OPTIMIZING SAMPLE-RETURN SCIENCE BY BEING AN INFORMATION PACKRAT. A. J. G. Jurewicz[1,2] [1]ASU Center for Meteorite Studies (Amy.Jurewicz@asu.edu), [2]Visiting Scholar, Dartmouth College.

Introduction: This work reviews lessons learned from Stardust and Genesis presented in 2011 [1] and adds additional lessons from the past decade.

Premise: "A NASA Mission is like a train running at full speed: people get on, people get off, but it has a momentum all it's own" [1]. Pre-flight, personnel building key hardware (e.g., collection systems, sample containment) for Sample Return missions are usually out of work after the hardware has been built. Often, they will need to leave the mission early to ensure continuous employment. Others may be vendors and may consider processes proprietary. Yet, they may contribute to the eventual science return in a myriad of ways. Records must detail their successes and concerns, or you may be blindsided in the future.

Post launch (during flight and after return) Science Team members plan and explore various scenarios for handling the returning samples. Some procedures are successful; some are not. Successes are usually archived for future use. Are the failures?

If information is not recorded it cannot help us, but too much information is okay– if it is both available and indexed so that we can use it easily when questions arise. Thus, recording salient data requires the foresight to guess what is important *a priori*, or you need to archive every detail and make it both understandable and widely available in the future.

Preflight: *Effect of Small Choices.* Seemingly innocuous technical decisions regarding the spacecraft and collection system can make a big difference to the science gleaned from the samples. Choices may be as simple as "Should we use the bake-out furnace with the Monel retort for the aerogel?", "Should we acid etch the collection surface, or is a solvent cleaning good enough?", "Should the vendor do the usual cleaning with an Ar plasma so that the thin-film protective coating on this part will adhere better?". Unfortunately, Mission functions are necessarily compartmentalized to meet tight schedules, meaning that it's harder for those choices to be made with a comprehensive vision. Many decisions are not made by the science team: they are made by engineers and technicians who follow the engineering and flight specifications but may not understand the implications of their choices on future analyses, e.g., contamination on collectors or sample containment vessels.

Identifying what to record. The future is inscrutable. So, to archive all salient data, you either need to guess what is important *a priori*, or you must archive "every detail". Hardware fabrication is only rarely done by someone on the Science Team. To ensure quality, a science team member should tag alongside the techs manufacturing these sensitive parts to check small choices and record potentially relevant data. At the least, a team member should ask comprehensive questions ahead of fabrication, *or* officially require detailed notes and other fabrication documents not provided automatically. Treating techs as members of the mission team – especially explaining the reasons behind specifications – will not only help them make more informed choices, but they will be more excited about the work, and may suggest improvements in processing or quality control.

Post flight: *Records and their availability.* Every manufacturing plant and laboratory scientist knows the importance of taking notes at the time of fabrication. But, traditionally, engineers, quality assurance, vendors, and Science Team members all archive their data at different locations and on different media. Vendors may also have techniques they consider to be proprietary. Thus, the question becomes whether the files containing flight-data be conveniently accessible (and readable) to scientists 20 years in the future. To ensure access to information that may affect future science, a subset of the Science Team needs to be responsible for archiving potentially important notes, including negotiations for releasing redacted proprietary information and pooling potentially important information from engineering.

Record storage. Paper or electronics? Paper is bulky and deteriorates. Hardware and software for archiving data undergo continuous development followed by obsolescence. Example: Stardust aerogel fabrication data was stored on Jaz drives – who uses one now? These days, there is a push to put everything "in the cloud". But, even if data is localized on a single server, the software needed for reading them inevitably changes. Will archived files remain compatible with software upgrades? Do we need to physically archive a computer with appropriate software to read these files?

Other archives. Plans are needed for archiving post-flight records and tangibles, including scientific/engineering results not publishable as stand-alone papers [2], and specialty analytical standards (e.g. [3]). These issues are discussed for Genesis in [4].

References & note: [1] Jurewicz A. J. G. (2011) *SSSR Workshop (2011), Abstract #5053 (LPI).* [2] Allton J. H. et al. (2018) 49th LPS, Abstract #1671. [3] Jurewicz A. J. G. et al. (2021) *JAAS* 36:194-209. [4] Allton J. H. (2021) this workshop.