

## SUMMARY

This work was created as a result of the need to solve the problems of FŁT Kraśnik S.A. related to the implementation of the production of unitized bearing hubs. As part of the experimental work carried out, the production of a second-generation bearing hub based on a double-row angular contact ball bearing design was launched. The main objective of the doctoral thesis was to develop a concept for determining the technological heritage of the bearing ring production process based on statistical analysis of the measurement results obtained.

The achievement of the main objective was preceded by a description of the current state of knowledge on composite bearing hubs. A review of the literature was conducted, emphasising the key importance of the phenomenon of technological inheritance in the engineering of precision products. It points to the need for a comprehensive approach to the design of technological processes, combining knowledge of materials, their microstructure, stresses and machining parameters with mathematical modelling. The complex mathematical models developed, based on matrix and differential calculations, are not used in industrial conditions. Therefore, simple solutions are sought that allow the development of production processes taking into account technological inheritance.

The main objective of the work, the research thesis and the method of implementation of the doctoral thesis preceded the chapter in which an analysis of the second-generation bearing hub design was carried out and a mathematical model of the dimensional chain equation for axial clearance and its tolerance equation was developed. The mathematical model was verified by analysing and synthesising the dimensional chain and verifying the tolerances adopted by the designer. The hub components for the experiments were selected, the number of samples was determined, the observed quantitative variables were selected and the technological parameters were defined as independent variables for the turning operation. The suitability of the machines was tested in terms of ensuring the required indicators for key characteristics. The results of the measurements, taken after each operation of the technological process, were subjected to statistical analysis using multidimensional correlation and regression. It was determined which dimensions and after which operations are sensitive to previous operations by performing a descriptive analysis and testing the normal distribution of raceway diameters using the Shapiro-Wilk test. Correlations between dependent and independent variables were examined using Pearson's two-serial point correlation test, and an analysis of variance homogeneity was performed using Levene's test. Pearson's test was also used to analyse potential cascade relationships. A cross-correlation test was performed for the outer ring raceway. Strong and moderate correlations were observed between the diameters of the raceways after rolling and the diameters after heat treatment for all ring types. The coefficient of determination and Fisher-Snedecor statistics were calculated. The normality graphs of the residuals were examined, and the intercept, regression coefficient  $b$ , standardised regression coefficient  $b^*$ , and significance levels  $p$  were calculated for the statistical evaluation of the significance of individual parameters. Technological heritability models were developed for the diameters of bearing races after quenching and tempering of a unitized second-generation bearing hub using an angular contact ball bearing design.

The research results and developed mathematical models of technological inheritance equations were used to draw up the final conclusions presented in chapter seven of the thesis. They also include a brief summary of the literature review. The achievement of the main objective of the thesis, which was to determine the technological inheritance relationship of the dimensions of selected components of a second-generation unitized bearing hub, was emphasised. The research showed that the geometric features resulting from previous technological operations have a significant impact on the quality of the product. They confirm the validity of the adopted research concept and provide evidence for the research

thesis of the thesis on the existence of technological inheritance. The practical value of the research results obtained was also emphasised, with the possibility of applying the developed methodology in the bearing industry. Directions for further research on technological inheritance were proposed, covering additional factors affecting the final quality of the product, such as thermal deformations, residual stresses, and shape and dimensional proportions.