

A new concept of jig rotary holder system for 3-axis CNC milling machine operated by the main machine control

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Scope

This study aims to develop a new jig holding system able to be controlled by the CNC installed on 3-Axis Machining Centers, which can improve drastically the productivity in the machining operations, enabling the machining of unparallel plans in the same setup.

Methodology

This study is based on the Action Research methodology which, through a practical approach, intends to generate transferrable knowledge to other organizations whose situations are similar to that of this study. The practical actions and the knowledge acquired co-create the changes needed for improving these processes.

Findings and Originality/value

- Using a case study, it was observed that savings of about 40% can be easily achieved for parts with low geometric complexity. If the complexity of the parts increase, it is expected that these savings can be even higher. The return of investment is less than two years, which is usually affordable for enterprises.
- Through this study it was possible to develop a new jig holding system that can be attached to a 3-Axis CNC Machining Center and clearly expand its functions and productivity. With this system, it is possible to work in different plans of the part in sequence, as well as use a double-side table for the jigs, doubling the production batch each time the machine is loaded. Moreover, a list of key settings has been created with the main requirements and recommendations to adopt this kind of production system, which can be highlighted as main research output.

Discussion

The optimization of machining operations has been an issue deeply investigated, because machining remains as one of the most important manufacturing processes for the metalworking industry. Tsutsui et al. (1995) developed an integrated CAD/CAM/CAT system which comprises all the stages from the jig design to the accurate machining of jigs, but their study did not included the necessary flexibility in terms of manufacturing process because the focus of their work was to simplify the development of simple jigs., Kumar et al. (2019) also developed a new jig system for milling operations regarding a specific part, using DMADV/Design for Six-Sigma and SWO methodologies to achieve the better design approach to the jig able to properly deal with a complex part. The modularity of the jig design and the increased capacity of the jig under the new design allowed for a production increase by 24%. Comparing the results obtained through this work with the obtained by Kumar et al. (2019), it can be observed that the gains obtained using the now presented approach are relatively better, increasing the production by 40%.

Conclusions

This work describes a problem commonly observed in several small industries where the first approach to optimize the machining process of complex parts is not properly done as a first step. Thus, the operations instead of being concentrated on as few equipment as possible, they are spread by many machines implying internal logistic operations, a better inventory control and more human labor. Moreover, some managers are passive facing some problems, do not taking action to improve the machines performance that companies possess. Thus, this work intended to study a common problem of lack of effectiveness and competitiveness, showing the way to improve process with simple solutions which present perfectly affordable payback times. The main action taken through this work was the development of an holding system for 3-axis CNC machining equipment able to provide the equipment with a supplementary axis, which becomes possible to machine parts in more than one plan, as well as the use of a double jig which allows to improve drastically the productivity.