OMIC R&D TECHNOLOGY BOARD
CONCEPTUAL ABSTRACT

TITLE: **Machining of Hard Metal Thin-Walled Tubes**

RELATED ROAD-MAPPING DESIGNATION ID#: **M60**

SUPPORTIVE INDUSTRY: Boeing, Kennametal, Mitsubishi

PROJECT TYPE: General Project

PROBLEM STATEMENT (What Are We Trying to Solve?): The turning of large, thin walled, hard-metal tubular parts is a common pain point amongst many industry members. Machining often involves numerous trial and errors to arrive at operating parameters, tool life, chip breaking, and surface finish (63 Ra or better). Typical problems include not being completely aware of the vibration characteristics of these parts. Therefore, users are unable to efficiently dial in speeds & feeds, locations of steady rests. This work could also incorporate the use of Active Dampening Systems.

PROJECT DESCRIPTION: This project carries with it a very specific focus as outlined below:

- This research needs to specifically focus on the efficient use of the turning technology to machine a large hard-metals thin walled tube. As identified during roadmapping, the need originated from aerospace, but this pain point resonated with numerous industry partners. Therefore, the researcher would have to collaborate with the supportive industry member to confirm the material and dimensional attributes of the facsimile part being studied. For the purpose of writing the proposal, the below characteristics are sufficient:
    - Workpiece Material: Titanium (6Al4V), or Steel (~32 Rc)
    - Overall Length (L) = ~40”
    - Outside Diameter (D) = ~8”
      [NOTE: If the research were to focus on a smaller part, then the L:D should be 5:1 or greater]
    - Wall thickness (T) = ~0.2”
      [NOTE: This dimension is proportionate to the Outside Diameter of the part]
    - A final part finish of 62 Ra or better is required

- In its current mode of operations, the industry exercises numerous trials in arriving at the optimal way to machine such parts. The intent of this research is to arrive at a systematic approach to machining parameters, tool geometries, and NC strategy for machining these parts. The research should not singularly focus on parts with the agreed upon dimensions

only. The process developed should be robust enough to where it could be applied to an equivalent family of parts.

- To accomplish the above, the researcher needs to be aware that one of the largest pain points in machining such parts is vibrations during machining, which lead to poor surface finish, and can be detrimental to tool life. Mapping the dynamic characteristics (vibration tendencies) of the part needs to be a key characteristic of this research. In many ways, this study should be the starting point of this research.

- Based on the foundational study for the vibration tendencies of the part, the research should then apply it toward machining decision of the following:
    - Cutter selection
    - Operating Parameters (Speeds, Feeds, Depths of Cut)
    - NC Strategy
    - Location of Steadyrest
    - Use of dampening devices, and their location on the part

- These machining trials should be conducted on the OD and ID of the tubes to demonstrate successful outcomes.

- Optimal machining parameters should also yield chip breakage.

- Once the optimal parameters are selected, a tool wear map should be created to demonstrate expectations of tool life.

- The research outcomes should demonstrate successful outcomes by demonstrating repeatable, reliable performance during machining. The machining operation should yield a part finish of 62Ra or better.

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:
  http://omic.us/applied-research/additive/
  http://omic.us/applied-research/subtractive/
  http://omic.us/applied-research/materials/
  http://omic.us/applied-research/robotics/
  http://omic.us/applied-research/inspection/

- OMIC Staff or SMEs
  http://omic.us/applied-research/

PROJECT DELIVERABLES:

- Final report
- Final presentation
- Final machined parts

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. 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.

ADDITIONAL COMMITMENTS TO FACTOR: Researchers may be asked to present their final project at an OMIC R&D biennial Technology Exchange Symposium. This symposium is an in-person event, held at the OMIC R&D campus in Scappoose Oregon. The Symposium is held in the spring, and researchers should factor in their availability when bidding on projects.

Researchers may be invited to participate in OMIC R&D's marketing efforts that showcase the working history of the project.

PROJECT DURATION: It's OMIC R&D's strong preference that duration of a General Project aligns with the academic calendar cycle (July 2025 to June 2026). It is preferred that the project be completed by June 2026. 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 project's useful working duration is typically 9 to 10 months. Researchers are also encouraged to give 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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