OMIC R&D TECHNOLOGY BOARD

CONCEPTUAL ABSTRACT

TITLE: **Diagnostic System of Identifying Types of Vibrations in Machining**

RELATED ROAD-MAPPING DESIGNATION ID#: **M45**

SUPPORTIVE INDUSTRY: ***SECO, Kennametal, Boeing***

PROJECT TYPE: **General Project**

PROBLEM STATEMENT (What Are We Trying to Solve?): There are multiple root causes that originate unwanted vibrations during machining. Classically these vibration types can be categorized as: Free Vibrations, Forced Vibrations, and Regenerative Vibrations. To an end-user, they all manifest by way of: poor surface finish, unpleasant sound, excessive tool wear, and even catastrophic tool failure. Techniques and instrumentation to recognize and trouble-shoot each of these vibration types is readily available. However, the end-user must be sufficiently informed on employing the correct technique to resolve the specific type of vibration, and failure to do so can yield detrimental results. Often to less informed users, it even affects their confidence in the reliability of the solution. ***For Example***: If the instruments (Tap Testing & Stability Lobes) and technique to resolve a Regenerative Vibration type (i.e. classical Chatter) were used to resolve a Forced Vibration (e.g. worn bearing, or loose fixture), it simply would not yield a successful outcome.

PROJECT DESCRIPTION: This research strives to develop a diagnostic system that would allow an end-user to conclude the type of vibration that exist in their machining system: Free, Forced, or Regenerative Vibrations.

Some common sources of ***Forced Vibrations*** are:

- Loose or unevenly worn spindle bearing
- Asymmetrical tool holders
- Loose tool-holder assembly
- Loose fixtures
- Tool runout
- Unbalanced tool-holder assembly

Some common sources of ***Regenerative Vibrations*** (classical chatter) are:

- The natural tendency of a tool to vibrate when proximal to detrimental frequency sources (motors, pumps, etc)
- Cutting RPMs

A user-friendly diagnostic system needs to be developed to aid an industrial end-user to differentiate the type of vibration. This would allow them to apply the appropriate techniques, instruments, to reconcile them, or call the appropriate SME. It should be recognized that actually trouble-shooting the vibration source is not in the scope of this research project.

Identify Related OMIC R&D Resources: Proposing researchers should use their best judgment in deciding on the optimal resources for the research. To further aid in this decision, the OMIC staff has taken the initiative to best identify on-site resources (machines, equipment, and staff) that may relate to the scope of this research. Please recognize that researchers are not limited to these resources.

- Machines and equipment at OMIC can be reviewed at: https://www.omic.us/explore/facility
- OMIC Staff or SMEs

PROJECT DELIVERABLES:

- Final test report
- Final report
- Instrumentation of the developed diagnostic system
  - Related training material on utility of the developed diagnostic system

SPECIAL NOTE: It should be recognized that this Conceptual Abstract is written based on comments collected during OMIC R&D Road-mapping workshop and based on industries need for applied research. However, researchers as SMEs, are encouraged to lend specific technical feedback to further refine the Project Description and or Project Outcomes. The proposing researcher may do so either directly to OMIC R&D, or in the submitting proposal.

UTILIZATION OF OMIC RESOURCES: Researchers are encouraged to utilize the capital and personnel resources available on the OMIC R&D campus in their proposals. Use of OMIC time and machines should be included in the Proposal funding request. If use of OMIC resources are not identified in a proposal and are requested during, the project sponsor will be responsible for requesting a costed project amendment from the Tech Board.

PROJECT UPDATE EXPECTATIONS: Researchers are required to have monthly update discussion with OMIC R&D to provide a summary update on project status. This is done by way of a user-friendly format known as the OMIC 6-Block update. Typically, these meetings are scheduled on the first Wednesday and Thursday of each month. Secondly, depending on the scope of the project, OMIC R&D's industry Tech Board representatives are often interested in periodic project

updates, and even in project participation. Researchers are required to communicate with supportive industry and facilitate communications as required.

PROJECT DURATION: It is OMIC R&D's strong preference that duration of a General Project aligns with the academic calendar cycle (July 2023 to June 2024). It is preferred that the project be completed by June 2024. Researchers are encouraged to factor in variables such as contracting, student hiring (if needed), procurement, holidays, and travel. It has been OMIC R&D's experience that a projects useful working duration is typically 9 to 10 months. Researchers are also encouraged to lend feedback, and to adjust the scope of work to best fit this preferred timeframe. Additionally, it is reasonable to even recommend phasing breakdowns to the project. In some unique circumstances, if the project is to take significantly longer than the duration of the academic year, this reasoning should be explicitly explained in the proposal.

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