Moon to Mars Planetary Autonomous Construction Technology (MMPACT) Lunar Surface Construction Activity at NASA Marshall Space Flight Center. J. Edmunson[1] , R.G. Clinton[1], M.R. Fiske[2], and M.R. Effinger[1], [1]NASA Marshall Space Flight Center, Science and Technology Office Building 4221 Marshall Space Flight Center Huntsville AL 35812, [2]Jacobs Space Exploration Group serving Marshall Space Flight Center, Science and Technology Office Building 4221 Marshall Space Flight Center Huntsville AL 35812. (Jennifer.E.Edmunson@nasa.gov)

Introduction: The goal of the Moon to Mars Planetary Autonomous Construction Technology (MMPACT) Project at NASA Marshall Space Flight Center (MSFC) is to develop, deliver, and demonstrate on-demand capabilities to protect astronauts and create infrastructure elements on the lunar surface via construction of landing pads, habitats, shelters, roadways, berms, and blast shields using lunar regolith-based materials. MSFC has strong collaborations with industry, academia, and other NASA Centers to accomplish this goal.

The MMPACT project consists of three elements. The first focuses on the development of an autonomous construction system. The second focuses on construction feedstock materials development. The third element focuses on the development of a microwave sintering construction capability.

The team plans to demonstrate construction on a small Commercial Lunar Payload Services (CLPS) lander in the 2025 timeframe, with a future goal of constructing a subscale landing pad in 2028-2029.

The MMPACT project is funded through the Lunar Surface Innovation Initiative, which is part of the Space Technology Mission Directorate.

Technology Development: The MMPACT team will evaluate multiple autonomous construction and microwave construction technologies, materials, and construction element forms. Selected technologies will be matured; processes and operations will be defined for the two flight missions. Evaluations of materials, as well as the technology itself, will be demonstrated in simulated lunar environments as part of the technology maturation process.

The team is keenly aware of the properties of the lunar environment. Its temperature swings, negligible exosphere, and unprepared site foundations factor into the materials for both construction and hardware, the concept of operations, and the technology's interdependencies.

Materials: The team is looking at materials that can be produced from in-situ resources in an effort to make lunar construction cost-effective. The particular focus of the materials team is cementitious materials, metals, and sintered and melted regolith. These materials will be studied for tensile, compressive, and flexural strength. They will also be tested for their ability to handle thermal swings and vacuum. They will be fully characterized using various microscopy techniques to examine microstructures, chemistry, and crystal formation.

Interdependencies: There are many interdependencies that MMPACT has already identified. These include:

- Excavation interface
- Regolith feedstock beneficiation
- Regolith feedstock storage and provision
- Requirements for structures
- Site-to-site mobility systems
- Availability of lunar simulant
- Lander off-loading capabilities
- Navigation systems
- Power
- Regolith composition and mineralogy
- Lander specifications
- Communication protocols

Technology developments in these additional areas would be beneficial to MMPACT.