PREVIOUS EXPERIENCE has shown that the rate at which new technology is infused into space exploration missions has room for significant improvement. An informal survey conducted at JPL suggested that the predominant impediments to technology infusion fall into the following three areas:

- Requirements related: customer (mission) requirements were either miscommunicated, misunderstood, or under-defined,
- Readiness related: the technology was deemed non-flightworthy in its current state of development (i.e., the technology was not considered for infusion into the flight design because of some unforeseen engineering issues), and
- Competitiveness related: other nearly-equivalent available technologies that can possibly substitute for the to-be-developed technology are, or will become, available.

These findings indicate that technology infusion rates might be improved by establishing a clearer definition of the mission requirements, addressing earlier the technology-specific engineering difficulties that may result from alternative technology/mission architecture decisions, and improving understanding of the projected status of the development of competing technologies from the present to the estimated time of delivery.

The risk-centric Defect Detection and Prevention (DDP) methodology (S. L. Cornford, M. S. Feather, and K.A. Hicks, "DDP - A Tool for Life-Cycle Risk Management", Proceedings, 2001 IEEE Aerospace Conference) has been applied to achieve these improvements. The resulting process, called "Technology Infusion Maturity Assessment (TIMA)", has been used successfully at JPL on a variety of technologies. In brief, the key steps of the TIMA process are:
1 Establishing the stakeholders in the technology, i.e., those with the most to gain by infusion.

2 Identifying the customer requirements that the technology needs to meet before designers & managers will have adequate confidence to infuse the technology into a flight project (e.g. survives 100 krad, operates over -120 C to +20 C, survives launch loads etc.).

3 Determining the potential, relevant failure modes of the technology and assess how much each failure mode can affect the requirements (identifies tall pole failure modes) (e.g., what percentage of a given requirement will be lost if the failure mode occurred).

4 Identifying Preventative measures, Analysis, process Controls, and Tests (PACTS) that can reduce the risk of failure and assign weights to the effectiveness of a given PACT on a particular failure mode (e.g. chance of failing to detect or prevent the failure).

5 Generating a rough estimate of the cost of implementing each identified PACT.

6 Using the DDP tool to perform Risk Balancing calculations. Determining which are the tall tent pole items that, when addressed, will buy down the most risk. Also determining the optimal Cost/Benefit funding recommendations to increase technology infusion success.

7 Reporting the TIMA findings to the stakeholders, including suggested recommendations.

The full paper will elaborate on the TIMA process, identifying and illustrating the way it gathers human expert knowledge through a disciplined knowledge elicitation process, backed by custom-built software support for knowledge representation and reasoning.

The research described in this abstract was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.