Algorithm for Dealing with Complaints Data from the Use Phase

Is the application of the 8D report still contemporary and sufficient to deal with the predominant complexity in present time?

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Abstract — **The increasing complexity of products, services, and organizations, as well as the resulting surge in failures, demonstrate an increasing need for complaint management in organizations. Nevertheless, this raises the question of whether the possibilities of complaint management can even master the prevailing complexity. In order to investigate this, the method of the 8D report, which is highly regarded in the automotive industry, was questioned concerning its limits. First, the advantages and disadvantages of the 8D report were researched and analyzed related to the current problem. It turns out that the 8D report is no longer able to deal with the extensive flow of information. For this reason, an approach in form of an algorithm, which should make it possible to use complaint information for failure cause search and solution finding, is proposed in this article. It is a prototype that needs to be systematically validated and evaluated in the industry. With a total of four different phases, the algorithm should help to make the complaint management up-to-date and, above all, to improve the search for failure causes and the solution finding. The evaluation of the approach based on specific requirements for the algorithm showed that it is perfectly capable of making the enormous flow of information in the field of complaint management more usable. Nevertheless, further elaborations are needed on how a practical implementation of the algorithm can be realized.**

Keywords- Complexity; Systems; Failure; Algorithm; Complaint; Solution.

I. INTRODUCTION

Whether it is to increase the creation of new ideas for the innovation process [7] or to prevent customer churn [10], complaint management seems to be necessary, especially today. One aspect of this, among other things, is the sensible handling of complaints data from the use phase in order to estimate the customer's opinion, for example [12]. However, not only the measurement of customer satisfaction but also the detection of weaknesses and potentials to improve the company or the products can be realized with complaint data. Above all, the focus is on the identification of failures and the effective search for causes, since some failures and their causes can only be identified through complaints in the use phase [13]. It is important to use the data as an opportunity to improve continually the consumer protection and the image of the company. Despite the opportunity to profitably use complaint data from the use phase, companies often underestimate the relevance and importance of generated information [6]. One of its reasons is, that complaints are often seen as a nuisance of extra work, especially in medium-sized companies [2]. In addition there is a lack of complaints management in such companies [2]. A study from 2018 on data usage shows that data is often collected, however despite its potential, remain unused and "hoarded" [9]. Although this study refers to service companies, the problem can still be assigned to manufacturing companies. In order to counteract this kind of problem, some companies are focusing on methods such as the 8D report, which through their structured procedure should help to process complaints purposive and organize the search for causes of failures more efficient. Nevertheless, is this always the case? Kiem [4] rightly points out that the use of the 8D report also requires a great effort in order to be able to successfully handle complaints. Especially today, where product and production systems are becoming increasingly complex, the goal should be to minimize the effort so that the resource “time” can be used as efficient as possible. Accordingly, within the context of the problem, it must be questioned whether current methods, in this case explicitly the 8D report, can still meet this requirement or if it makes sense to develop new approaches that reduce the challenges for companies.

To find this out, Section 2 first gives an overview of the method of the 8D report. Therefore, the procedure and the advantages and disadvantages will be presented. In addition, requirements for the algorithm are derived based on the advantages and disadvantages. After that, Section 3 presents all four phases of the failure cause searching and the solution finding algorithm. For that, the theoretical concept will be clarified and then explained on the basis of a practical example. In Section 4, the algorithm will be evaluated in terms of derived requirements in order to obtain a summary of how the development of the algorithm should be progressed in the future. We conclude the paper in Section 5.

II. METHOD OF THE 8D REPORT

The method of the 8D report describes a problem-solving method, which is divided into a total of eight disciplines

(8D) and used by companies for complaint processing. It serves, as already mentioned, as a method of communication between supplier and customer. A targeted problem-solving can be achieved by the realization of a structured procedure in eight steps and the use of tools such as Ishikawa diagram, Failure Mode and Effects Analysis (FMEA) or Pareto Analysis [1] and [5].

A. Procedure

Beginning with the "Team Building" (S1), people, who should coordinate the problem-solving process, have to be defined. This might be persons such as the production section manager or the quality engineer, for example. This team will then initiate the second step, the "Problem Description" (S2). In this step, the relevant information has to be collected to ensure a clear and understandable acquisition of the problem. Available tools that can be used for the description are, among other things, Failure-Collecting Cards, Histograms or Pareto Analysis. Just after the description of the problem, the next step takes place, "Immediate Measures" (S3). This step minimizes the consequence of the problem, initially. Nevertheless, it should be noted at this point that these immediate measures are usually not sufficient to eliminate problems since the causes of the failures are often still unknown. Tools in step three are the Inspection Plan, for example. Since, as already mentioned, the cause of the failure is often still unknown, it is necessary to carry out a "Cause Analysis" (S4) in the fourth step. In the problem-solving team, causes of the problem and their interactions can be identified using tools such as Cause-and-Effect Analysis or the Correlation/Scatter Plot. If the causes of the failure are known, it is necessary to act. The "Definition of remedial Measures" (S5) should eliminate them. Nevertheless, it should be noted that the measures are only successful if tools such as the FMEA or Process Capability Tests could also prove their effectiveness. In addition, it should be noted that the measures would only serve their purpose if they are "Anchored in the Organization" (S6). For this purpose, the measures can be incorporated in Training Plans, for example. Building on the anchoring, the knowledge gained should be reflected. For this reason, "Prevention Measures are taken" (S7) in the seventh step. These measures are documented in Design Guidelines, for example. Finally, with the 8D report, the problem-solving process is completed (S8) [1] and [5].

B. Advantages and disadvantages

Based on the procedure, the first advantages and disadvantages of the method can already be deduced. Above all, the recording of the advantages and disadvantages should help to derive requirements for the handling of complaint data with the algorithm. Starting with the advantages of the method, it can be stated that the 8D report contributes to the problem-solving process through a structured and goal-oriented approach. Above all, the high level of acceptance, for example, in the automotive industry, highlights the importance of the method in practice. By identifying causes, deriving countermeasures, as well as documenting and anchoring, the method aims to continually improve the organization. The findings of problems that have already occurred are translated into improvement measures and often allow an increase in customer satisfaction through compliance with the measures. Nevertheless, the method also has weak points. A major disadvantage is, as already mentioned, the high time and personnel implementation effort. This can cause employees to consider the method as a burden and to use it only sporadically. However, especially nowadays it may also lead the employee to invest too much time and resources to use the method and therefor, postpone processing other tasks, such as performing process audits. Another disadvantage of this method is that although it provides a structured approach over eight-step sequence, it has a lack of a standardized survey of the required complaint data. This means that the method does not specify which parameters are necessary in order to promote efficient and goal-oriented problem solving. Companies often have their own company-specific approach. For example, the second step "Problem Description" (S2) is carried out very differently in different companies. This should be avoided in order to simplify cross-company communication as well as to facilitate efficient problem solving by setting uniform parameters. This should save time, which can be used for execution of other activities. In addition to the standardization, there is also a lack of automation of the processing of complaint data from the use phase. Again, the aspect of time is a crucial factor. The more automated the processing of data, the fewer resources are needed. This should also save time and above all costs. By way of example, the automation could be realized with the aid of an algorithm, which processes the complaint data. It turns out, therefore, that the method of the 8D report holds above all a potential for the time factor, which should be used [1] and [5]. The advantages and disadvantages are summarized in Table I.

TABLE I. PROS AND CONS OF THE 8D REPORT METHOD [3] AND [14]

Pros	• The method is widely accepted in the automotive industry and has been tried and tested in practice. • Detected problems will be avoided in the future by means of documentation. • Insights gained flow into improvement measures. • The method is based on a structured approach. • Cross process and departmental thinking are promoted. • It is an effective way to increase customer satisfaction.
Cons	• The method causes a high implementation effort, in terms of both time and personnel. • Hasty emergency measures could be problematic. • The method does not foresee the use or coupling of a model to master the currently prevalent complexity. • Standardized collection of complaint data from the usage phase is not specified. • Automated processing (eg. by means of an algorithm) of the collected complaint data from the usage data is not given.

C. Derivation of requirements

It was already mentioned at the beginning that based on the advantages and disadvantages of the 8D-Report, requirements on the method for the handling of the complaint data from the use phase are derived. On the one hand, it has the purpose that based on the requirements, a possibility for an algorithm can be developed, which takes the not fulfilled aspects by the 8D report into account. On the other hand, it offers a possibility of evaluating the proposed algorithm. By evaluating the algorithm concerning the fulfillment of the requirements, conclusions can be derived regarding improvement potentials and weaknesses of the algorithm. This points out, in turn, new research projects. By deriving the requirements it is especially important that the requirements for the algorithm are even more extensive than the requirements for the method of the 8D report. Therefore, all benefits of the 8D report are translated one-to-one as “must-have requirements” for the algorithm. Furthermore, “should requirements” are worked out by means of the disadvantages. To summarize, the requirements for the algorithm about dealing with complaint data are shown in Table II.

TABLE II. REQUIREMENTS FOR THE ALGORITHM

Must-have (MhRe)	1. High acceptance and validation in practice 2. Documentation of already detected problems 3. Derivation of improvement measures based on knowledge 4. Structured approach 5. Promotion of process and departmental thinking 6. Increase customer satisfaction
Should (SRe)	1. Time and personnel expenses should be as low as possible 2. Prevention of hasty emergency measures 3. Use of a model approach 4. Standardized collection of complaint data 5. Automated processing of the collected complaint data

The table illustrates that, among other things, the algorithm must be a structured approach, which document already recognized problems. In addition, the algorithm should use a model approach and make the automated processing of complaint information possible.

III. ALGORITHM FOR HANDLING COMPLAINT DATA

Based on the above-mentioned must-have and should requirements, it is now possible to develop a prototype for an algorithm. It is first necessary to determine which steps the algorithm should have to deal with complaint data. In considering of SRe 4 "standardized collection of complaint data", the algorithm must first be able to collect complaint data from the usage in such a way that they can be used for further processing. Furthermore, it must be able to extract relevant information from the complaint data, because further processing of all complaint data would not be expedient. In the second and third step of the algorithm, it should be possible to prioritize complaints and use the relevant information from the first step in order to locate the cause of the failure in the production system. Only by such a step, a clear system limitation can be made, which should reduce the additional expenses of solution finding. The final step is to find a solution to the located cause of the failure. Therefor, case-related solutions, depending on the cause of the failure, are used to illustrate ways to deal with the failure cause. In order to present the individual steps of the process in a more transparent way, a prototype of the algorithm was developed and tested on an application example from the industry (Complaint of Shaft W0943). This prototype will be explained in the following sections, first from a theoretical point of view and then based on the industrial example.

A. Probing of complaint data

The first step is called probing of complaint data. It should serve to filter relevant information from the amount of complaint data. This is necessary to make the unstructured volume of complaint data manageable for failure cause and solution finding and thereby making complaint management more attractive to employees.

To achieve this kind of probing process, the algorithm must be able to distinguish between relevant and irrelevant information. In order to put this process into practice, it was programmed using Visual Basic for Applications (VBA). Since the representation of the entire programming code would be too extensive, the process is shown schematically in Figure 1.

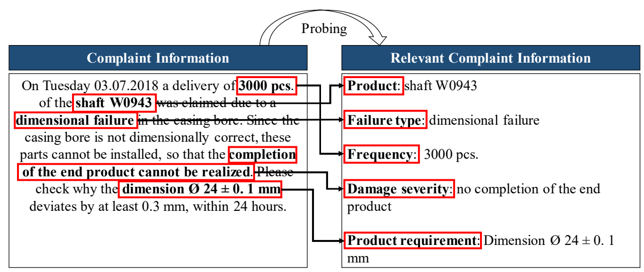

Figure 1. Schematic representation for probing complaint data.

From Figure 1, it can be seen that the algorithm is able to probe relevant complaint information for the application example of the "Shaft W0943". This is made possible by comparing the contents of the complaint text, for example, the product name "Shaft W0943" or the information on product requirements "Dimension Ø 24 ± 0.1 mm", with the information from systems of the company, including, for example, Enterprise-Resource-Planning (ERP) or Computer-Aided Quality (CAQ). If the algorithm detects relevant information within the complaint text, it probes them for further processing. Since this process can be automated and work on a wide variety of systems, a saving of personal and time resources is already realized in the first step. However, as there is still a lot of information to work with, it is important to investigate which complaint has the highest priority.

B. Prioritization of failure causes

In order to realize this, the previously probed relevant complaint information is being used for prioritization, thereby enabling the company to focus on the most relevant complaints. Only in this way the resources of the company can be used as effectively as possible for a targeted failure cause searching and solution finding.

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To apply the prioritization of complaints successfully in practice, this step has also been programmed in VBA. Once again, a representation of the entire programming code is too extensive so that only a schematic representation of the prioritization step is shown in Figure 2.

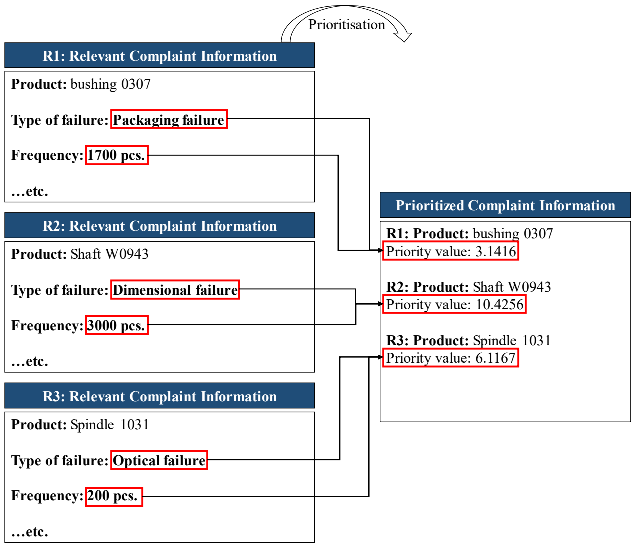

Figure 2. Schematic representation of the prioritization of complaints.

As shown in Figure 2, prioritization is based on different dimensions. The total of nine prioritization dimensions, including, for example, the type of failure or the frequency of the failure, are first calculated by the algorithm and subsequently evaluated. For example, in the case of the "Shaft W0943", the algorithm uses the failure type "dimensional failure" or the frequency "3000 pcs." and bundles all this information into a priority value. In this way it can be deduced which complaint is to be classified as very critical and which as less critical. Based on the most critical complaint, the algorithm initiates the third step, the localization of the cause of the failure.

C. Localization of failure causes

So that localization of causes of failure within a production system is even possible, it is necessary to connect the unfulfilled requirement (the failure) of the complaint with the production system. For the example of "Shaft W0943" this means that the algorithm has to find out at which point of the production system the requirement "dimension Ø 24 ± 0.1 mm" was not fulfilled. To make the complexity of the product system more manageable, it is recommended to use a model. This example uses the approach of enhanced Demand Compliant Design (eDeCoDe) by [8] and [15]. The background to the choice of eDeCoDe is that it can map socio-technical systems through a minimal number of views (requirements, persons, components, processes, and functions). On the other hand, it is able to record correlations and thus make the traceability of responsibilities possible. This is exemplified in Figure 3.

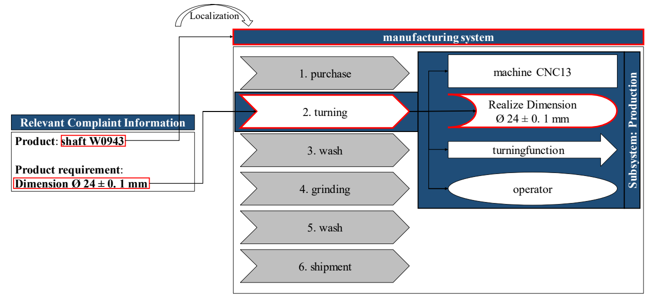

Figure 3. Schematic representation of the localization of failure causes.

Figure 3 shows the schematic process of locating the cause of the fault. This was also programmed with the help of VBA and checked based on the "Shaft W0943" example. The figure shows that the "Shaft W0943" is assigned to the corresponding manufacturing system. This is possible because the algorithm checks in which process step the requirement "Dimension Ø 24 ± 0.1 mm" theoretically should have been implemented. In this example, the algorithm explicitly recognized the „turning process", which should realize the requirement "Dimension Ø 24 ± 0.1 mm". Because the requirement has not been fulfilled, the algorithm concludes that a cause of the failure is to be suspected within the "turning process". This achieves a decisive system limitation and leads to the fact that the cause of the fault is not searched within the systems in which it cannot occur. Thus, with the help of the third step, resource saving by focusing can be realized.

Although the algorithm is able to locate the cause of the failure, it cannot yet determine which exact cause led to the complaint.

D. Solution finding for failure causes

To determine the exact cause, it must be able to evaluate the system in which the cause of the fault was located. In the case of the example "Shaft W0943" this was the "turning process" which was recognized in the "manufacturing system" (Figure 4).

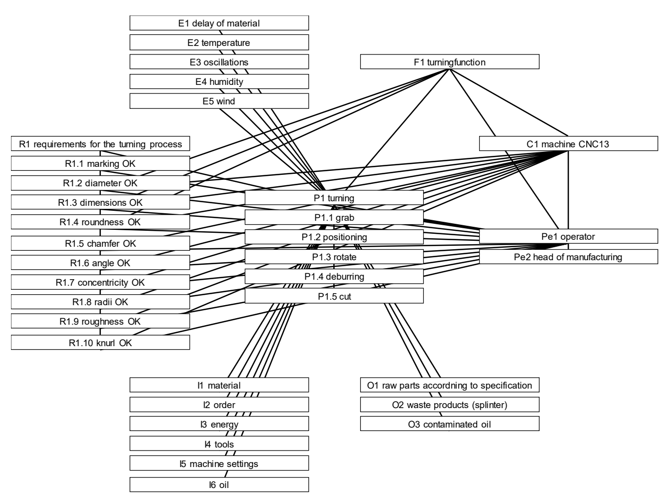

Figure 4. Schematic representation of complex visualization of the manufacturing subsystem

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In order to be able to clearly assign a cause to the occurrence of the failure, it is necessary to analyze the interrelations of the unfulfilled requirement from the complaint, in this case, the imperfect dimensional compliance of the “diameter Ø 24 ± 0.1 mm”. Since a manual evaluation would result in an extra effort, it is recommended to resort to a software solution, which makes the evaluation of causal chain relationships transparent and can be coupled with the eDeCoDe model. For example, the software LOOMEO from the company REDPOINT.TESION can be used for this purpose [11]. It allows systems to map over self-defined domains as well as the creation of elements and their interrelationships using matrices. In particular, the so-called "focus function" of the software is a decisive advantage if the limited subsystems are to be examined regarding isolated elements. Using the "focus function" for the requirement "diameter i.O", which was declared unfulfilled in the context of the complaint, the interrelations to other elements and thus possible causes of failures are clearly highlighted.

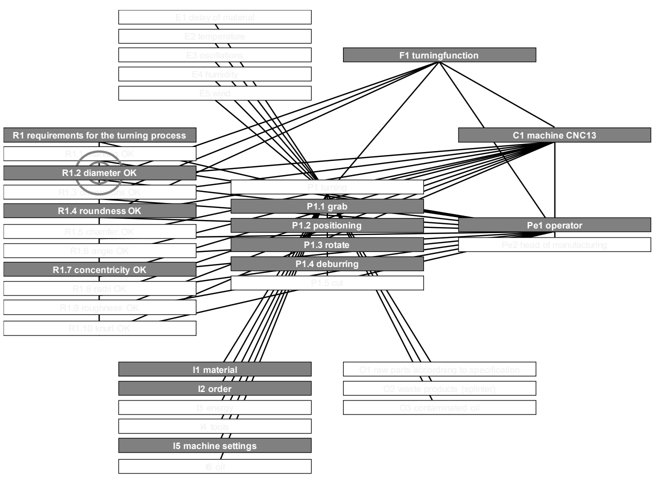

Figure 5. Schematic representation of the application of the "Focus Function" to the complex representation of the Subsystem Manufacturing

Figure 5 illustrates that by focusing on the unfulfilled requirement, it is possible to achieve a clear assignment of causes of failures through the relations. Thus, for example, the “operator” or the “machine CNC13” is a possible cause of failure, which resulted in the non-fulfillment of the diameter and thus the complaint. This presentation provides a basis for the desired solution finding. If the machine is actually the reason for the failure, constructive measures, such as the conversion or adaptation of the device, are necessary. If the operator is identified as the cause of the failure, organizational measures, such as training, are likely to be the solution. However, these approaches must be defined case-related and more specifically depending on the cause of the failure. The knowledge that results from the solution-finding must then be returned to the production system and the company to avoid consequential failure. All these steps should be bundled in course of the algorithm. In order to investigate the meaningfulness of the algorithm, it is now evaluated based on the previously defined requirements.

IV. Validation of the Algorithm

With the presentation of the algorithm, an evaluation can now be carried out based on the previously stated requirements. These will be subsequently evaluated regarding to their degree of fulfillment and the resulting conclusions used for further research projects in the outlook.

In order to be able to assess the fulfillment of the requirements, it is first necessary to define an assessment scheme. For this purpose, three classifications are considered. The symbol "●" describes requirements that have been fully met, "◑" requirements that were met only to a certain percentage and "○" requirements that could not be met. Once again, it should be noted that the both must-have requirements "MhRe 1: High acceptance and valid in practice" and "MhRe 6: Increase customer satisfaction" can only be validated by validation in practice, thus evaluating this is now not possible. Based on this rating, the requirements could be evaluated as follows:

A. *Must-have requirements (MhRe):*

◑ = MhRe 2: Documentation of already detected problems. As the knowledge gained through the feedback from production leads to continuous improvement, problems are "documented" by the already derived and implemented improvement measures. However, a separate recording by means of a document is not considered, as a result of which the requirements can only be met in part.

● = MhRe 3: Derivation of improvement measures based on knowledge. Based on the effective failure cause search, targeted improvement measures can be carried out. This means that the findings of the model evaluation are included in the derivation.

● = MhRe 4: Structured procedure. The structure specification by the eDeCoDe approach and the application of an automated four-step processing method by means of an algorithm contribute to a structured procedure. The identification of the cause of the failure using LOOMEO also follows a given structure.

● = MhRe 5: Promotion of process and departmental thinking. The cross process and departmental thinking are sharpened in the presentation and evaluation of individual subsystems of the production system.

B. *Should requirements (SRe):*

● = SRe 1: Time and personnel expenses should be as low as possible. Automated data sounding, troubleshooting and solution finding using algorithms help to reduce the time and effort required. Instead of a team from different disciplines, which typically performs the problem-solving process, it is only an employee required, who processes the complaint, and a person, who is responsible for the limited subsystem.

◑ = SRe 2: Prevention of hasty emergency measures. Due to the effectiveness of the algorithm, the causes of failure can be assigned much more specifically and also faster to a subsystem. According to that, the need of performing of hasty emergency measures should be greatly minimized.

Nevertheless, it cannot be completely proved, so that this requirement can only be partly met.

● = SRe 3: Use of a model approach. Using eDeCoDe, both the product system and the production system can be represented with a minimal number of system views.

● = SRe 4: Standardized collection of complaint data. By using a data-screening filter, information about the product is collected in a standardized manner. Thus, relevant information is filtered and provided uniformly.

● = SRe 5: Automated processing of the complaint data collected. Based on the presented four steps, which together shall form the automated algorithm, this requirement can be fulfilled completely.

Based on the symbols, it can be seen that all requirements, with the exception of "Documentation of already detected problems" and "Avoiding hasty emergency measures", could be assessed as completely fulfilled.

V. Conclusions

Based on the previous validation regarding the fulfillment of the requirements of the algorithm, the following conclusions can be made. On the one hand, it turned out that the method of the 8D report was able to establish itself very strongly in practice. Nevertheless, it could be shown that the disadvantages of the 8D report, especially in these days, should not be underestimated. This allows the statement that it makes sense to develop new approaches about dealing with complaint data from the usage phase. On the other hand, this should be more efficient in terms of personnel and time. In addition, a model approach should be used to minimize complexity. An automated evaluation should also have strived. Based on these requirements, the article developed an algorithm that incorporates the benefits of the 8D report while compensating for its disadvantages. The application of the eDeCoDe approach creates an efficient and, above all, goal-oriented process to localize causes of failure in the production process and to reduce or avoid them by carrying the solution out. By using the knowledge regarding the cause of the failure, potential for improvement can be identified and used.

It turns out in summary as an outlook that it makes sense to expand and further develop the presented algorithm within further research projects and carry out a systematic validation and evaluation in different companies in order to highlight the potential of the algorithm and to highlight weak points. In addition, it makes sense to investigate whether the algorithm can also be applied to complaints social networks and to measure the actual savings in terms of personnel and time-related implementation efforts and draw conclusions on how to save costs.

To achieve this, it applies to work out a uniform structure for the data screening filter from the survey and to prepare a procedure, which according to it, the prioritization of the complaints and finally the search for the causes of the failure are carried out. Furthermore, it makes sense to develop a method kit that provides solutions depending on the case-related cause of the failure.

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