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USE OF STATISTICAL METHODS IN QUALITY CONTROL

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More and more organisations are beginning to realise how important is it to implement a quality management system. Its main task is to rejuvenate the given processes in production. Problem solving is systemic within quality assurance procedures of an organisation. This work describes a quality management system according to ISO 9001 and statistical methods in quality management. The theoretical part contains the characteristics and description of the system listed above. The practical part shows the use of knowledge in the organisation to solve problems.

Keywords: quality, statistical methods, organisation

The quality of products and services plays a key role in enhancing the quality of life in human society. A current trend is linking economies and removing barriers to the import and export of production (Korenko et al., 2010). One of the conditions of competitiveness is either the strategy of low production costs, which is currently the policy of Asian countries, or offering a significantly better product, increased in performance, applying the result of development, innovation and implementation of new technologies and, last but not least, economy in production, consumption and disposal of products (Gejdoš, 2010).

Nowadays, it is necessary not only to produce high-quality products for the satisfaction of customers but there is also a need to pay attention to the modernisation of production processes in the organisation. Any organisation having a quality management system should focus on reducing its losses in production and increase its productivity by introducing new modern methods in manufacturing (Korenko and Kaplík, 2011).

The aim of this work is to reduce the number of uncentred compressors by using statistical methods to be implemented in the organisation Danfoss Zlaté Moravce.

The requirements that should lead to reducing the error rate of compressor concentricity will be established for the organisation. The statistical methods to monitor the quality of compressors manufactured will be implemented in production, and we will remove any errors.

Material and methods

SIPOC method

A tool that involves these elements is a SIPOC method (Fig. 1). SIPOC is an acronym for Supplier – Input – Process – Output – Customer. This method helps to identify the main aspects of processes.

Compressor characteristics

In order for the compressor to work properly, a balanced air gap must be ensured between the rotor and the stator. This can be achieved by a proper centring of the engine block and stator (Fig. 2). When the engine block and stator are incorrectly centred, there would be problems with start, or an increased electric current consumption might occur (Fig. 3).

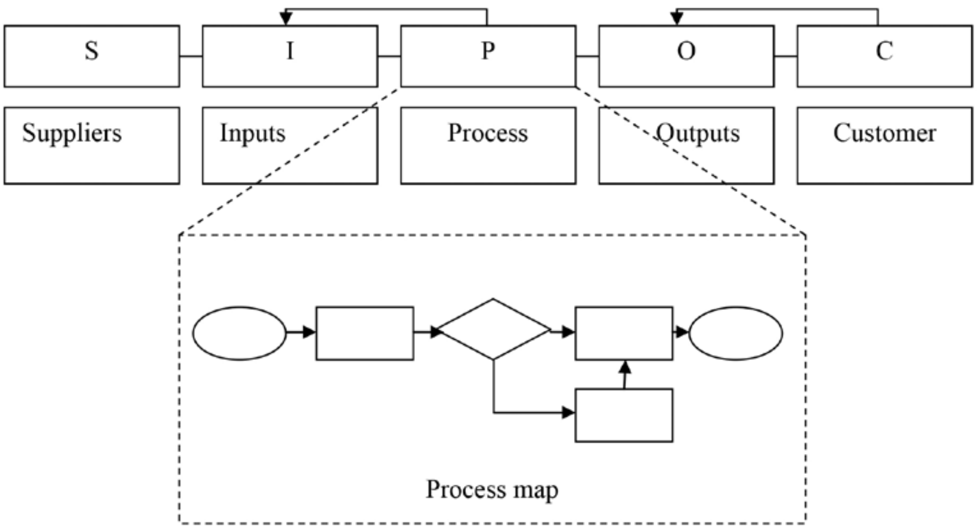

Figure 1 SIPOC method

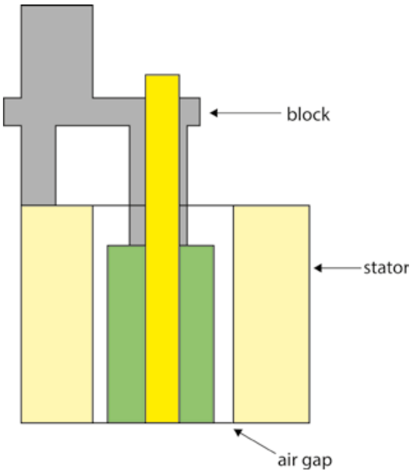

Figure 2 Correctly centred compressor

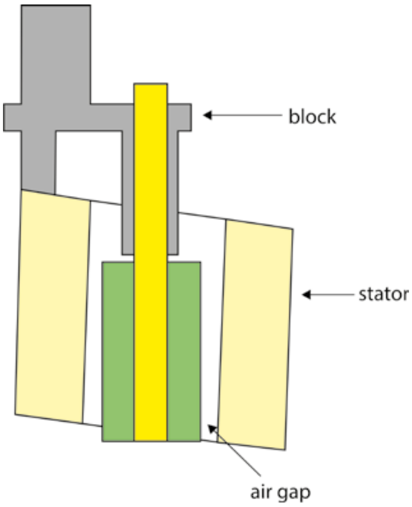

Figure 3 Incorrectly centred compressor

Results and discussion

Centring is performed on a rotary table where compressor assembly is ongoing. Matching the engine block with the stator is performed on the rotary table to ensure the best possible concentricity between the stator and the engine block (Fig. 4 and 5). The rotary table moves clockwise and consists of six positions and four robotic arms. In the first position, the arm of the first robot loads the stator from the stator feeder; in the second position, the stator is re-measured for x and y axis perpendicularity. The stator is measured due to matching the stator with the engine block. According to the slope and perpendicularity of the stator, the block's feet are grinded. The height difference between the right and left side of the stator is measured at the point where the block is to be bolted.

After measurement, the stator goes to the third position where the bolts needed to screw the engine block and the stator are rammed. In the fourth position, the engine block feet are grinded using two mechanical robot arms. Grinding is done on the basis of measured values obtained in the position number two. The position of robots for grinded feet is calculated according to the height difference between the feet and the measured stator height. The grinded block then goes on to the rotary table where it is matched with the stator (Fig. 6 and 7).

In the fifth position, the engine block is screwed with the stator, continuing to the sixth position. Here, the stator with the engine block is offloaded from the rotary table by the last mechanical arm, spring holders are rammed, and this assembly is unloaded on a conveyor belt. The last act performed out of the working table is air gap measuring. A feedback whether centring was done properly is carried out at the position where deflection of the stator against the block is measured. The measuring position consists of a meter (mandrel) which is placed into the hole of the engine block and stator. On the meter, there are four inductive sensors that measure the values at two different levels. The measurement of air gap between the stator and the engine block runs throughout the whole meter track while the measured values are visualised on a computer screen.

In solving the problem of centring error rate reduction, we used the SIPOC method (Fig. 8).

Corrective actions

After finding the causes on the diagram, the following corrective actions were made:

1. Removal of heavy hydraulics's parts and use of stronger springs.
2. Pinch jaws were set in plane.
3. Hydraulic tubes were exchanged for more flexible hoses, and the attachment point on hydraulics was changed.

Figure 4 Stator measurement

Figure 5 Stator measurement

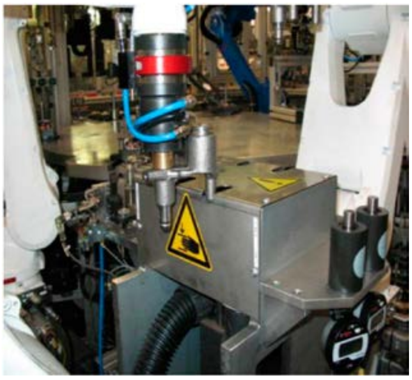

Figure 6 Grinding the engine block feet

Figure 7 Grinding the engine block feet

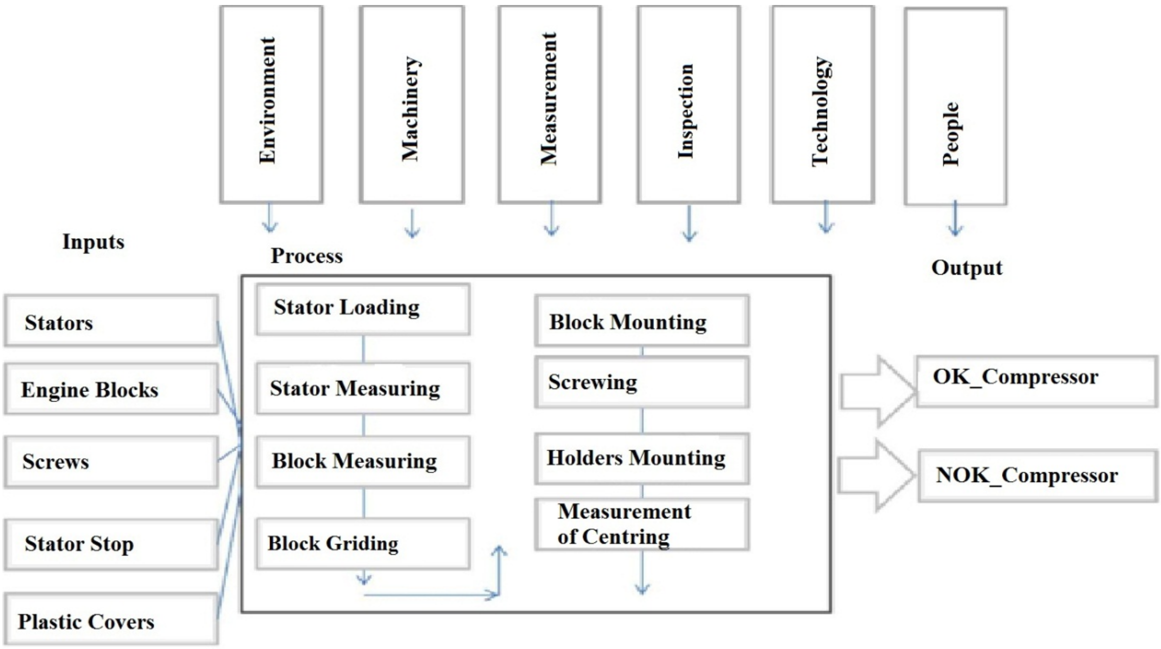

Figure 8 SIPOC method

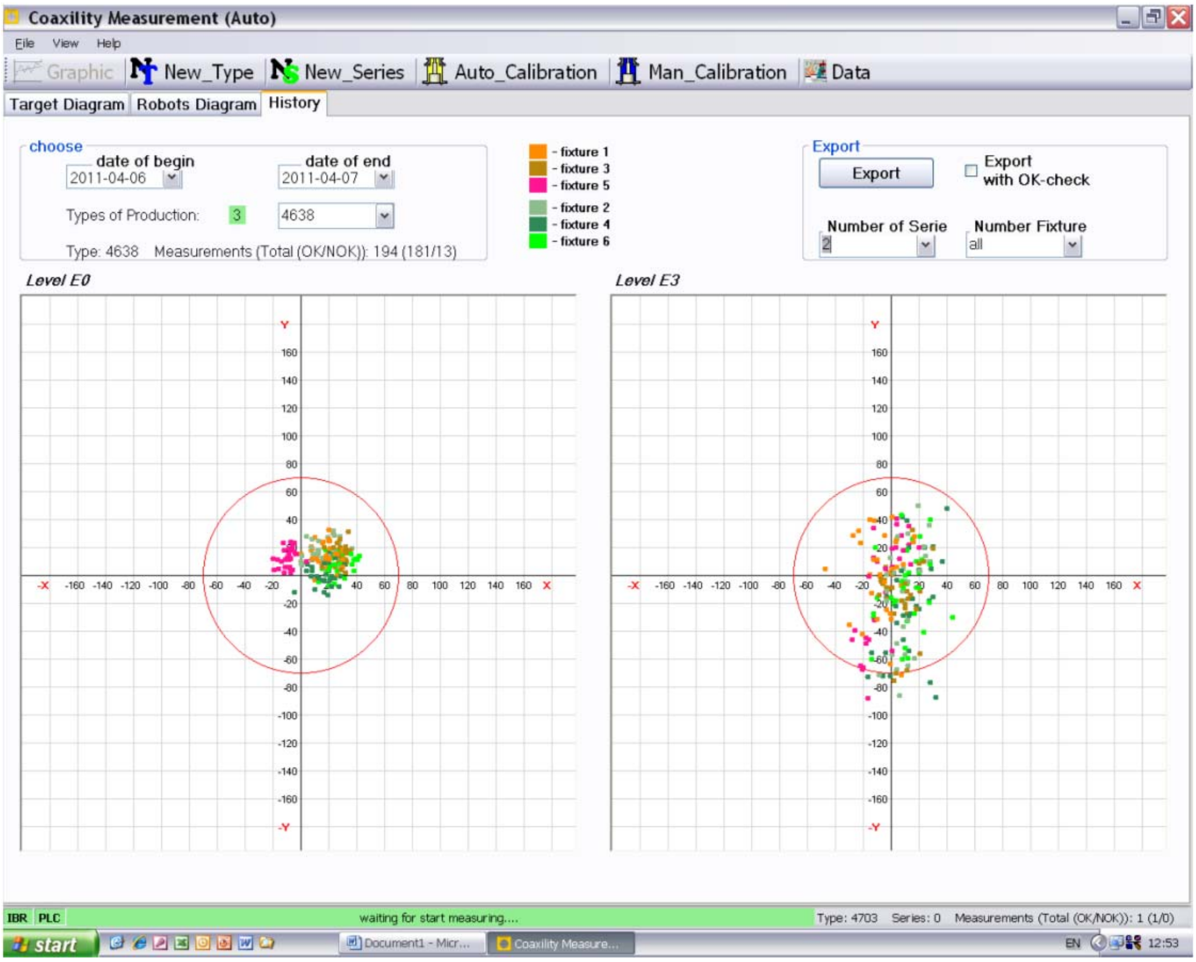

Figure 9 Measurement output before corrective actions

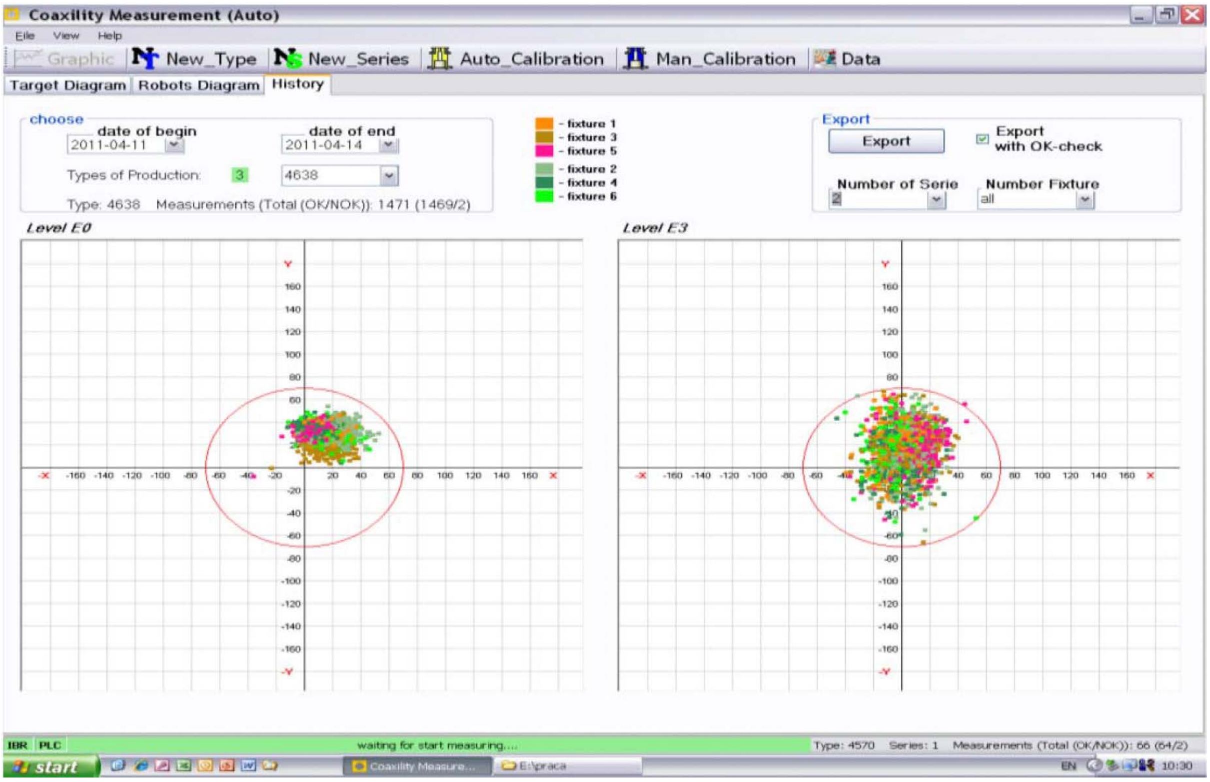

Figure 10 Measurement output after corrective actions

4. We found the pins were not hardened; therefore, they were exchanged for hardened ones.
5. We fixed the new positions on pinch jaws to avoid unequal distances.

After completing all of the corrective actions, we have started the process of centring the stator to the block, and it was monitored whether the process error rate is reduced. As the following measurements show, the aim of concentricity was fulfilled, and the error rate was reduced to the desired level.

The visual outputs from the computer provide information on the offset of the engine block and stator. The circles in the output show the maximum permissible centring, while the left circle represents the upper plane and the right circle is for the lower plane (Fig. 9 and 10).

Conclusion

Nowadays, every customer cares mainly about the fact that all products meet the required quality. This is the reason why all the organisations that want to go ahead and make profit prioritise the quality. It is therefore very important that the quality is implemented right from the beginning, i.e. from marketing, development, logistics, pre-production preparation, expedition, etc. The manufacturing sector has introduced a number of processes that aim to reduce the number of low-quality products.

While measuring the quality, the SIPOC method was used as the first, by which we determined the processes entering into compressor production. We identified all the issues that could influence the process of measuring the stator, and corrective actions were performed afterwards. The compressor manufacturing process started after that, and it was followed by concentricity check. The output of measurements provided a reduced error rate in production.

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