Management of the process of implementation of corrective and warning actions taking into account their efficiency when installing window structures

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Abstract. A special place in the totality of the quality system processes is occupied by corrective and preventive actions that can significantly reduce the risk of releasing defective products. The article analyzes the main types of defects that occur during installation and operation of window structures. Also, an assessment was made of the effectiveness of corrective and preventive actions with the subsequent development of recommendations to the management of the enterprise.

Introduction

The development strategy of the organization provides a complex of the works directed to constant improvement of quality of products or services. An effective solution of this task is creation of the quality management system meaning integrated management of quality at all stages of life cycle of products (service) [1].

Corrective and preventive actions are an integral part of the process of continuous improvement, which also combines quality planning, implementation of audits, data analysis for improvement and management review of the effectiveness of quality systems [2].

The basis for the development of corrective and preventive actions is the identified existing or potential nonconformity, i.e. non-compliance with legal and regulatory requirements for the provision of products (services) to the consumer and the established requirements of ISO 9001 [3].

Depending on the nature of these discrepancies, on whether they are potential or discovered, corrective and preventive actions are applied to them. Problems of occurrence of defects can be repeated if the root cause of the problem has not been eliminated, and corrective actions could not eliminate the identified causes of the defect.

As a result of the analysis of the data provided by the company which borrowing with services in installation of metalplastic window designs main types of problems because of which the enterprise incurs contingencies were defined.

These costs include claims. Complaints are planned, which indicates that their occurrence can be prevented either at the measuring stage or at the installation stage. About 5% of all registered complaints are due to personnel errors. An error can be made by the installer, by incorrectly measuring the opening in which the structure is installed, and by the manager, when entering data into the...
calculation program. It is also necessary to take into account some structural features of the building that cannot be foreseen at any stage (subsidence of the building, change of its geometry, ventilation features, etc.). The overwhelming number of complaints is related to violation of the process of installation of structures or the presence of defects arising at the production stage.

The analysis of claims of clients allowed to create the list of main types of the defects arising at a stage of installation or operation the metalplastic designs. Treat main types of defects: slack of the sash, purge the sash, condensate on the double-glazed window, freezing, formation of a mold, change of geometry of a design, cracking glass, etc. (Figure 1).

On the basis of the conducted researches it is established that the greatest number of claims belongs to the reason "sagging of a shutter" (figure 2). Sagging of a shutter – malfunction which demands urgent elimination. This problem is a cause of infringement of tightness, frost penetration in windows and formations of frost. If quickly not to eliminate this effect, then replacement of a double-glazed window can be required subsequently. (Figure 2).
Materials and Methods

Indicators of effectiveness and efficiency of corrective and preventive actions are of key importance in the development of management decisions aimed at reducing the number of defective products. The general algorithm for evaluating these indicators is presented in Figure 3. The application of this methodology is based on the calculation of a number of indicators of efficiency and effectiveness [4].

Results and Discussion

Consider an example of evaluating corrective and preventive actions for a defect that manifests itself in the slack of a sash (Table 1). According to the results of the assessment, it is possible to establish the feasibility of certain types of corrective and preventive actions from the standpoint of economic feasibility.

Table 1. Calculation of performance indicators and effectiveness of corrective and preventive actions (CA, PA) in the slack of the sash

| No. | Characteristic and parameters of nonconformity | Characterization and parameters |
|-----|------------------------------------------------|-------------------------------|
| 1   | Business process                                | Installation of metal-plastic window structures at the customer’s site |
| 2   | Process owner                                   | Sales manager                 |
| 3   | Process objective function                      | Installation of metal-plastic window structures made according to the requested parameters of the consumer |
| 4   | Executor                                        | Mounting team                 |
| 5   | Input data                                      | Measurement made at customer’s site |
| 6   | Output                                          | Metal-plastic window construction with a |
|   |   |   |
|---|---|---|
|   | glass package, fittings, window sill, ebb, slopes depending on the order of the consumer. |   |
| 7 | Resources | Polyurethane foam, hardware, gasoline, time, salary of the installation team, etc. |
| 8 | Parameters of the process implementation mechanism | The degree of professionalism of the installation team |
| 9 | Process parameters | Duration of installation, season, production time of metal-plastic window construction |
| 10 | Product parameters (intermediate) | Build quality metal-plastic window construction |
| 11 | Control actions | Telephone Manager's Guidelines |
| 12 | Normative base | GOST 30971-2012 Seams assembly joints of window blocks to wall openings. General specifications, GOST 30674-99. Window blocks made of PVC profiles. Technical conditions |
| 13 | Outrage | When opening the sash, it touches the frame |
| 14 | Interference | Unsuitable weather conditions, production load |
| 15 | Force majeure | Fire, natural disasters, war, military actions of all kinds, replacement of current legislation, etc. |
| 16 | Customer satisfaction indicators | Compliance with the established installation time, compliance of the metal-plastic window construction with the established requirements, cost, etc. |
| 17 | Mismatch | Slack shutter |
| 18 | Content correction and corrective action | Sash adjustment |
| 19 | Process response time to corrective action, $T_p$ | 1 [h] |
| 20 | Duration of corrective actions, $T_a$ | 0,33 [h] |
| 21 | The degree of inconsistency (deviation), $DK$ | 3 (On a scale from 1 before 5) |
| 22 | The degree of residual nonconformity after taking corrective action, $PK$ | 1 |
| 23 | Planned cost of corrective action, $ZK_p$ | 200 [ruble] |
| 24 | Actual cost of corrective action, $ZK_f$ | 300 [ruble] |
| 25 | Corrective action performance indicators, $RK$: $RK=(1-PK/DK)100\%$ | $(1-1/3)100=67\%$ |
| 26 | The average growth rate of the corrective action performance indicator, $SRK$: $SRK=\frac{RK}{(T_p + T_a)}$ | $67/(1+0,33)=50\%/[h]$ |
| 27 | Indicators of the effectiveness of corrective action (the value of the target function of corrective action), $EK$: $EK=(1-PK/DK)/(ZK_f/ZK_p)100\%$ | $(1-1/3)/(300/200)100=45\%$ |
|   | Criterion of effectiveness of corrective action | EK > 40[%] (Set by process owner) |
|---|-----------------------------------------------|-----------------------------------|
| 29 | The average growth rate of the corrective action efficiency indicator, SEK: SEK=EK/(Tp + Ta) | ≈34 [%/h] |
| 30 | Potential mismatch | Cooling of the room due to cold air flow |
| 31 | Preventive action | Careful adjustment of the sash when installing a window, when placing an order to recommend to the customer the construction of a sash of sizes not exceeding 700×1700 [mm] |
| 32 | Process response time to preventive action, Tp | 0,5 [h] |
| 33 | Duration of the preventive action, Ta | 0,5 [h] |
| 34 | Degree of potential nonconformity, DP | The likelihood of a mismatch – 5[% ] |
| 35 | The degree of potential nonconformity after a preventive action, PP | 0 (expert review) |
| 36 | Planned costs for preventive actions, ZPп | 200 [ruble] |
| 37 | Actual cost of preventive action, ZPф | 150 [ruble] |
| 38 | Indicator of the impact of preventive action, RP: RP=(1-PP/DP)100% | 100 [%] |
| 39 | The average growth rate of the preventive action indicator, SRP: SRP=RP/(Tp + Ta) | 100/(0,5+0,5)=100[%] |
| 40 | Indicator of the effectiveness of preventive actions (the value of the target function of preventive actions), EP: EP=(1-PP/DP)/(ZPф/ZPп)100% | (1-0/5)/(150/200)=133[%] |
| 41 | Criterion for the effectiveness of preventive action | EP > 100[%] (Set by process owner) |
| 42 | The average growth rate of the indicator of the effectiveness of preventive action, SEP: SEP=EP/(Tp + Ta) | SEP ≈133[%] |

**Summary**

The results of the assessment indicate that, for the inconsistency in question, the most effective is preventive action, the effectiveness indicator of which is EP = 133%.

The proposed approach to assessing the effectiveness of corrective and preventive actions in the framework of the current quality management system will improve the efficiency of the resource allocation system within the organization.

**References**

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