



Analysis of Key Performance Indicators Impact in a Company of Change Requests brought to Speed Sensors in the Automotive Industry in Order to Optimize the Manufacturing Process

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Abstract: Key performance indicators (KPIs/KPRs) made in a company with a field of activity in automotive allow for the gathering of knowledge and explore the best way to achieve the organisation's objectives. Many researchers have offered different ideas for determining KPIs either manually, semiautomatically or automatically applied on different fields. This paper focuses on providing a study of an approach to explore key performance indicators (KPI/KPR). This work presents explanations about the process organization, the selection path of KPI/KPR and a practical example of measuring KPI/KPR in production department with the meaning of providing an interesting image of how people work and analyze complex situations and design or react to their strategies.

Keywords: Performance indicators, Planning phase, Validation phase, Implementation phase

JEL Classification: O39

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1. INTRODUCTION

Getting material goods as a result of sensor production process development is the main activity of the industrial enterprise.

Carry out activities for obtaining material goods involves possession of a set of raw material and materials which are also called work objects which are taken from nature and represent the result of other production activities. The processing material and raw materials together with working resources handled or supervised by human being become economic goods destined to achieve the consumption needs of the whole society (Breckling, 2010).

The purpose of this paper was to help optimize the way we work and inform all people involved in the process of requesting change, a simplified way to create indicators that always show us the status we are at.

In the production process are following activities:

- The manufacturing process of the sensors, this activity is performed through the industrial production process;

- Laboratory work, such as research and assimilation activities in the manufacture of the new products, activity direct related to manufacturing (Zhang, 2002).

In order for production process take place optimally, there are several factors which condition this process:

- The workforce through the conscious actions that people do;

- Capital defined by the means of labor;

- Natural processes that cannot be influenced (Wegmuller, 2000).

By making a technical-material report, the production process is defined as totality of technological process, work processes and natural processes that contribute at obtaining products, in this case wheel speed sensors or the execution of works and services that are the enterprise activity object.

The result we obtain is depending on the way people act over the works objects, in the production process we distinguish the following process types: work processes, technological processes and natural processes (Ungureanu).

The production activity is carried out through the production process, development of which is conditioned by various factors.

The desire and goal of each company is always to have the best methods of managing and carrying out the production process. In the production of sensors there is a constant flow of change requests that are made in order to optimize the production process. Changes are made to both the process and the product (Sorace, 1997).

2. DEFINING THE RESEARCH PROBLEM

Change requests are documents by which any internally hired person can make optimization changes to a product or process. A change request shall include a set of necessary data on the change to be made in the production process (The IEEE, 2002).

These change requests are created in a special system implemented for this change request process and which also presents the change request registration system. This system is called Change Management used to optimize the products and services offered (Shell, 2002).

The change request, in its process of creation and concretization, goes through certain phases, namely:

Preliminary phase. This is the phase where an associate starts an electronic request to change into the system. To create a change request, you need a process or product optimization idea, or a component change. Changes can be varied but are always related to the process or product. Once all the necessary information from the preliminary phase is filled in the system, it is sent directly to the Manager (Karnik, 1999). The manager will analyze the change request, and before approving it, he will appoint a person from the department who will be responsible for



following and coordinating the whole process until the change is implemented in the production system. The nominated person may be the same person who initiated the change request or it may be another person in the department (Padhye, 2004).

The manager is responsible for monitoring if the customer is affected by the change, whether all quality conditions are met after the change is implemented and whether the change involves costs (IEEE, 1997).

The planning phase. In this phase it is nominated a person who will handle the application, it will make sure it is completed correctly, it will be presented to a group of people who will carefully check the change request. These persons check all change requests before they are sent for approval to the nominees in each department involved. The person nominated to create the change request and who will follow up on the change will organize together with the project team all the activities necessary for the change to be feasible.

Processing and validation phase. In this phase the change was approved by all the people involved in the process. The necessary analyzes will be performed to test if the change is in the parameters, all measures will be documented so that all the documents that are necessary to implement the change are updated and available to all persons involved in the process.

Also in this phase, the person responsible for the change request has the possibility to modify the content of the request. Once the application has been submitted for final approval, its content cannot be changed. If it is necessary to change something in the content of the request, it has to return to a correction phase but after the completion will bring the application back for approval to all persons involved.

Because of this reason it is very important that the application is created correctly and it must contain all the necessary information and to be treated seriously especially by the responsible person. A correction phase for a change request is not desired because it can affect the production process, the coordination process or the customer (OECD, 2008).

Implementation phase. In this phase, it is checked carefully in the change application if the list of approvers contains all the persons involved in the process who must approve the application. It is checked the content of applications if it is correctly completed. It is checked whether the implementation date set by the person in charge of the application is correct, it can be exceeded but this will negatively influence the coordination process.

The implementation phase is the one in which the change that the request responsible wants to be implemented will actually appear in the production system used. In order for the change in the production system to be implemented, the change request must include a clear description of the changes. The description must be very well detailed, it must contain all the changes that will be made and where they will be reflected. If one of the above conditions is not met, the application risks being rejected and sent back to a correction phase (Migley, 2009) arte mari și la reclamații din partea clientului (Van, 2006).

It is very important that the implementation responsible, a person from Technical Documentation Department generally, checks all the requirements mentioned above because a wrong change in the system can negatively affect the production. This can lead to very high additional costs and customer complaints (Van, 2006).

Once the implementation is done in the production system it means that the change will physically appear in the production process.

The system is a very well designed and it helps to create change requests which bring a physical effect on the production process. These changes can affect both the product and the process, depending on the change that any indirect employee can make for optimization purposes (Lawson, 2001). For creating a change request in the system, you can choose one of the three options available. The choice of the optimal variant is made in the approval phase by the group responsible of the one who starts the change request (Schumpeter, 1939).

A change requests can follow one of the following flows:

- Standard;
- Simplified;
- Correction.

Depending on the chosen flow for creating applications, there are different criteria for completing and implementing them (Lauer, 2006).

The flow of change requests is large, and this requires statistical monitoring and continuous tracking of all optimization changes made by change requests created in the Optimization Change Management system. For this part of monitoring to become concrete, we decided to use the functions of generating performance indicators according to change requests phases (De Jong, 2003).

3. PRESENTING THE RESEARCH FINDINGS

Process or product change management offers the possibility to generate indicators that can help us to follow our internal change requests much more easily, and where is needed to define improvement measures [Woszczyna K.].

The indicators we can generate and monitor are the following:

Key performance indicator in planning phase (KPI 1), (Kiran)

The first stage of monitoring is performed in the planning phase of the change request. The planning phase means that the change request is to be submitted to the change request team that will assess the content.

This stage is the phase in which the request is already approved by the manager, the change is defined in the request and is presented to the change request team to know that a new change is coming and to be able to plan the activities involved in the new change.

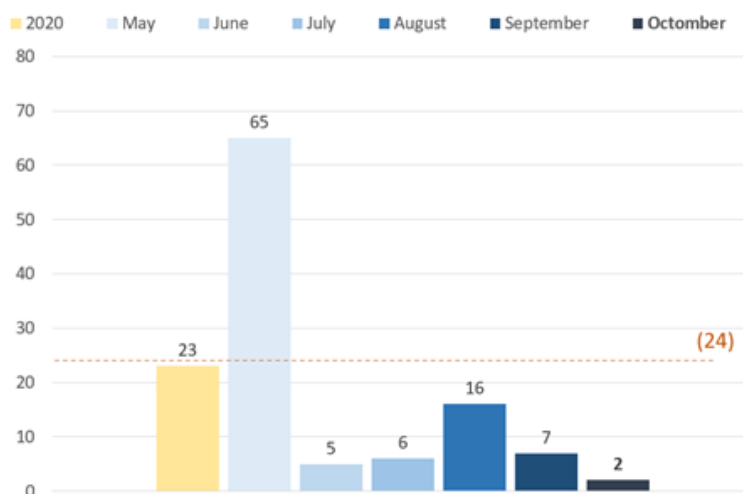
What does the performance indicator mean in the planning phase?

Monitoring change requests in the planning phase means that the change representative must meet an imposed target when this stage begins. This target is defined internally and represents the number of days from which the change request is approved by the team that verified it until the day this period ends.

For this phase in the present paper, the target was set, for the performance indicator in the planning phase, between 20 and 24 days.

This first indicator is further put into practice and the whole process that takes place after its generation is presented.

Figure no.1 – Key performance indicator in planning phase



Source: Intern from company



On vertical axis you can see the period, in days where the planning phase of change requests takes place. On the horizontal axis you can see how many days there are, on average for all change requests, for each month, but also an average for the previous year.

Data processing is done monthly through an internal company system that processes all change requests for each month and generates the graph above, calculating the average number of days in which the planning phase took place.

The formula of this indicator is based on certain factors: the date of the day when the change request is sent for approval to the specialized persons for verification of the request, the date we noted with n1 minus the date on which the approval process ended,

$$KPI 1 = n1 - m1:$$

Figure no.2 – Calculation Performance indicator in the planning phase

KPI 1	
Name of Key Figure	Cycle Time of Team Review: Duration of the Team Review approvals
Scale Unit	[number of days]
Calculation	CT-TR (calendar days): Period of time of the Planning Phase from start to the end of the Team Review
IT-System	Export the data from the IT-Systems

Source: Intern from company

The result obtained cannot exceed the number represented by the defined target.

The process of this indicator is influenced by certain factors, such as: the reason for the change, the documents required to bring the change, the products affected, the costs required to process the change.

To verify the source of the problem and to define some improvement measures, it was established in the internal process regular meetings between the local change coordinator and the people from each department involved in the change request.

The process for analyzing the source of the cause and identifying the measure is done using PDCA (Plan Do Check Act). PDCA (Mezzovico) method helps to organize and carry out management activities and is aimed to continuous improvement of the quality management system that company has.

These results represented by indicators are monthly generated and presented to the senior management by a nominee from the Technical Documentation department.

All these discussions are based on the request for change. Therefore, there is a strong emphasis on a change request to be created correctly and to contain all the necessary information when someone accesses it and wants to know more details.

By performing the first performance indicator, it is verified whether the change requests respect the period imposed in the planning phase and reflect a clear

annual overview and as well an evolution of the situation and it helps to continuously improve the process and discover the weaknesses that need to be removed and the strengths that are more emphasized.

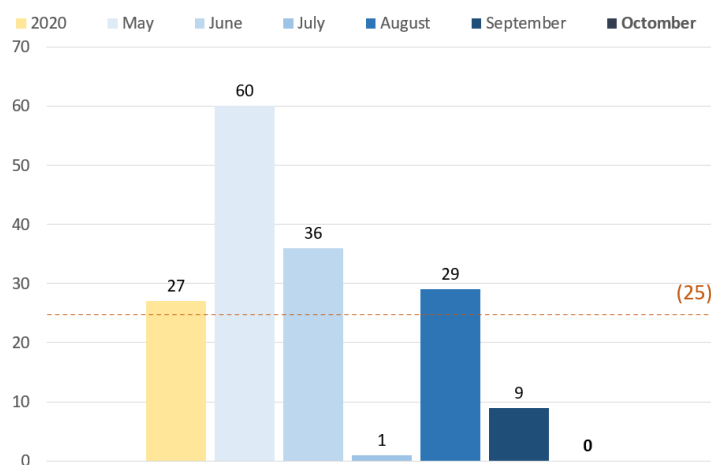
Key performance indicator in the validation phase (KPI 2)

The second indicator the system allows to be generated is the performance indicator in the validation phase. The principle of this indicator is the same as the performance indicator in the planning phase. It works in the same way but shows if the validation phase, this time fits in a certain number of days. The target is also set for each product and is approved by the manager.

What does the performance indicator mean in the validation phase?

After the planning phase is completed, the change request moves to the validation phase. At this stage, the Change Representative can make certain changes, if necessary. These adjustments are requested by the team who check the changes and change representative is responsible for making these changes. Once the change request is ready, change representative can send it for approval to the team set as approvers in the validation phase. The people who approve the change request at this stage are from departments involved in the change request process.

Figure no.3 – Performance indicator in the validation phase



Source: Intern from company

The data is processed monthly through an internal company system that processes all change requests for each month and generates the graph above, calculating the average number of days in which the validation phase took place.

To calculate this indicator is the same principle as for the first indicator: the date the change request begins the approval process by the departments concerned, marked with n2 minus the date on which the change request obtained the last approval, marked with m2

$$KPI2 = n2 - m2:$$

Figure no.4 – Calculation of the indicator in the planning phase

KPI 2	
Name of Key Figure	Cycle Time of Final Review: Duration of Final Review approvals
Scale Unit	[number of days]
Calculation	CT-FR [calendar days]: Period of time of the Processing and Validation Phase from start to the end of the Final Review
IT-System	Export the data from the IT-Systems

Source: Intern from company

The result we get after calculating this indicator must be less or equal than to the required target.

The presentation should be very simple, but with all the necessary information so that it can be easily understandable by anyone who wants to see the situation of change requests. At a national level, each location has defined targets for performance indicators (Jarratt, 2004).

Key performance in delivery phase (KPR), (Kiran)

There are three indicators that are followed. All are of major importance, but the most important of the three is the delivery or the indicator of implementation of changes in the production process. To be included in the target imposed on this indicator, the first two indicators must be respected.



If the delivery of the products with the new changes is done on time, it means that there is a satisfied customer. This is the most important reason why products and services have to be delivered on time (Tale-Yazdi).

What does it mean to implement change requests over time?

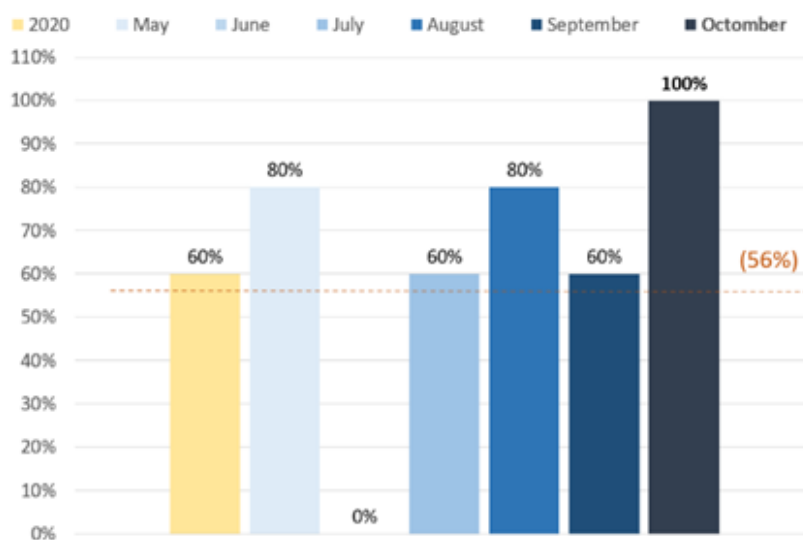
Implementation over time means that the change reaches the production process on the date written in the field in the change request. When a new change request arrives, specify the date when the production is to contain the new change. This date must consider all the steps that the application will take and all the additional activities that the responsible persons must do to be able to approve the application and to comply with the new change. Some activities may have a long duration and for this reason this implementation date must consider the duration of each activity (Jarratt, 2004).

What does the performance indicator mean in the delivery phase?

In the company it is important what is the percentage of delivery of products to the customer, what percentage of what is planned is delivered to the customer in a timeframe defined in the change request. For the record, a percentage was set for each product group, which represents the target that must be reached monthly in terms of implementation over time of changes in the production system.

The emphasis is placed on this indicator, so it seeks to be as high percentage of change requests, implemented in the production process.

Figure no.5 – Performance indicator in the delivery phase



Source: Intern from company

Data processing is done monthly through an internal company system that processes all change requests for each month and generates the graph above, calculating the percentage of implementation of change requests.

The formula of the indicator is:

$$KPR = (n3 / m3) * 100$$

n3 represents the date the first delivery is made

m3 is the date on which it was planned when the change request was created, to have the first delivery

The result is multiplied by 100 because this indicator is measured in percentages:

Figure no.6 – Calculation of the performance indicator in the delivery phase

KPR 1	
Name of Key Figure	On Time Delivery: Changes implemented on time planned
Scale Unit	[%]
Calculation	(actual/plan) *100 (plan = Introduction date in the Planning Phase)
IT-System	Export the data from the IT-Systems

Source: Intern from company

In progress of this indicator, factors influence our result are production planning and material availability.

For deviations, the change requests that have not been implemented in time will be analyzed and the causes will be identified, and measures will be taken to prevent this kind of failure. The same presentation will be made with the causes and measures to be taken.

4. CONCLUSIONS

The main results obtained are the up-to-date data where we can see what is the current situation of change requests in each phase of it.

A key aspect of engineering change management is the efficient management of engineering changes in the product development process. Thus, performance measurement criteria, such as performance indicators or key performance indicators, are often used in a variety of areas, either to reveal the performance deficit or to improve a particular process (Wright). However, in the field of engineering change management, the literature does not have a broad understanding of key performance indicators (Dragana) as well as its applications. This lack of performance indicators can be remedied by transferring available knowledge about performance indicators from other areas of research. Therefore, this paper presents an initial perspective on the research activities on performance measurements in different fields of research. Moreover, constraints in technical change management are identified for the application of KPIs to improve the overall management of technical changes. As a result, a performance level model for the application of performance values in engineering change management is described [Bahram H.].

We have also exemplified how to generate and present them, chosen after several attempts and how it can still withstand optimization changes.

The functions we discover and use constantly give us the opportunity to improve our work much faster and easier because we can always see exactly where the problem occurs that can interrupt or aggravate our process (Tarwiesch, 1999).

During this work, the obstacles we encountered were mostly related to cooperation, because for the analysis of the data it is necessary to cooperate with colleagues from the departments involved, and this is often an obstacle.

The decision to study and develop this part of performance indicators came from the idea that we need to find a way to track our work, to be able to analyze our solutions more easily and to always have a status of all requests for change. is developed and implemented on the production of wheel speed sensors.

This paper aims to provide a functional framework for defining knowledge content appropriate to the environment of development and implementation of changes and an outline for



a new level of approach and tracking of optimization changes, with increased emphasis in engineering (Lu).

Each organization always aims to create a simplified way of working and presenting all the factors that make up the work process. To put this process of performance indicators into practice, the stages of the process were precisely defined, the most important phases to be paid attention to at the time of their development were followed and thus the performance indicators were defined in the phases more important aspects of the process (Chapman).

For the future, I found it interesting to develop a thorough analysis of how to carry out a change request from its inception to implementation. This way it is easy to understand what are the hardest moments to overcome and you can see in detail what are the causes that can generate deviations from the process.

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