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| **Project Name:** | Improving Multiphase CFD Capability |
| **Project Reference:** | 75195/ICAM[62] (IC)a |
| **Principal Investigator:** | Professor Chris Pain |
| **Co- Investigators:** |  |
| **BP-Mentor(s):** | Dr Andre Nicolle |
| **Fundamental/Applied:** | Fundamental |
| **Research Personnel:** | Dr Asiri Obeysekara |
| **Project Start date:** | 1st October 2019 |
| **Project End Date** | 30th September 2020 |

**Quarterly Progress- Q(2)- June 2019**

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| **Attendees:-**  Professor Chris Pain (ICL), Dr Asiri Obeysekara (ICL)  Dr Andre Nicolle (BP), Dr Samir Khanna (BP)  Progress:  Q2 meeting was conducted on the end of May 2019 to discuss progress to date and delivery of the project as it approaches completion of 1st year and Phase 1. A summary of the project to date was given my Dr Obeysekara. The main deliverable for Q1, namely, the code installation of the IC-FERST on the BP-HPC clusters using MPI and all associated libraries to allow parallel simulations to be run. Additionally, the code has been linked using GITHUB between the HPC and ICL researchers to allow newest code changes and developments to be tested in the HPC.  Two cases have been identified as appropriate to validate and benchmark IC-FERST applicability to applications relevant to industry and BP CFD workflows. Evaluation Case 1 investigates flow past a cylinder at Reynold’s number 3900 in 3D. The test case will be profiled in terms of strong and weak scaling on local workstations and BP-HPC. Additionally, comparison and convergence study with different mesh adaptivity settings. If there is time, the additional benchmarking against other commercial codes will be conducted in coordination with BP-AMT team. Similarly, ‘Evaluation Case 2’ is turbulent flows in pipes for Reynold’s number ~100000. This work will involve determining suitable pipe network configuration or pipe bend configuration. Generation of pipe network or geometry using existing software GMSH. As in Evaluation Case 1, strong and weak scaling on local workstations and HPC will be completed by convergence study of different numerical method and mesh adaptivity settings of IC-FERST.  Phase 1 and end of 1st year close-out report will be completed by end of August 2019, detailing evaluation cases as summarised above. Additional details on the progress installing the code IC-FERST on the HPC, alongside the tools and libraries that enabled the successful install will also be detailed. All complementary tools produced as part of the Phase 1 will be collated and detailed for use within the IC-FERST+HPC workflow.  As part of academic development of the project, and to develop tools that are relevant to the project directly, two MSc students have started their 3 month research projects at the start of June, due to completion at the end of August. As part of their main deliverables, python tools for analysis and benchmarking (Evaluation case 1 and 2; Tools for BP/Industrial application of IC-FERST) will be the focus. Namely, (1) generation of pipe network geometry (Evaluation Case 2) and (2) analysis of flow past a cylinder with validation (Evaluation case 1).  No major concerns have been highlighted. |
| **Health and Safety:** This is in relation to your BP ICAM project and local laboratories - Please report by university. No. more than 4-5 lines – please provide a brief explanation of Health and Safety activity within the quarter as summarised above (include also Health and Safety training, Health and Safety improvements made), including numerical data on:  **Total no. of safe acts/conditions observed in quarter:-** N/A  **Total no. of accidents/incidents reported in quarter:-** No reported incidents  **Total no. of local lab walkthroughs in quarter:-** No lab based work  **Health and Safety Notes:**  No health and safety notes |

**MILESTONES:**

**Blue - 'complete'; Green - 'on-track', Yellow - 'concern but doable', Red - in trouble or overdue; Purple - 'Reprioritised'**

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| **MILESTONE** | **TARGET DATE** | **STATUS** | **COMMENTS** |
| Familiarisation of code and HPC | - |  |  |
| Installation of code in BP-HPC | - |  |  |
| Run test-cases in serial and parallel to validate installation | - |  |  |
| Enable Intel MPI compatibility and compare to Open MPI | - |  |  |
| Run cases on varying number of cores, from 10s to 1000s | - |  |  |
| Do preliminary scaling study of ICFERST code on BP-HPC | - |  |  |
| Plan and start evaluation cases – Flow past a cylinder and Pipe Flow | - |  |  |
| Coordinate supervision of MSc students with project evaluation cases | June-August 2019 |  |  |
| Complete simulation and validation of Evaluation cases 1 and 2 | August 2019 |  |  |
| Gather tools created from MSc students and researcher in location accessible to BP and IC researchers | August 2019 |  |  |
| Finish Phase 1 closeout report | 28th August 2019 |  |  |