"HENRI COANDA"
AIR FORCE ACADEMY
ROMANIA

"GENERAL M.R. STEFANIK"
ARMED FORCES ACADEMY
SLOVAK REPUBLIC

INTERNATIONAL CONFERENCE of SCIENTIFIC PAPER
AFASES 2012
Brasov, 24-26 May 2012

RESEARCH ON THE EFFECTIVENESS AND EFFICIENCY IN QUALITY MANAGEMENT

Adrian NICULESCU*, Radu IOVANAS**

* Romania Draexlmaier Electric Systems Company Ltd.,
**Scientific Coordinator, Transylvania University, Brasov

Abstract: *Effectiveness and efficiency: two terms often confused, two terms that for many users mean the same. Although the standard SR EN ISO 9000:2006 presents definitions of effectiveness and efficiency, it is difficult to assess whether a given activity is or not effective or efficient. The problem is even more complex if we decide to determine the effectiveness and efficiency in quality management processes, belonging in this case to different quality control phases.*
Can effectiveness and efficiency be quantified?
Can they be determined by a formula?
How are the results of calculation to be interpreted?
To answer these questions, we started a project, so as to single out a method for determining the effectiveness and efficiency of quality control processes, as part of quality management, starting the assessment by calculation of these indicators. The project aims to rethink the current concept of quality control activities, by instituting the basic principles of effectiveness and efficiency.
According to academic literature, through efficiency is understood the state of achieving predetermined targets. Effectiveness is assessed based on the effort (material/ human) submitted to the objectives.
Home project aims to:
Improve performance in quality management/control based on measurable objectives;
Determine formulas for calculating the effectiveness and efficiency;
The originality of the paper work consists of determination by calculation of the effectiveness and efficiency of the quality control activity and as well of the interpretation manner of the achieved values.

Keywords*: quality, management, effectiveness, efficiency, running inspection, final inspection*

1. INTRODUCTION

Effective and efficient are very common business terms. Most of people tend to mix their meanings and usage occasionally. It is very important to define the two notions which help us to create a better set of measures. Effectiveness is doing the right things and efficiency is doing the things right. With the help of this project I wanted to determine the calculus relationship between the effectiveness and efficiency of control processes and their verification in practice, applying these formulas within the quality management department I lead.

2. DEFINITIONS

Effectiveness: "the extent to which planned activities are realized and planned results are achieved" [1]

Effectiveness = objective achievement measure.

Effectveness = the ratio of realized and the proposed target.

Efficiency: ”relationship (ratio) between the result achieved and resources used” [1]

Efficiency = ratio of predefined quality objectives and effort required to achieve objectives.

Efficiency is a measure of economic (cost-benefit relationship).

3. RESEARCH METHODOLOGY/ APPROACH

The method is based on a case study, on observations of existent situation and on willing of quality process improvement.

The project is about determination of effectiveness improvement method and the efficiency of quality assurance processes, starting from the calculating evaluation of these indicators. The project’s goal is a rethinking of actual concept regarding the quality control activity on the basis of effectiveness and efficiency principle. Within this project, my goal is to determine the calculating proportions of the effectiveness and efficiency of control processes from the quality assurance activity and their practical check as well, by application of that formula to activity of quality management department of company where I am working.

We started from situation assesment of the quality control activity, namely the control of the various production processes, following the flow chart of the control preocesses (fig.1).

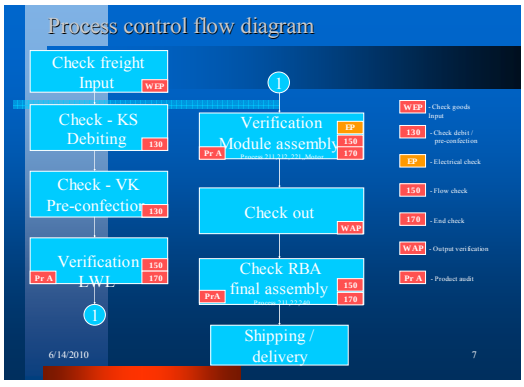

Fig.1 Process control flow diagram

It is very important to identify all phases of control over production process. The well known ”rule of ten: the later a effect is being discovered, the more expensive are implications and its corrections” [2] is also applied in this case.

This rule, applied to production processes in DRM, looks like the figure below (fig. 2).

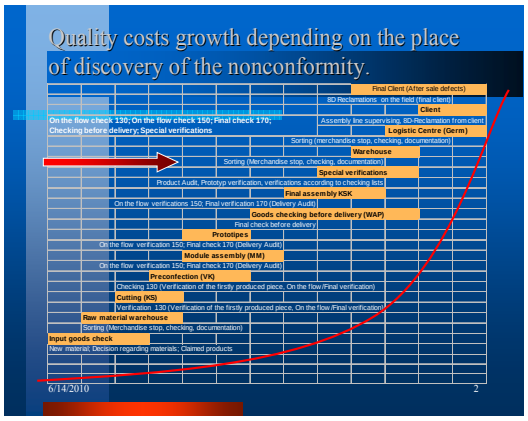

Fig. 2 Increased costs depended on where quality nonconformities are discovered.

We can observed that the highest costs of non-quality, occur when product defects are found in the most advanced stages of execution, exponentially increasing as we approach the final product.

Costs are higher if product errors are discovered by client, or even the end customer or car buyer in the case of auto industry.

Following discussions of the quality management department, have established the necessary steps to determine the calculation formula:

a) Setting the time period for the addition of errors documented for each verification process and within each main production process. Taken into consideration were last 160 days (eight month).
b) Documenting daily life activities for two days of each quality worker, then their categorisation within five main activities.
c) Internal assessment documented errors (sum of the internal evaluation system).
d) Evaluation of errors from complaints (sum of errors recorded in complains).

e) Determination of calculation formulas – defined translation efficiency and effectiveness in specific language quality control processes.

4. DEFINING FORMULAS FOR EFFECTIVENESS AND EFFICIENCY

Formulas were determined from definitions of EN ISO 9000:2006.

Effectiveness means measure to achieve the objective. The objective in this case is finding errors produced on a given production stage.

If we want to determine the effectiveness of finding the errors in a production process, we consider:

$\sum Gf$ = sum of errors discovered on a particular stage of production (cutting, pre-confection, assembly, etc.);

$\sum Gtf$ = sum of all errors that come from a certain stage of production, irrespective of their discovery (cutting operations + pre-confection + internal customer + external customer), it then results in the effectiveness formula:

$$\sum Eft1 = \frac{\sum Gf}{\sum Gtf} \times 100 \ [\%] \quad (1)$$

If we want to determine the effectiveness of finding the errors in a quality process, we consider:

$\sum Gf$ = sum of errors discovered on a particular stage of production (cutting, pre-confection, assembly, etc.);

$\sum Gt$ = sum of all errors that come from a certain stage of production, irrespective of their discovery (rolling control + final control + sorting activities + internal customer + external customer), it then results in the effectiveness formula:

$$\sum Eft2 = \frac{\sum Gf}{\sum Gt} \times 100 \ [\%] \quad (2)$$

Efficiency means relationship (ratio) between the result obtained and resources used.

Efficiency formula for the control process is determined taking into account three elements:

a) $\sum Gf$ = sum of errors discovered on a particular stage of production (cutting, pre-confection, assembly, etc.);
b) T = actual time used for doing a control process (rolling control, final control, etc.), in hours;

The actual time used to process control is determined taking into account the number of people assigned for controlling process, share of time allocated, number of hours worked daily, the number of working day taken into account and the coefficient of leave (medical or recreation).

With other words,

$$T = NP*Pta*h*Nl*Cc \quad (3)$$

where:
NP = number of people assigned for controlling the process;
Pta = Share of time allocated [%];
H = number of hours worked daily;

Nl = Number of working days taken into account;
Cc = coefficient of leave (medical or recreation).

c) Kef = coefficient of efficiency – efficiency ratio which means all verification activities, the ratio of total number of errors found and the total time used for their discovery.

$$Kef = \frac{\sum Gt}{Th} \quad [errors/hour] \quad (4)$$

Where:

$\sum Gt$ = sum of errors from all stages of completion, regardless of place of discovery;
Th = total hours of verification.

Efficiency formula as follow:

$$Efc = \frac{\sum Gf}{T * Kef} \quad [\%] \quad (5)$$

That can cause two leading indicators in evaluating the quality. First, Efc, indicating the efficiency of detecting faults in the production processes (cutting, pre-confection, module assembly, final assembly) or quality (pre-confection processes, rolling control or final examination).

The second, Kef, indicates the productivity of detecting errors general, the control processes (how many errors per hour are found by all checking staff).

5. ANOTHER APPROACH TO EFFICIENCY. EFFICIENCY AS AN ECONOMY

From this point of view, we define efficiency as the relationship between inputs and outputs, performance and costs and/or other disadvantages or losses.

In the following we treat not only efficiency and cost performance, as was treated in previous chapters of the work, but also as a link between planed human resourced and real human resources, necessary for quality control process. Following this idea, efficiency is defined by a relationship between outputs and inputs used or allocated.

In this sense, the question is, first, to establish an optimal ratio between quality human resources allocated to those allocated for production and secondly to determine the efficiency as the ratio of human resources planning and existing.

The average yield of staff is being defined(ratio of number of personnel quality-production = ω) as monthly average quality of staff by the average monthly production staff.

$$\omega = \frac{NP\ QS}{NP\ Prod} \quad (6)$$

Where:
NP QS = number of personnel engaged in quality;
NP Prod = Number of personnel engaged in production.

Optimal value of this report is considered as the objective of efficiency (100%) the share of quality personnel to its employees in production. Optimal value of ratio of specific activity was determined according to the production of automotive electrical wiring. Given the high percentage of manual processes, the optimal ratio is considered to be in the range 4%-5% with the possibility to be amended annually, depending on stability of production or the introduction of projects/new products that need 100% verification of the quality.

This indicator used to assess the efficiency relative to the number of employees. It is calculated as:

$$Efic\ N = \frac{Average\ \omega\ plan}{Mounth\ \omega\ real} * 100\ [\%] \quad (7)$$

Where:
Efic N = Quality efficiency relative to the number of employees in manufacturing;

Average ω plan = average ω plan efficiency, calculated as ratio between average monthly quality staff and average monthly production staff;
Month ω real = the monthly return, calculated as monthly ratio between the number of personnel employed in quality and number of personnel engaged in production.

In fig. 3 is presented the evolution of the indicator during the year 2011.

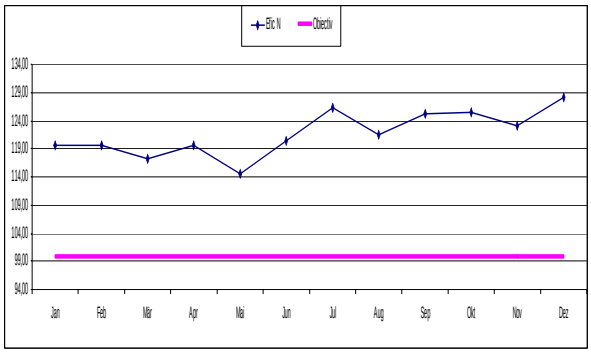

Fig. 3 Developments Nef during 2011

Base on data provided by the Controlling dept., according to the monthly review expenditure, a reported efficiency in personnel costs in the quality department can be calculated. To this end, the following formula:

$$\text{Efic C} = \frac{\text{CPQ plan}}{\text{CPQ real}} * 100 \quad [\%] \quad (8)$$

Where:
Efic C efficiency relative to personnel costs;
CPQ plan = Quality staff costs planned;
CPQ real = Quality personnel expenses, incurred in a particular month/period.

In fig. 4 is presented the evolution of this indicator during the year 2011.

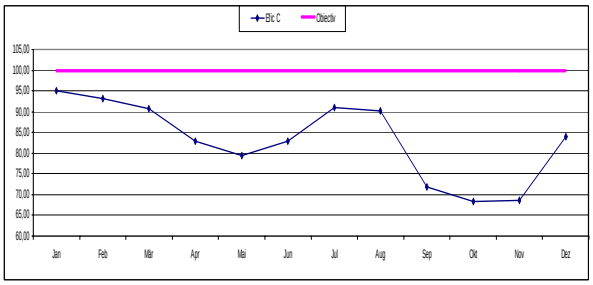

Fig. 4 Evolution of efficiency on staff expenditure, year 2011

As can be seen, although efficiency related to the number of employees has values over 100%, efficiency relative to personnel costs has values below 100%. This is explained by keeping under control the growth of quality personnel, in terms of unscheduled increases in order from customers. If the production department compensated the increases production minutes in additional staff, quality department tried to have a moderated staff increase at the expense of efficiency indicator Efc, relative to personnel costs.

This personnel policy was determined given the fact that besides increasing orders, 2011 was home to a number of new projects in the organization, which, as experience shows, requires a lot of overtime performed in support of production. Quality control activity for projects is not scalable as well as in the case of series product. There are times of crisis, when there are problems in projects, the products have to be repaired/ restored, modified as required, and quality controllers must work overtime to ensure timely deliveries.

Thus explains the inefficiencies related to personnel costs.

As above illustrated, these two efficiency indicators allow quality departments to dimension their quality staff, according the fluctuations in production personnel, but at the

same time, keep within the budgeted expenditure.

This however is possible only by optimizing control processes and by implementing new methods of quality planning, which do not allow low quality level of production, as a result of fewer staff. The size of Quality and Logistics departments have a negative impact on production efficiency gains, just by distributing products based on minutes and staff from the departments above mentioned.

6. ORIGINALITY / VALUE

The originality of the paper work consists of determination by calculation of the effectiveness and efficiency of the quality control activity (quality management process) and as well of the interpretation manner of the achieved values.

The method helps to the decision about the number of persons for an examination process, according to the type of check. For an accordant efficiency, the errors on product have to be detected by the nominated personnel where these are being manufactured, not in the following processes.

7. PRACTICAL IMPLICATIONS OF PROJECT

The effectiveness formula determines in percentage, the reference between the number of errors discovered in a certain production phase, related to the number of errors discovered in all phases, including the errors, noticed by external client.

The efficiency formula determines the discovery degree of errors, by the quality personnel, designated for this purpose on a certain production phase (cutting-off, assembly, final assembly) or on a certain checking process (process inspection, running inspection, final inspections). The number of errors discovered in the incipient production activities, the more the efficiency of the quality control activity is.

Efficiency problem is to answer the question: “do we do things right, correct? , unlike that of effectiveness: do we do the things needed?” (Drucker 2007) [3].

A famous quote of professor Drucker on efficiency sounds like: “Efficiency is doing better what is already being done” [4].

REFERENCES

1. SR EN ISO 9000:2006 Romanian Standard corresponding to EN ISO 9000:2005. *Quality Management Systems – Fundamentals and vocabulary*
2. Krebs, B.,. *10-Regel der Fehlerkosten* [online]. Available: http://www.olev.de/0/10er-regl.htm (June 2010)
3. Drucker, P.,. *Peter Drucker quotes* [online]. Available: http://thinkexist.com/quotation/efficiency_is_doing_things_right-effectiveness_is/218648.html
4. Drucker, P.,. Peter Drucker quotes [online]. Available: http://thinkexist.com/quotation/efficiency_is_doing_better_what_is_already_being/321906.html

BIBLIOGRAPHY

1. Bobancu, S., *Creativitate şi inventică, Universitatea „Transilvania” din Braşov, 2005, p.38,* [online]. Available: http://www.unitbv.ro/LinkClick.aspx?fileticket=C3lkRaJWfNk%3d&tabid=4583 (24.06.2011).
2. Drucker, P.,. *Peter Drucker quotes* [online]. Available: http://thinkexist.com/quotation/efficiency_is_doing_things_right-effectiveness_is/218648.html
3. Drucker, P.,. Peter Drucker quotes [online]. Available: http://thinkexist.com/quotation/efficiency_is_doing_better_what_is_already_being/321906.html
4. Goodman, J.,. *Basic Facts on Customer Complaint Behaviour and the impact of Service on the Bottom line.* [online] Available http://www.newtoncomputing.com/zips/basicfacts.pdf , (06.03.2009)

5. Krebs, B.,. *10-Regel der Fehlerkosten* [online]. Available: http://www.olev.de/0/10er-regl.htm (June 2010)
6. Ministerium der Finanzen August 2000, *Handbuch der standardizierten Kosten- und Leistungsrechnung in Rheinland-Pfalz.* [pdf] Meinz Ministerium der Finanzen. [onliene]. Available: http://www.fm.rlp.de/fileadmin/fm/downloads/finanzen/kosten_leistungsrechnung/007_KLRHandbuch.pdf, (20.05.2011)
7. Șoim, H., Teodoru, M. – *Economie. Microeconomie-Macroeconomie, Mondoeconomie* – Casa Cărții de Știință, Cluj Napoca, 2008
8. *** *Organizarea structurală a unităților economice*. [online] Available: http://www.contabilizat.ro/file/cursuri_de_perfectionare/management_si_marketing/management/cap4.pdf (29.05.2011)
9. SR EN ISO 9000:2006 Romanian Standard corresponding to EN ISO 9000:2005. *Quality Management Systems – Fundamentals and vocabulary*
10. SR ISO/TS 16949:2009 *Sisteme de management al calității. Cerințe specificate pentru aplicarea ISO 9001: 2008 în organizații cu producția de autovehicole și de piese de schimb aferente*, Cap 5.6 Analiza efectuată de management, ASRO, 2009