environment (*right way*)[4]. The 8R concept defines the necessity to simultaneously monitor and assess the quality of data and business analysis system from the perspective of the above-described perspectives. It is a relatively complex task requiring ensuring appropriate resources and methods, including advanced information technologies.

On the other hand, according to the 5 SDR, an integrated information management process based on the highest quality standards (8R principle) should lead to decision making in order to: 1) ensure a proper balance between economic goals and social/ecological costs (optimization principle); 2) eliminating contradictions between various decision-making aspects (the principle of cooperation); 3) minimizing contradictions, avoiding conflicts of goals (the principle of compatibility); 4) making decisions based on verified and reliable data (the principle of credibility); 5) taking into account industry, technological, legal, etc. conditions (the principle of competition)[5].

Both the 8R concept and the 5 SDR model set us the fundamental premises leading to the implementation and maintenance of high quality information system management. In the further part of this study, the aspect of the business

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[4] J. Mangan, Ch. Lalwani, T. Butcher, *Global Logistics and Supply Chain Management*, Wiley & Sons, New York–London 2008.

[5] A. Wiktorowska-Jasik, *Organizacja procesu transportu ładunków transportem zintegrowanym*, [in:] I.N. Semonov (ed.), *Zintegrowane łańcuchy transportowe*, Difin, Warszawa 2008, pp. 40–41.

decision-making process in the company will be described in more detail in the perspective of the so-called "Data defects" in database administration.

2. "Data defects" and the quality of business decisions made in the company

In general, the data that make up the information management system in the company are stored in databases. They are related to such data properties as: sharing, integration, integrity, security, abstraction and independence[6]. In our analysis, we will be interested in data integrity, i.e. a precise reflection of the area of analysis, the base of which is a model. In practice, this means that if there are real-world relationships between the objects represented by the data in the database, then the changes made in fact must be reflected in the database, and changes in one part of such a relationship in the database should be accurately reflected in the other part of the relationship. Integrity means that we should have confidence in what is in the database regarding the correspondence between the facts stored in the database and reality.

This trust can be undermined by the so-called "Data defects" understood broadly, in particular as damage, defect or missing. The origins of such defects may be different, and indirectly it is a classification (categorization) of defects, as shown in Figure 1[7].

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6 A detailed discussion of these characteristics can be found in P. Beynon-Davies, *Database systems*.

7 D. Gałęzowski, M. Sienkiewicz, *Zarządzanie jakością danych*, presentation in Warsaw SGH 06/12/2016, https://studylibpl.com/doc/684763/jako%C5%9B%C4%87-danych (accessed on July 27, 2019).

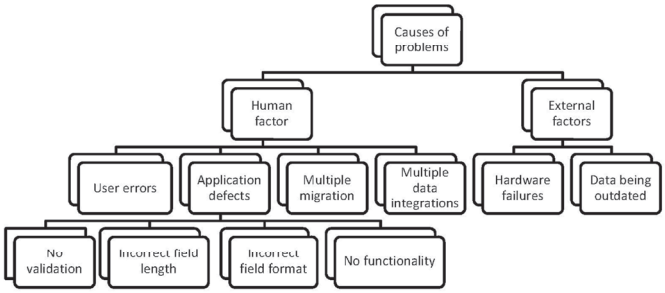

Figure 1. Origins of defects. Prepared on the basis of the presentation by the Warsaw School of Economics.

Source: D. Gałęzowski, M. Sienkiewicz, *Zarządzanie jakością danych*.

Janicki[8] thinks that the quality of database is dependent on the completeness of information, correctness of information, consistency of data, timeliness and domain. Let us briefly introduce the above concepts:

- completeness of information – the degree of filling the database records with data;
- correctness of information – means their compliance with the actual state of affairs;
- data consistency – means correctness of mutual relationships, correctness of connections between the parameters, non-exclusion of data and references;
- topicality – is compliance with the facts despite the constant changes of reality;
- domain – is an area of information to be collected.

At the same time, consideration should be given to the causes of poor data quality. Janicki[9] lists the following:

- lack of completeness at the uploading stage;
- lack of correctness at the uploading stage;
- no updates;
- field mismatch;
- the evolution of IT systems;
- conversions between IT systems;
- extending the use of information contained in the database;
- processing errors.

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8 W. Janicki, *Jakość bazy danych*, "Automatyka", 9 (2005), item 5; http://journals.bg.agh.edu.pl (accessed on July 27, 2019). Similar features can be found in: K. Błaszczyk, R. Knosala, *Problem jakości danych w hurtowniach*, "Prace Naukowe Akademii Ekonomicznej w Katowicach" (2006), http://www.swo.ae.katowice.pl (accessed on July 27, 2019).

9 W. Janicki, *Jakość bazy danych*.

They fall into the categories of defects listed in Figure 1. There is an obvious question about the possibility of ensuring good data quality and effective defect detection. In general, these tasks fall within the scope of the activities carried out by the IT department or a specialized unit responsible for data quality. Can, however, a user-recipient of data be confident about their correctness and reliability despite the developed systemic solutions? Janicki[10] notes that poor data quality may affect, *inter alia*, the following areas[11]:

- customer identification and service;
- data processing;
- preparation of reporting data;
- management data;
- marketing activities.

In these areas, the data is used by a user to make various decisions. In general, incorrect data result in wrong decisions. Is the decision-maker only reliant on accepting the received information or reports as error-free? Perhaps there is a way of detecting errors, "data defects" based only on the analysis of reports or charts?

Based on the simulation modelling method and the proprietary "Check Alert" (CA) technique, an attempt was made to develop a systemic solution used just to support the data owner in the process of verifying the reliability of the analysed reports. Ultimately, it is to allow a recipient of reports from the BI class system to indicate potential ranges of source data that may be considered to be incorrect.

3. Simulation modelling — description of the research method

Simulation modelling is an extremely useful method of verifying hypotheses defined in multiple academic projects, including research carried out in the field of organizational and management sciences. In this paper, simulation, simulation modelling are understood as "imitation, imitation of a real system by means of experiments carried out on a model representing this system"[12]. An indispensable element allowing for carrying out research and experiments under the above

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10 Ibid.

11 In practice, this leads to the following defects at the table, data cell level: 1) value omission (blank field); 2) multiple use of the same value; 3) omitting or adding one or more digits, and 4) changing the order of digits within the same value.

12 M. Beaverstock, A. Greenwood, E. Lavery, E. Nordgren, *Applied simulation. Modelowanie i analiza przy wykorzystaniu FlexSim*, FlexSim Software Products, Orem, Utah, 2011, p. 6.

method is the need to develop and define an appropriate model – the aspect of verification and validation and the selection of an appropriate IT system[13].

There are, with no doubt, numerous advantages of this method, both in terms of research and managerial practice. These include: big realism of the model and data, the ability to diagnose solutions/strategies that do not exist to date, the ability to take into account the time/seasonality parameter, flexible selection of optimization criteria/priorities/business goals, automation in the field of testing many different variants/business scenarios, minimization of knowledge and skills mathematics, low cost and relatively short time to acquire the required business knowledge. The disadvantages of this method would be as follows: the inability to draw general conclusions and recommendations that go beyond the scope and subject of the research, the need to carry out many experiments – time conditions, problems with indicating optimal solutions – the issue of selecting priorities, risks related to data manipulation in order to obtain the expected results or also the verification of previously adopted hypotheses[14].

In this study, as part of simulation modelling, the author's own "Check Alert" technique was developed, which allows, using BI class systems, to make a qualitative assessment of the processed data and try to indicate the sources of the so-called "Data defects".

4. The use of the "Check Alert" technique and SAP Analytics Cloud software in the qualitative assessment of business data — case studies

The "Check Alert" technique consists in carefully reviewing the graph or charts reflecting the processed and analysed data and paying attention to the detected irregularities. These may in particular include the following:

1. peaks, i.e. values representing global extremes, i.e. the largest or smallest values in the data set clearly lying outside the plot line;
2. flattening, i.e. several identical values occurring next to each other;

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[13] A. Balcerak, W. Kwaśnicki, *Modelowanie symulacyjne systemów społeczno-gospodarczych: różnorodność podejść i problemów*, [in:] A. Balcerak, W. Kwaśnicki (eds.), *Symulacja systemów społeczno-gospodarczych*, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław 2005, pp. 6–7: "Simulation should be considered a specific technique of studying reality, developed particularly intensively in recent decades. The development of this technique was possible thanks to revolutionary changes in computer technology (...), therefore, when speaking about simulation today, we usually mean computer simulation".

[14] Ibid., p. 6.

3. contradiction with experience, i.e., noticing that the appearance of the chart does not corroborate the user's expectations resulting from experience and knowledge;
4. an additional warning signal for the user may be the behaviour of the plotted trend line.

The "Check Alert" technique does not automatically indicate a data defect, because in fact there are unexpected situations causing anomalies on the chart. Examples include: sharp rises or falls in stock prices after information about the destruction of factories producing components or mines extracting strategic resources as a result of a disaster (e.g. tsunami); or information about military coups in countries with a dominant role in supplying some raw material causes a peak on the chart of changes in stock prices; terrorist attacks on strategic objects or infrastructure. The final decision whether an irregularity detected by the user is the result of a data defect or results from unexpected changes in the economic reality in the external or internal environment must be made through the implementation of an appropriate procedure with the participation of the data quality section from the IT department.

In the analysis presented in this paper, the "Check Alert" technique has been used in order to analyse simulations of events in three different companies (Enea S.A., Orbis S.A. and Quantum Software S.A.). For the purposes of the simulation, the original data have been modified to include "data defects"[15] introduced deliberately. Then, reports were prepared using the advanced Business Intelligence system (SAP Analytics Cloud) and the reports contained charts with the trend line and a forecast for the two future quarters[16]. In each of the cases discussed in the paper, graphs have been provided and the type of detected anomalies has been indicated with the potential source of the anomaly (the source of the defect).

In point 3, the definition of simulation refers to the model of the system, while the experiments described below have been performed using the commercial

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15 In order to perform the simulation, the following changes (defects) in the data tables were made in a manner unknown to the tester-analyst: 1) For Enea SA, a) for the "Sales revenues" feature, the values were repeated in the field 2016Q2 from 2016Q3; b) for the 'Equity' feature, in field 2018Q2, the value 13 was changed to 31; c) for the "Book value of 1 share", "1" was added in the 2018Q4 field, changing the value from 39.93 to 311.93; 2) For the "Orbis S.A" company, for the "Equity" feature for the 2018Q4 field, the value was changed by removing 1 digit, i.e. from a value of 2,386,425 to 386,425; 3) For Enea S.A., for the feature "Sales revenues" while preparing the appropriate structure of the data file, the data from the "Book value of 1 share" feature was copied and thus the data was repeated, two features had identical data.

16 All possible trend lines available in the system were used to illustrate the program's functional capabilities. However, it should be remembered that there is no universal method of forecasting using the trend.

system version provided by the manufacturer for educational purposes and the actual data modified for the experiment.

4.1 Enea S.A. — the first data set

Using the SAC program[17], forecasts were made taking into account three available methods for three data groups: equity, sales forecast, book value of 1 share. The next three figures indicate the effects of the analysis and forecast.

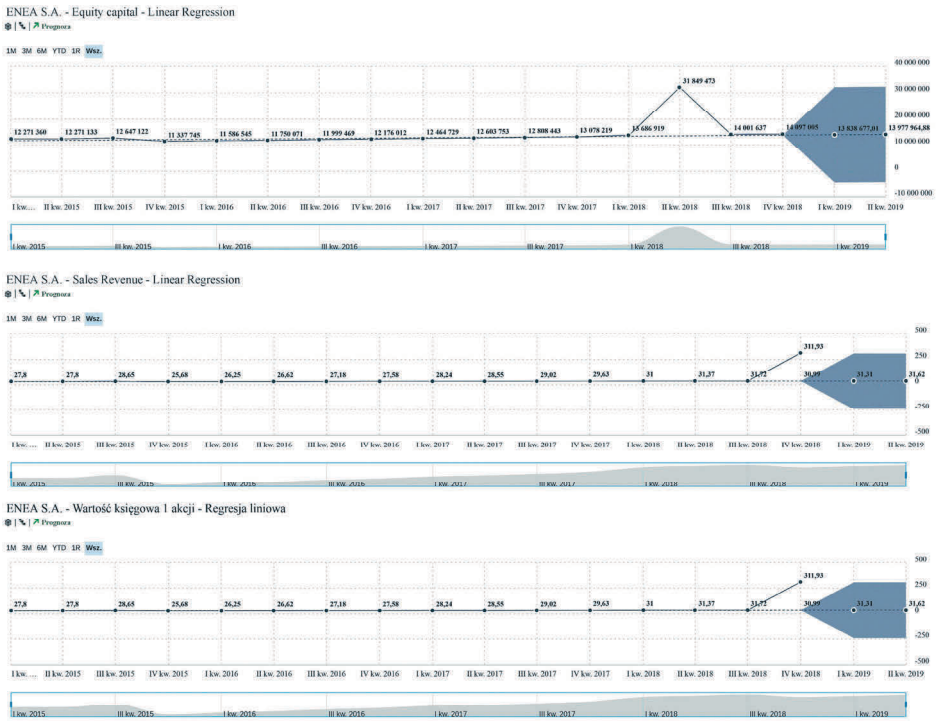

Figure 2. Enea S.A., method: linear regression.

Source: SAC system report.

17 SAC was used in the *SAP Analytics Cloud for Higher Education version* with the "Academic Account" license. It includes a complete business analysis, planning, predictive analysis and the *SAP Digital Boardroom* functionality within a shared learning environment.

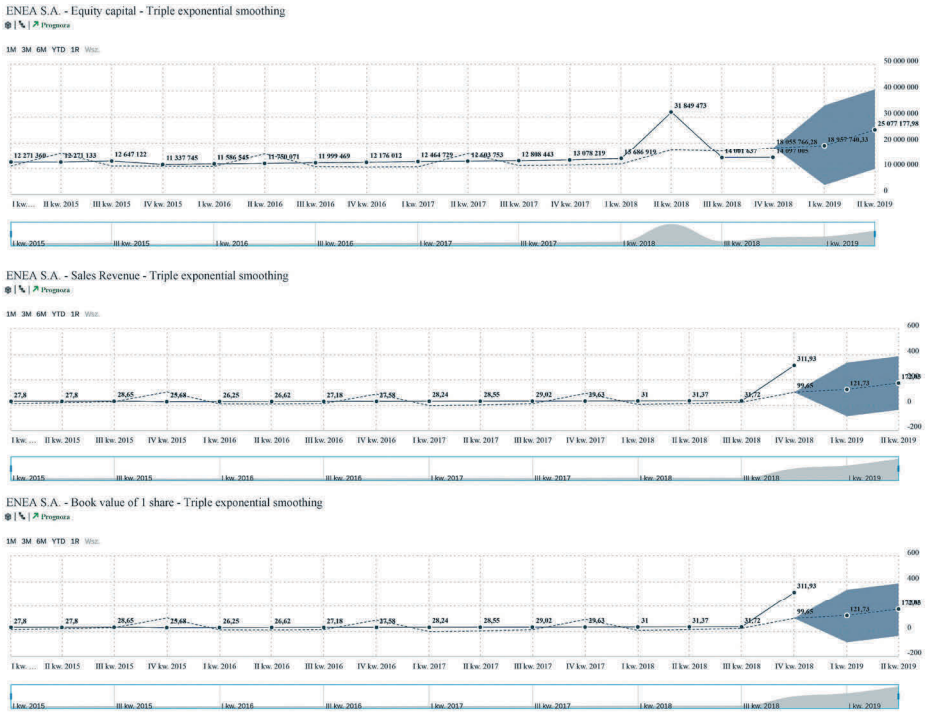

Figure 3. Enea S.A., method: triple exponential smoothing.

Source: SAC system report.

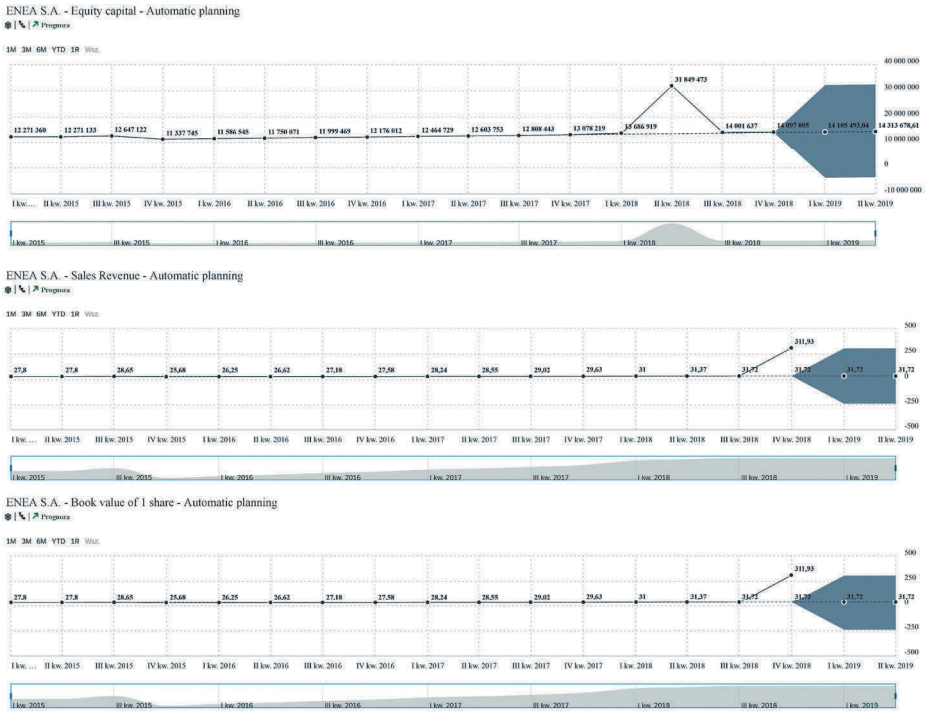

Figure 4. Enea S.A. method: automatic planning.

Source: SAC system report.

The recipient (data user) who analyses the above charts should notice three things.

1. Looking at the equity chart, the first in each of Figures 2–4, we can see a clear jump in value in Q2 2018. The dashed line, the chart of values calculated according to the selected forecast method, suggests a much lower value in the value line of the source data. The sharp jump in capital and an equally sharp decline during the quarter suggest a data error.
2. Similarly, in the graph of sales revenues, the second in each of Figures 2–4, we have a clear increase in the value of sales in Q4 of 2018. This, in turn, results in an optimistic increase in sales in the first half of 2019. Here, it is not obvious that the increase could not have happened, but it is too big even for the fall and winter months. The value of this quarter, calculated according to the selected method of forecast is placed in the line of the value of the source data, which suggests that the value should be lower.
3. The charts for sales revenue and the book value of 1 share are identical, which means that one of the charts had an incorrectly assigned data source. By analysing

the data values, the user may expect that the book values of 1 share have been assigned to the sales revenues.

4. All cases are the result of potential data defects and should be reported for clarification in the data quality assurance section (to the IT department). Upon obtaining an acknowledgement of the removal of defects, the user has to "refresh" the charts – repeat the forecast calculations, in accordance with the applicable procedure. The recipient (user) was informed that the data defects had been removed and, after running the report, they obtained the charts as shown in Figures 5–7.

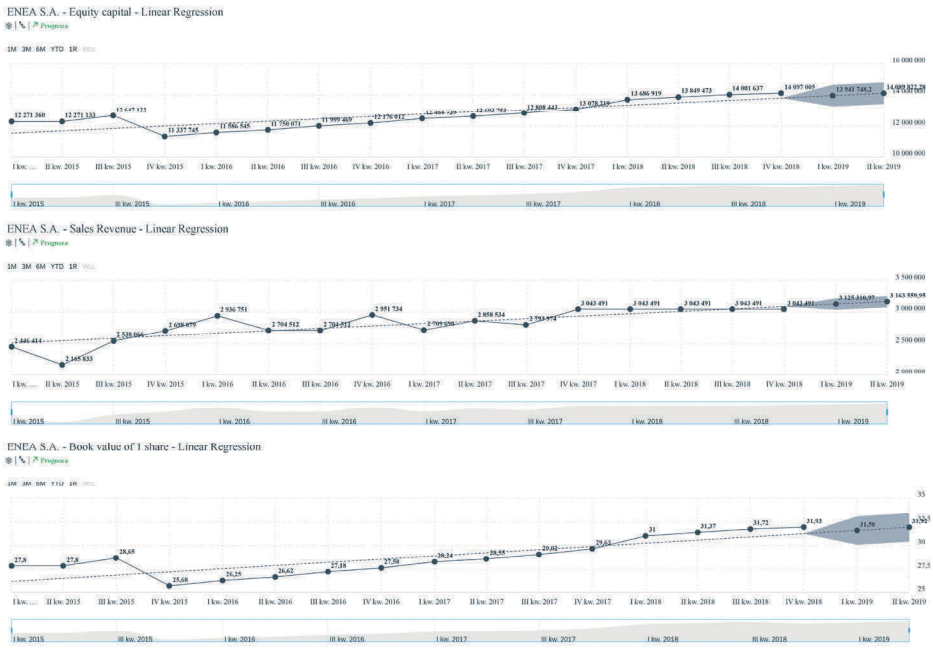

Figure 5. Enea S.A., method: linear regression.

Source: SAC system report.

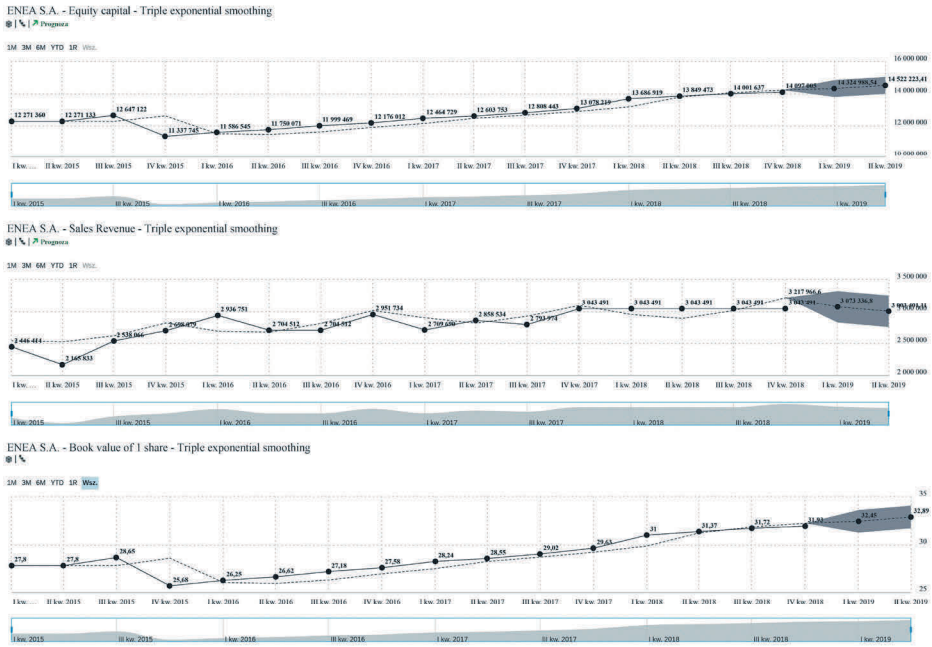

Figure 6. Enea S.A., method: triple exponential smoothing.

Source: SAC system report.

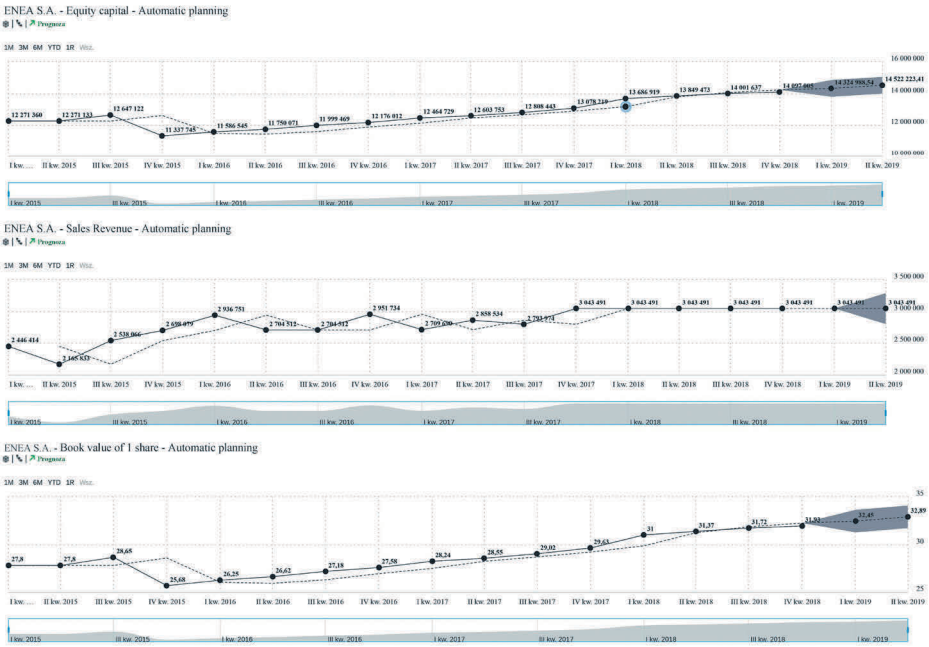

Figure 7. Enea S.A., method: automatic planning.
Source: SAC system report.

Another area that requires clarification is the constant value of sales revenues in the period from Q4 2018 to Q4 2019. It is unlikely that the sales revenues will remain constant for a year. Thus, this is another potential error due to a data defect. The recipient/user is not able to conclude that two identical values in the same chart in 2016 are a possible result of a data defect, not necessarily of the same one. The indicated errors may be the result of the following defects according to the classification presented in Figure 1:

- user errors;
- application defects;
- multiple migrations;
- data aging.

However, according to the reasons mentioned by Janicki[18], they can be as follows:

- lack of correctness at the uploading stage;
- the evolution of IT systems;

18 W. Janicki, *Jakość bazy danych*.

- conversions between IT systems;
- processing errors.

Removing defects and preventing them in the future is the duty of the data quality assurance section (IT department).

4.2 Orbis S.A. — the second data set

The second example is analogous to the defect considered in subchapter 4.1 for the book value of 1 share, the data lies outside the data range, which will appear as a peak in the chart. Using SAC, the data was analysed, this time only one method of calculating the trend was used and the results were obtained as in Figure 8.

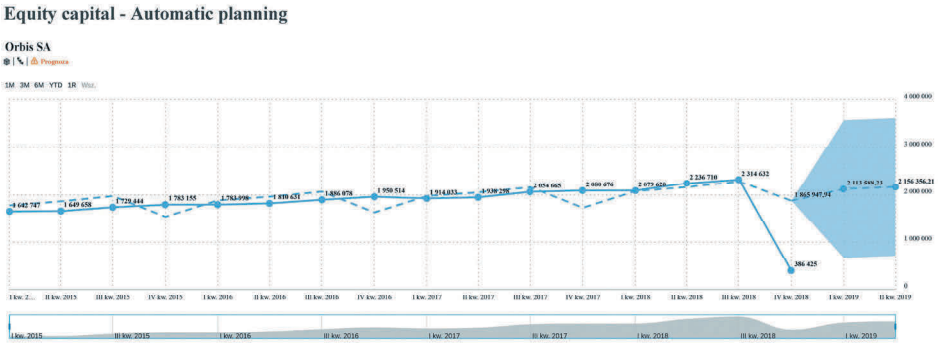

Figure 8. Orbis S.A. — equity, method: automatic planning.
Source: SAC system report.

The last data for Q4 2018 clearly differs from the line of the remaining data. The situation is similar as in the graphs in Figure 4, except that the data for the last quarter of 2018 are clearly below the graph line. Verification of the value of equity capital for Q4 2019 confirmed the existence of an error, and after correction, we received the same results as in Figure 9.

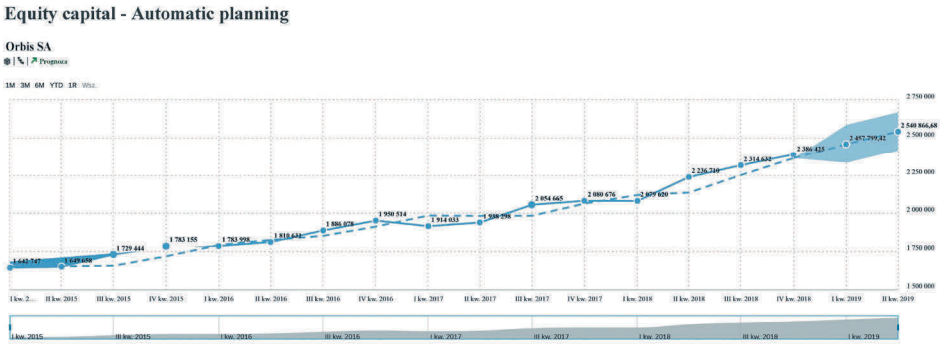

Figure 9. Orbis S.A. — equity, method: automatic planning, data after adjustment.
Source: SAC system report.

Such an evident case is rare, but it can be a hint for verification of data entered "manually", i.e. a defect within the category "user errors" (Figure 1) or "incorrectness at the input stage"[19]. With data from the database, this should not happen, nevertheless, reading the database from incorrectly operating devices may also be the cause of a similar error.

4.3 Quantum Software S.A. — the third data set

Now consider an example that may also contain erroneous data, i.e. the existence of a data defect. We used SAC again and got the same result as in Figure 10.

19 Ibid.

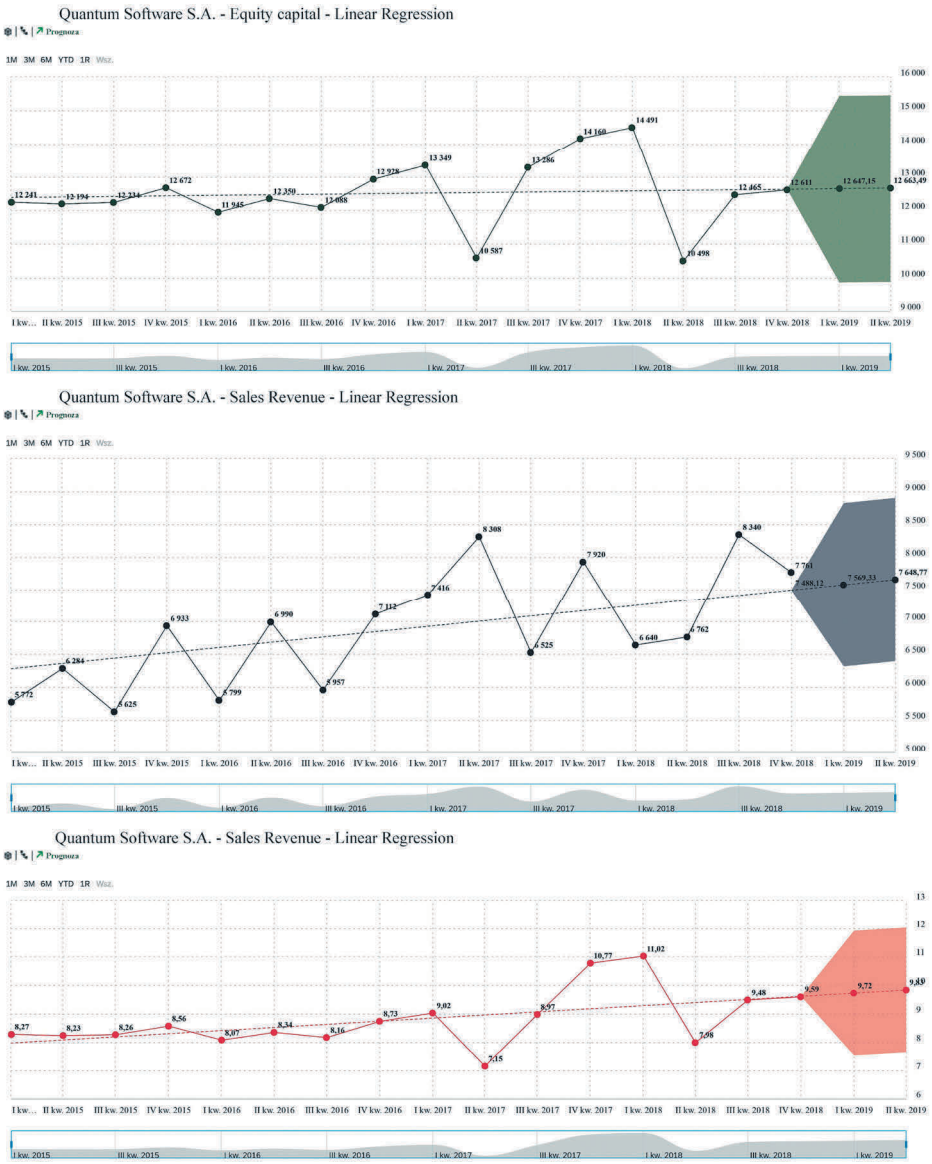

Figure 10. Quantum Software S.A., method: linear regression.

Source: SAC system report.

The charts of equity and book value of 1 share show peaks similar to the charts of equity in Figures 2–5. However, upon careful analysis, you will notice that these charts are similar and have peaks for the same quarters. It is easy to notice the correlation of the book value of 1 share with equity. This is shown in

Figure 11. On the other hand, the sales revenue chart with many peaks suggests seasonality of sales.

The fact that the data is not defective is also evidenced by relatively small differences between the subsequent quarters. In the previous examples, the differences contained in an order of magnitude.

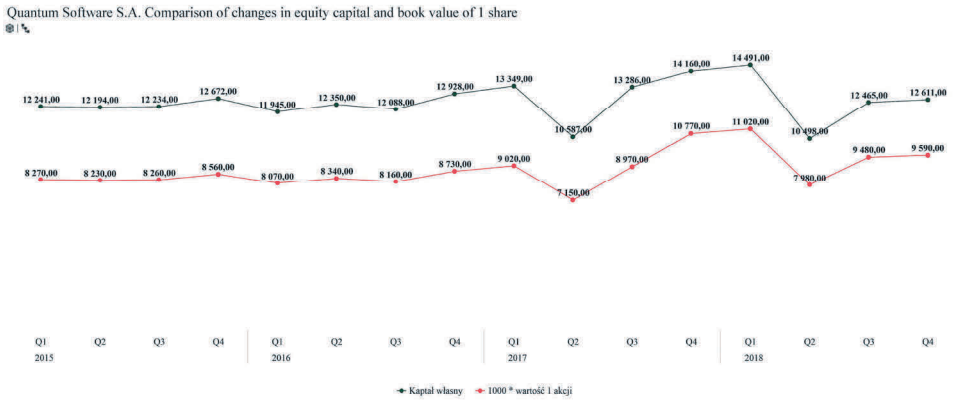

Figure 11. Quantum Software S.A., comparative chart.

Source: SAC system report.

Since the book values of 1 share are about a thousand times lower than the value of equity, they have been scaled in the diagram in Figure 11, multiplied by 1000, otherwise, with the common scale of both graphs, the share values would appear in a straight line. After the scaling operation, the similarity of the graphs for the data under consideration is clearly visible.

To sum up, after analysing all the described cases, it should be stated that the applied CA technique is not a reliable instrument for detecting data defects, but it is a very good "litmus test" for determining a potential threat in terms of ensuring the required reliability.

5. Conclusions and recommendations

Based on the analysis of the subject-matter literature and simulation modelling, taking into account real and simulated business data, it was found that:

1. The quality of the information management system in the company is determined both by ensuring high efficiency at the level of the information product and the process itself (Martyniak).
2. A necessary condition to prevent the appearance of the so-called "Information disease" is the implementation of the concept of 8R (Mangan, Lalwani, Butcher) and 5ZRR (Wiktorowska-Jasik).
3. The most important reasons for the occurrence of data defects include lack of completeness or correctness at the stage of their introduction, lack of updating, field mismatch, conversions between systems or processing errors (Janicki).
4. As a result of the simulation based on the technique "Check Alert", there is a real benefit in successfully detecting potential data defects.
5. Potential indications of anomalies in the field of data visualization do not automatically mean a data defect and need to be consulted with the data owner.
6. Defect assessment depends largely on the type of a potential defect that requires individual diagnosis, e.g. data values determined by peaks and outside the indicated range or repeated values, etc.
7. In terms of mass handling of business data, a programme of the Business Intelligence class, e.g. the SAC system produced by SAP, is an extremely valuable tool.
8. There are no known intelligent algorithms that could automatically signal data defects in the form of graphical alerts (signalling icons).
9. From the perspective of the efficiency of the information system management quality in the company, it is much better to ensure high standards at the place where the data is generated (data source) and then to detect and correct them (the principle of "zero defects"[20] [Crosby][21]).

To sum up, detecting data defects is not an easy task, especially that there are no effective and automatic methods for detecting data anomalies despite the use of IT systems. However, it should be remembered that incorrect data lead to wrong decisions. Since within the last years there has been a shift in the scope of duties of individual jobs from entering or verifying data towards making decisions,

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[20] The key principle of TQM "Do it right the first time". Source: H.H. Steinbeck, *Total Quality Management. Kompleksowe Zarządzanie Jakością*, Wydawnictwo Placet, Warszawa 1998, p. 101.

[21] E. Skrzypek, *Jakość i efektywność*, UMCS, Lublin 2000, p. 100.

it is important to equip the user/employee with data defect detection techniques through the observed anomalies in their visualization. Despite the introduction of AI systems to decision making, there are still many areas where humans cannot simply be replaced.

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