



**FAILURE ANALYSIS SIMULATION MODEL FOR THE APMRD-II
(Phase 1)**

Progress Report – December 2015

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As of the end of December 2015, the first phase of the Failure Analysis Simulation Model for the APRMD – II is on track to be completed by the end of May 2016.

In this short progress report, we list the general tasks that have been completed to-date (as per CQADS Project #15-001-01, cf. Proposal of February 20, 2015); discuss some of the new tasks that have been requested by the NWMO (as per CQADS Project #15-001-01, cf. Amendment of December 9, 2015); provide a look ahead to the second half of the project, and summarize the project's financial and logistic details, as of December 7, 2015.

Whenever possible, we highlight the results of the tasks in the form of documents that have been delivered to the NWMO (or discussions with the NWMO team of SMEs).

1. Timeline of Major Tasks Completed To-Date

May

- Original project quality plan (PQP) sent to NWMO (May 19, CQADS-15-001-01-PQP-R000.pdf)
- Initial theoretical considerations (internal to CQADS)

June

- Analysis of simple study system (internal to CQADS)
- PQP returned by NWMO with requested revisions (June 11, APM Project Quality Plan Checklist for CQADS PAH.pdf)
- Set up file system (internal to CQADS)
- Project planning and ontology discussions (internal to CQADS)
- Preparation for first quarterly meeting in Toronto: review of NWMO system documents (internal to CQADS)
- Toronto Meeting: met with NWMO SMEs, presentation of methodology, met with quality assurance specialist
- Upon request from NWMO, sent a simple tutorial illustrating the method (June 24, Data Collection Tutorial (with Demo).pdf)

July

- Develop tagging scheme (internal to CQADS)
- Start of revisions on PQP to meet the ISO-standard requirements requested by NWMO (internal to CQADS)

August (Centre closed for Summer holidays)

- Continuing work on PQP (internal to CQADS)

September

- Initial discussions on system data extraction and visualization (internal to CQADS)
- Initial discussions on causal chain implementation and visualization (internal to CQADS)
- Created object model/hierarchy (internal to CQADS)
- Second version of PQP sent to, and accepted by, NWMO (May 19, CQADS-15-001-01-PQP-R01.pdf)

October

- Start of sentence tagging in NWMO documents (internal to CQADS)
- Visualization of sentence tagging (internal to CQADS)
- PQP compliance - procedural and temporal reports (internal to CQADS)
- Package sent to NWMO with deliverables (Oct 29, CQADS-15-001-01-HTML1-StructRepository-R00.html, CQADS-15-001-01-TREE1-SysComponents-R00.pdf, CQADS-15-001-01-MEMO1-PrepChecklist-R00.docx, CQADS-15-001-01-FIG1-StructRepositoryInfoViz-R00.png)

November

- Preparation for second quarterly meeting in Toronto: selection of pre-prototype chain to suggest to NWMO SMEs (internal to CQADS)
- Toronto Meeting: met with NWMO SMEs, gathered a large amount of datum regarding the system, settled on prototype causal chain
- NWMO need for re-scoping in re: manufacturing process made evident (see Section 2 for details)

December

- Re-scoping of project to include process-mapping of container manufacturing (Dec. 9, Proposal - [15-001-1] NWMO (Phase 1) – Amendment.pdf)
- Settled on final Prototype Causal Chain, including a node on manufacturing containers and limitations of such an approach (email exchange between Alan M. and Patrick B)
- Sent progress report for 2015 (this document)

2. Re-scoping of Project

At the second quarterly meeting in November, the NWMO requested an extension of the scope of the original agreement. Specifically, the NWMO requested an addition to the suggested prototype casual chain consisting of a process model of some aspects of the UFC manufacturing process, which can be used to derive the probability in the prototype causal chain that a container that has become flawed during the manufacturing process in particular ways will eventually be placed in the repository in spite of these flaws.

The CQADS proposal of Dec. 9 (Proposal - [15-001-1] NWMO (Phase 1) – Amendment.pdf) for a re-scoping of the project was provisionally accepted by the NWMO (C/O to be finalized in the new year).

The prototype causal chain (which had originally been suggested at the November meeting) will now contain a pre-placement node to attempt to get a better handle on the likelihood that flawed containers might be sent to, and sealed in, the repository.

Using the manufacturing process presented by the NWMO at the November meeting, CQADS will build a process map to capture the following output: a container which has been sealed in the repository has a single through-wall flaw. The possibility of adding an additional output such as a single thin-wall defect somewhere on the container will also be considered. In both instances, a number of simplifying assumptions will have to be made – in particular we will not be looking at the frequency with which a given container is re-sent for repairs after testing and inspection; rather we will look at the probability of tests and inspections failing to identify and remove flawed containers from the flow, based on their defect states at previous stages.

The assumptions are necessary not so much because the process is complicated to describe, but mostly because that it might be rather difficult for SMEs to come up with separate conditional probabilities for the non-simplified model at this point. Other limitations of this type of model were discussed in the proposal.

3. Look-Ahead to 2016

From this point forward, a large proportion of our activities will revolve around the implementation of the prototype chain. In particular, we plan to

- Continue gathering data specific to the proposed prototype causal chain;
- Incorporate it into the model-structure and setting the parameters to create the implemented prototype;
- Write a first iteration of the input and output parts of the implemented prototype;
- Run a series of functional tests on the implemented prototype to confirm that it is operating as expected;
- Consider some simple behaviour analysis scenarios, and finally
- Write a simple report of the results of the analysis of the implemented prototype, as well as appropriate next steps.

4. Financial Details

The value of the work completed as of December 7, 2015 on the Failure Analysis Simulation Model is shown in the table below:

Invoiced to date		
Quality Plan	\$	5,760.00
Components of Structured Data Repositories	\$	40,320.00
Causal Chain and Conceptual Prototype Model	\$	7,200.00
Travel (2 trips + cancelled meeting)	\$	2,770.91
Total:	\$	56,050.91 666 hours (travel excluded)
Worked to date (hours)		
	Projected	Actual
Quality Plan	72	312
Data Collection/Conceptual Analysis	580	769
Total:	652	1081

The next invoices of the original agreement will be to the order of 70,560.00\$ in advance of Deliverable 4: Prototype Creation early in the New Year, and 14,400.00\$ in advance of Deliverable 5: Demo Analysis and Report in April.

Invoicing due to the accepted re-scoping for the Quality Plan (additional 6 weeks to meet ISO standards and the appropriate compliance supplementary time), as well as for the Manufacturing Process chain will also be added to the schedule: the first one (for 26,000.00\$) early in the New Year, and the second one (for 12,000.00\$) upon completion of the project.

The original deadline was May 15, 2016, but the re-scoping is likely to push back the deadline (CQADS has suggested May 31st as a new deadline, but we will monitor our progress and consult with the NWMO on this matter if the need to do so arises).