## Project Interim Progress Report (Rapport d’avancement de project intérimaire) July 1, 2016 - January 31, 2017 Please submit by January 16, 2017 (Attn: Joanne O’Connor [management@nserc-canrimt.org](mailto:management@nserc-canrimt.org))

## Instructions

*This progress report, updated milestones**and the Form 300 are required as a condition of research funding support from the sponsors of the NSERC CANRIMT.* ***Please report for activity in the current reporting period only.***

**SUMMARY**

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| **THEME IV: *Adaptive Tooling/Processes & Novel Manufacturing Processes/Applications*** | | | | | | **Leader/ Chef:**  *(Veldhuis, McMaster)* | | |
| **PROJECT IV.C.5:** **Assess c-BN Tooling Performance in Machining of Grey Cast Iron** | | | | | | **Leader/ Chef:**  *(Veldhuis, McMaster)* | | |
| **PROJECT DURATION/DURÉE DU PROJET : 02 Years** | | | | | | | | |
| **STATUS/STATUT:** *(****Milestones*** *to be updated by each Project Leader)* | | | | | | | | |
| **Ahead of Schedule** | **X** | **On Schedule** |  | **Delayed** |  | | **Cancelled** |  |

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| **PROJECT DESCRIPTION/ DESCRIPTION DU PROJECT**  (*Brief description in point form, including role of project in Theme.)* |
| * Testing performed in the first phase of NSERC-CANRIMT highlighted the importance of binder composition on the development of protective tribofilms on the surface of the tool which served to lubricate, shield and protect the hard c-BN particles from the harsh cutting environment. * This project is specifically focused on the development and assessment of c-BN tooling for the machining of grey cast iron due to the volume of this material machined in the auto sector. * This project will work to better understand the role of individual elements within the binder, particle size and c-BN volume fraction at carrying the load, and the role of edge preparation in creating favourable conditions for cutting zone and coatings protecting the tool surface and influencing the cutting conditions. |

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| **PROJECT OBJECTIVES & METHODOLOGY/ OBJECTIFS DU PROJET & MÉTHODOLOGIE**  *(Include alignment with Network objectives.)* |
| * The objective of this project is to develop and assess c-BN tooling that may allow processing of parts made from cast irons with tight surface quality expectations that is an important requirement of the auto sector. * The aging phenomena of gray cast iron that effect the machinability of gray cast iron will be examined by using a range of characterization instruments. * The machinability tests of gray cast iron with c-BN tools will be done by using CNC machines. * The properties of tribofilms formed while machining of gray cast iron will be studied using Scanning Electron Microscope (SEM) and X-ray photoelectron spectroscopy (XPS). * It is expected that the tribofilms will act as a lubricant, protect the tool, reduce the tool wear and increase the tool life. |

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| **1. RESEARCH TEAM/ ÉQUIPE DE RECHERCHE** *(Summary for the current reporting period)* |

**1a: Research Personnel (Supervisors, Co-Supervisors, Collaborators)/   
Personnel de recherche**

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| --- | --- | --- | --- | --- |
| *Name, given name/ Nom., prénom* | *Organization/ Organisation* | *Sup./Co-Sup./*  *Collaborator* | *E-mail/Courriel* | *Phone No./ Téléphone* |
| Stephen C. Veldhuis | McMaster | Sup. | veldhu@mcmaster.ca | 905 525 9140  Ext. 27044 |
|  |  |  |  |  |

**1b: Students, Postdoctoral Fellows, Research Assist./  
Assoc./Eng., Technical/Professional, Guests** *(from outside Québec; from outside Canada)***/  
Étudiants, Boursier de recherches postdoctorales, assistants, techniciens et invites** *(invite hors Québec; hors Canada)*

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| *Name, given name/ Nom., prénom* | *Position* | *Organization/ Organisation* | *Name/Nom. (S) or /ou (C)\** | *Start/ Début* | *End/ Fin* | *CANRIMT Salary/Mo incl ben.* | *Extern. funding amount* | *Extern funding source* |
| Liu (Luke) Yesong | M.A.Sc | McMaster | Stephen C. Veldhuis (S) | Sept 2016 | Aug  2018 | *1282* | *317* | *SONAMI*  *(FedDev)* |
| Sushant Rawal | PDF | McMaster | Stephen C. Veldhuis (S) | July  2016 |  |  | 4200 | *SONAMI*  *(FedDev)* |
| German Fox-Rabinovich | Research  Associate | McMaster University | Stephen C. Veldhuis (S) | Mar  2003 |  | 5333 | 5310 | SONAMI  (FedDev) |

***\*(S) – Supervisor  
 (C) – Co-Supervisor***

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| **TOTAL #** | **BASc** | **MASc/**  **M.Eng.** | **Ph.D.** | **PDF** | **Res. Asst.** | **Res. Assoc.** | **Res. Eng.** | **Tech./ Prof.** | **Guests/ outside Ontario** | **Guests/ outside Canada** |
| 3 |  | 1 |  | 1 |  | 1 |  |  |  |  |

**1c: Partners & Contributions/   
Partenaires et Contributions**

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| *Organization / Organisation* | *Acronym/ Acronyme* | *Contact* | *Cash/ Espèce* | *In-Kind/ Nature* | *Overhead/ Frais généraux* | *Total* |
| Honda  McMaster-Veldhuis Projects |  | Mark Earle | 120,000 | 152,500 | 30,000 | 150,000 |

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| **2. RESEARCH PLAN FOR THE CURRENT PERIOD/PLAN DE RECHERCHE POUR  LA PÉRIOD ACTUELLE** *(Please list both the technical objectives, methodologies and milestones as stated in the previous report.)* |
| * Prepare literature review. * Safety training for various modules as per Environmental & Workplace Hazardous Materials Information System (WHMIS). * Training to operate SEM. * Develop skills to operate CNC milling/turning machines. * Machine shop safety training. |

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| **3. ALIGNMENT OF RESEARCH PROJECT WITH NETWORK OBJECTIVES/ ALIGNEMENT DU PROJET DE RECHERCHE AVEC LES OBJECTIFS DU RÉSEAU** *( Please comment on the alignment of the research project with the overall Network objectives.)* |
| * This research project is aligned with network objective to develop innovative, comprehensive and multidisciplinary technical, sectoral and professional skills in manufacturing amongst the students. * This research project on assessment of c-BN tooling performance in machining of grey cast iron is anticipated to provide research results as per the need of the industrial partner specifically the auto sector. * The results are expected to have positive influence on processes, productivity and competitiveness in the auto sector. |

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| **4. PROBLEMS and RESOLUTIONS/ PROBLEMES ET SOLUTIONS PROPOSÉES** *( Please summarize any problems arising during the current reporting period and their resolution or plans for resolution.)* |
| *Problem/ Problème:*  *Resolution / Résolution:* |

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| **5. RESEARCH PROGRESS and RESULTS/ PROGRÈS DE LA RECHERCHE et RESULTATS:** *(Summarize progress and results below.)* |

**5a: MILESTONES/ÉTAPES**  
*Summarize progress on milestones – including % completed – as outlined in the Research Plan for the current reporting period and any modifications since the last reporting period.* *(Milestones document also to be updated for each project.)*

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| **MILESTONE/ ÉTAPE:** **Literature review and training** | |
| **Progress:** The literature review for this research project will be completed soon. Majority of safety and machine trainings are done.  **Modifications:** | |
| **% Completed/ Rempli** | **20%** |
| **MILESTONE/ ÉTAPE:** **Lab testing and characterisation of tool properties including particle size, binder % and composition and impact on tribofilm generation and ultimately performance** | |
| **Progress:** Presently characterization of work-piece material (gray cast iron) to analyze aging phenomena of gray cast iron is going on. The characterisation of tool properties including particle size, binder % and composition and impact on tribofilm generation and ultimately performance will be started once the ageing examination of gray cast iron is completed.  **Modifications:** | |
| **% Completed/ Rempli** | **10%** |
| **MILESTONE/ ÉTAPE:** **Production Scale Testing** | |
| **Progress:** Not Started  **Modifications:** | |
| **% Completed/ Rempli** | **0%** |
| **MILESTONE/ ÉTAPE:** **Conclusion, technology transfer and publication** | |
| **Progress:** Not Started  **Modifications:** | |
| **% Completed/ Rempli** | **0%** |

**5b: PUBLICATIONS and PRESENTATIONS / PUBLICATIONS ET PRESENTATIONS**

*Please list all publications directly arising from Network-funded research during the current period. Do not include abstracts.*

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| ***A: REFEREED CONTRIBUTIONS - ARTICLES***  *Include articles in refereed publications – please specify whether the article has been submitted (S), accepted (A) or published (P).* | | | |
| Last Name, Initial | *Year* | *Title, Journal, Volume* | *Status* |
|  |  |  |  |
| ***B: REFEREED CONTRIBUTIONS - OTHER***  *Include papers in refereed conference proceedings, letters, notes, communications, review articles, monographs, books, book chapters and government publications.* | | | |
| Last Name, Initial | *Year* | *Description* | *Status* |
|  |  | Conference Title, Location and Date (Status: Invited, Not invited) |  |
|  |  | Journal/Book/Publication Title (Status: S-submitted; A-accepted; P-published) |  |
| ***C: NON-REFEREED CONTRIBUTIONS***  *Include papers in non-refereed conference proceedings, papers, letters and review articles.* | | | |
| Last Name, Initial | *Year* | *Description* | |
|  |  | Conference Title, Location and Date | |
|  |  | Journal/Book/Publication Title | |
| ***D: SPECIALIZED PUBLICATIONS - PRESENTATIONS***  *Include theses, presentations, industrial/technical reports, internal reports, discussions of abstracts and symposium records.* | | | |
| Last Name, Initial | *Year* | *Description* | |
|  |  | Thesis or Conference Title, Location and Date | |
|  |  | Journal/Book/Publication Title | |
| ***E: PUBLICATIONS –  Not originally funded by NSERC CANRIMT but continuing or completed with Network funding*** | | | |
| Last Name, Initial | *Year* | *Description/Title* ***(include start date of NSERC CANRIMT funding)*** | |
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| ***F: PUBLICATIONS – Not funded by NSERC CANRIMT but related to the Network research focus*** | | | |
| Last Name, Initial | *Year* | *Description/Title* | |
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**5c: PATENTS and LICENSES/ BREVETS ET LICENSES**

*Non-disclosure agreements signed, patent applications filed, patents issued, copyrights, licenses under negotiation, licenses granted, etc.*

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| *Category* | *Owner* | *Description* |
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**5d: OTHER COMMUNICATIONS, AWARDS/ AUTRES COMMUNICATIONS, PRIX**

*Provide information on additional communications related to your work, such as awards and distinctions, news stories, interviews, public forums, press releases, etc. for the current reporting period (please provide copies or links.)*

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| *Name, given name/ Nom, prénom* | *Details* | *Date* | *Link or copy attached* |
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| **6. TRAINING/ FORMATION** *(Describe the extent of cross-network and partner involvement in training for the current reporting period.)* |
| Honda has supplied a large amount of CBN tooling, tool holders and workpiece material for testing. We have been using this material to start training and to establish benchmark performance. |

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| **7. RESEARCH PLAN FOR NEXT 6 MONTHS/ PLAN DE RECHERCHE POUR LES 6 PROCHAINS MOIS***(Describe Planned Research Activities for the next 6 month period and include any modifications made during the current reporting period.); also please list both the technical objectives and milestones.)* |
| * The literature review will be continued and summarized as per the objective of the research project. * To conduct the machinability test of gray cast iron using c-BN tool. * Characterization of tool properties and impact on tribofilm generation. |

**8. OPTIONAL – Comments, Questions and/or Feedback/  
OPTION – Commentaires, questions et/ou des commentaires**

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| *Include any supplemental comments or questions pertaining to the Network here.* |
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**9. NETWORK EVENTS ATTENDED or SUGGESTIONS /  
ÉVÉNEMENTS RÉSEAU ONT ASSISTÉ ou SUGGESTIONS**

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| *Please list any Network-related events attended and include comments and suggestions for events which may be helpful and informative for Network members to attend in future.* | |
| *Event* | *Comments/Suggestions* |
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**Progress:**

Gray cast iron ages at room temperature, and the aging process varies with temperature. It is anticipated that fully aged gray cast iron can improve machinability which, in turn, will provide extended tool life and reduce production cost.

The objective of this project is to understand and assess the aging phenomena of gray cast iron. The microstructure of a gray cast iron sample was ground and polished to 1µm and is shown in figure 1; graphite flakes are present in ferrite-pearlite matrix. Figure 2 shows the image of the same sample used to measure the microhardness of the matrix. A relation between size and volume of graphite flakes and the hardness of matrix phase will be studied by analyzing microstructure and micro/nano-hardness of samples collected at different periods and ambient temperature in phase 1. The machinability tests of gray cast iron with c-BN tools will be done in phase 2. The measurements of various mechanical properties and the effect of the aging process on machinability of gray cast iron will be determined by using CNC machines and other characterization equipment.

H:\Honda\Gray cast iron\Re-imaging\2017_01_06\Total\S150928-1-1(SCALE).tif

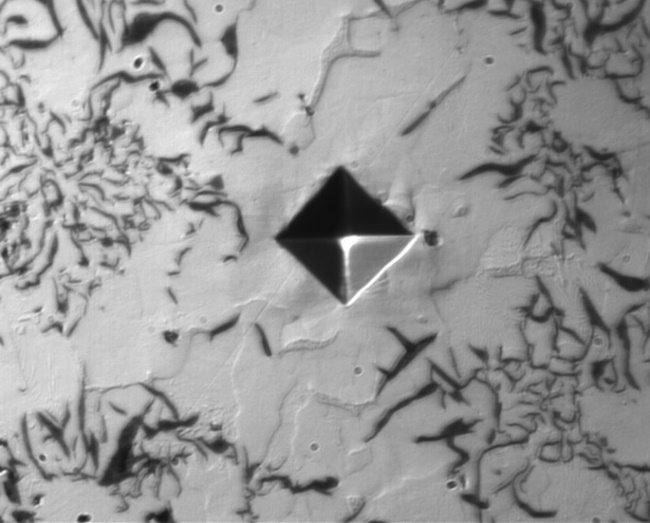
Figure 1. Microstructure of gray cast iron, ground and polished up to 1µm 

Figure 2. Micro-hardness measurement of gray cast iron