CHEMICAL STIMULANT ACTIVITY OPERATIONS AND PLANNING FOR CANMOON 2019. M. Cross[1,2], [1]Institute for Earth and Space Exploration, University of Western Ontario, [2]Department of Electrical and Computer Engineering, University of Western Ontario (mcross8@uwo.ca).

Introduction: Mission operations for the CanMoon 2019 analogue campaign was conducted at the University of Western Ontario. The analogue mission was carried out in partnership between the Canadian Space Agency (CSA) and the Institute for Earth and Space Exploration at the University of Western Ontario, as part of the CSA's Lunar Exploration Analogue Deployment (LEAD) project.

The analogue campaign was based on a near-realtime lunar sample return mission operations concept that required an operations team to work under constantly changing constraints and conditions. Some moments required intense focus among the science interpretation team to make science interpretations to determine the next sequence of activities. Other moments required an orchestrated sequence of actions among several planning team members to uplink a required command within a constrained timeline. In addition, there moments of downtime while waiting for returned data or failed commands. All these activities were performed in concert with the remote field team that implemented the actions for the simulation.

The mission operations were split over two weeks at two separate field sites. The first week examined 1 large operations team working for 10 hours. The second week split that group into two smaller groups working for 5 hours plus a shift handover. As the field team was geospatially separated from the operations team five time zones in advance, operations began each morning at 4am local to the mission operations team.

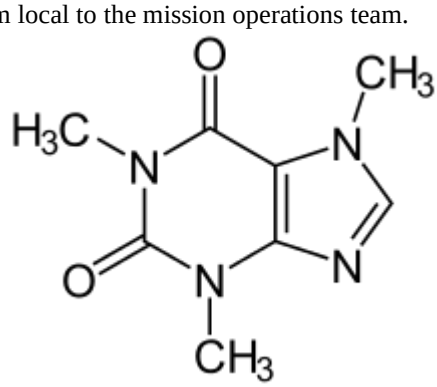

Figure 1: Chemical structure of methylxanthine-class stimulant

The success of the operations was dependent upon the effectiveness of individual team members. Team members required optimal environmental conditions to perform analyses and develop solutions to planning challenges. The utilization of chemical stimulants in the form of coffee was therefore a determining factor in overall mission success. Detailed preparation and planning was required to ensure optimal delivery of chemical stimulation.

Daily Chemical Stimulant Operations and Planning: Several modes of stimulants were utilized during CanMoon operations, including a corylus avellana - theobroma cacao composite. This abstract focuses on preparations and delivery of coffea arabica-derived, and fluid delivered, methylxanthine, as shown in Figure 1.

Pre-processed coffea arabica underwent a thermo-fluid alternation and the resultant mixture could delivered methylxanthine orally. The rate of stimulant demand and the time required for thermo-fluid alternation necessitated parallel processing utilizing two similar, though not identical devices. A variety of preparations of coffea arabica were utilized during operations. The most common varieties were based upon the relative acidity of the resultant fluid. One prepared volume of coffea arabica-derived methylxanthine was further subdivided into non-standard stimulant delivery units; one volume could deliver on average 4 simulant units. Once a prepared volume was complete, it would slowly be distributed over time until empty and had to be re-activated. There were instances, however, in which a full volume was not fully utilized, either due to improper preparation or expiration. Tables 1 and 2 show the production volumes per day for each week.

Table 1: Stimulant preparation for Week 1 operations

Day	Chemical stimulant prepared volumes
1	10
2	7
3	11
4	12
5	13

Table 2: Stimulant preparation for Week 2 operations

Day	Chemical stimulant prepared volumes	
	Shift 1	Shift 2
1	6	3
2	6	3
3	6	4
4	7	3
5	8	3

The results show that the preparation and utilization of chemical stimulants was greater in week 1 compared

to week 2 and increased with time for both week 1 and 2. For week 1, the entire operations team was required to be present and ready to perform by 4am, whereas for week 2 only half of the team was present by 4am. This change in team allocation should explain the overall decrease from week 1 to 2. Over the course of an operations week, generalized fatigue may have increased with time which would then explain the trend of increasing consumption.

User Survey of Chemical Stimulants: 35 operations team members participated in a user survey on their methylxanthine consumption. Of the 35 respondents, 29 indicated they participated in daily chemical stimulation. The reported number of units of methylxanthine stimulants per day are provided in Table 3. It should be noted that the responses do not capture the resolution of shift length or start time, nor do they specific the volume of the unit delivery system.

Table 3: User-reported stimulation consumption

Daily stimulant units reported	Number of respondents
0	6
1 – 2	18
3 – 4	9
>4	2

Recommendations and Future Development: It is acknowledged that stimulant delivery was non-uniform across the population. Future considerations for standardized delivery would improve the resolution and reliability of the user reports.

Stimulant preparation was manually performed by the operations team member also responsible for the automated long-term planning tool, the automated CanMoonBot Twitter account, and the Science-Planning Integration position. An automated system for regular reporting on the stimulant status would be desirable.

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