Best Business Practices for Selecting and Developing Effective Working Partnerships with Implementation Partners: *Creating a Robust, Accessible, and Sustainable Commercial Space Economy for All*

By

Mari Anne Snow, CEO/Co-Founder, Eascra Biotech, InSPA Awardee
Dr. Yupeng Chen, Eascra Biotech, Co-founder, InSPA Awardee
Dr. Gary du Moulin, Eascra Biotech, InSPA Awardee

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Table of Contents

Introduction – objectives and overview

With the expansion of the space economy, tremendous opportunities now exist that have, until now, only been available to a rare few. As a result, many entrepreneurs, business leaders, and academics like you are seeking the benefits and business opportunities associated with sending commercial products, science experiments, or innovative early-stage technology to space. This decision will unwittingly catapult you into a highly sophisticated, complex, and mission-driven ecosystem that is in the midst of seismic, revolutionary change. Propelled by a unique and dedicated group of space pioneers, explorers, risk-takers, and visionaries, this tight-knit community is looking to create a thriving, sustainable commercial space-based economy as quickly as possible for the benefit of humanity here on Earth and beyond.

This is a long-term endeavor that is currently at a critical stage. Anyone associated with space is building on the previous work of many unnamed pioneers who dreamed big and took enormous risks. Now, because of their efforts, technical advances and this market's enormous potential, innovation is moving at an accelerated, aspirational pace, and there is big investment coming from a wide variety of players who are eager to advance things as quickly as possible. But success is not assured. This is a complex environment that demands multidisciplinary collaboration among a variety of stakeholders – you, the researcher or innovator, the growing commercial/private space sector, many academic institutions, and the many government agencies (in the United States and beyond) who are underwriting the future with their dreams, passion, knowledge, hard work, faith, and capital.

Given the enormity of the vision and the complex technical challenges before us, no one individual or entity can conquer space on their own. Nor should they. All of us must work together, learning to transcend old paradigms to build new types of collaborations built on shared goals to make it happen. This must be a global team effort. We must unite, partner, and share in unprecedented ways as there is greater power in a cohesive collective working in unison towards a shared future of a thriving space economy. This whitepaper is an attempt to support this collaborative future by providing you with best practices for establishing effective, cohesive, and necessary multi-disciplinary partnerships from day one. We want you to benefit from the collective knowledge of the many that came before you so you can advance your work quickly and efficiently for the benefit of all of us in the space community. If you win, we all win. We wish you great success and look forward to working with you in the future.

You want to go to space, where do you start?

The United States is committed to maintaining a robust and expanded space presence by building on a significant legacy contribution and long-established success as a global space leader. There is ongoing recognition that academic, public-private partnerships and significant international collaborations are the way of the future. It will take the combined efforts of governments, academia, and the commercial sector to accelerate the development of a robust and sustainable space economy that can support innovative research and aspirational commercial activities in all areas of space including low Earth orbit (LEO), lunar space, and beyond. Many people now see the potential of this largely untapped resource and they are jumping in fast. Consequently, there are growing opportunities for both government funding and private investment if you have a great space idea you want to advance.

However, this is a new frontier and getting to space is still a complex task involving many stakeholders and many logistical challenges. To reduce risk and enable academic labs and/or new commercial companies to navigate this complexity, you need space savvy partners to help guide you. There are a host

of companies, often started and operated by smart, dedicated people, many of whom are former NASA, ISSNL, military, or other tenured space professionals that play this role. They provide specialized space expertise that you will need when you start. These private companies are dedicated to building a sustainable space economy and are often commercial companies themselves. Known as “implementation partners,” they perform an invaluable service, standing ready to provide vital insider information unknown to most people outside the space community. They have the legacy knowledge, networks, and insider relationships you need to gain access to needed capital, technical expertise, and launch/mission success.

Whether you plan on manufacturing in space, creating the tools and technology to support lunar or Mars colonization, or you are simply aiming for one or two missions over many years, you still need help to navigate this environment and achieve your goals. Implementation partners are necessary and important for your space experience. They exist to help you take a terrestrial concept and make it “space” ready. They have specialized know-how related to their previous project work, their specialized hardware solutions, their understanding of the effects of microgravity on your science, and so on. Because much of the work historically conducted in space has largely gone unpublished and unshared, legacy knowledge resides with those who have worked in this ecosystem over time and their knowledge must be sought after and rediscovered. Your implementation partners can share their own firsthand experience and knowledge or that they have learned from their many contacts. Because of this, they are invaluable resources to you because of their vast knowledge and access to legacy information. Implementation partners, along with your new contacts at NASA, ISSNL, CASIS, and other space agencies will become an extension of your team, instantly transforming, and expanding your capabilities with their expertise.

Implementation partner contributions range from teaching you the many, many space acronyms, to completing/filing the necessary paperwork for flight readiness, advocating for your science during safety reviews, and providing the scientific and technical expertise you need to prepare your payload for a space mission. They help you pass all your flight safety requirements, get you badge access to inaccessible places, get your payload loaded for flight and help you successfully retrieve your payload post flight. For anyone with satellites or other technology that will stay in orbit or travel in space, your implementation partners help you get to space and stay there. Some of these tasks may seem trivial, but rest assured, they are not. Implementation partners are a necessity for any new space venture. In addition, if you are a new commercial company seeking funding to launch and buildout your space vision, identifying the right space implementation partner, and negotiating the terms of engagement before you start writing grant proposals or pitching potential space investors strengthens your case and makes you more credible.

Where can you find a reputable implementation partner?

Implementation partners come in a variety of forms these days. Before you choose one, make sure to take time to consider your requirements and the various service options each implementation partner provides. This is important as implementation partners have different expertise, and your requirements should align with what they have to offer. Some are more engineering-based and work with satellites, hardware, and other machines or equipment. Some work with defense or telecommunications applications. Some are more science, energy, or biology based, and they are familiar with handling advanced materials, live cell biologics, 3D printing, or synthetic biotech. As In-SPA program participants, we are working to build the operating model and infrastructure for the sustainable, cost-effective manufacture of biomedical products in low-Earth orbit (LEO) to benefit patients on Earth. Since no one

has ever done this before, we are literally creating something that does not currently exist. We're building it from the ground up, a daunting task and a big responsibility that is too important for us to take on by ourselves. That's why we view our partners as a critical part of our future success. You have your own unique vision as to what you want to accomplish in space. Consider your long-term vision, commercial objectives, project requirements, and technical considerations then tailor your search to complement your specific needs.

We suggest you start your search for your partners by checking out the ISS National Laboratory® website. They have a list of approved implementation partners along with the criteria it takes to become one. Conduct online searches, subscribe to space media, search contacts on digital channels like LinkedIn, attend space events, conferences, and symposiums. You will get a feel for the established players. Show up at events to see those players in person. They are very visible as sponsors, speakers, and are often headlining in space news. Look for commercial companies that are talking about and promoting space. Some are very large, traditional defense contractors or long-time space vendors. Some of them are small startups just bursting on the scene. Once you have a list of potential partners, be proactive. Contact them and schedule a time to meet with them. Ask lots of questions, seek introductions, and do your research just as you would if you were searching for grants, employment, or private investor money.

Once you have targets, contact them to learn more about them. Implementation partners are as interested in you as you are in them. They are searching for new partners just as you are, so a well-crafted inquiry will likely get you a meeting. Prepare in advance by visiting websites, conducting searches on recent projects, and ask around to learn as much as you can before the meeting takes place. If this is new to you and you aren't sure where to start, we've provided a framework for you to use in the following section. Talk to lots of people and seek to build relationships early whenever possible, don't wait. Having a partner before you jump into project collaborations is a blessing and will help you in lots of ways. Often implementation partners know about funding solicitations before you do, and they may have partner connections that can help you get started. We realize this isn't always possible as you may be on the hunt for an implementation partner just as you are writing your first space grant, or you may get handed an implementation partner by your grant manager or an investor. This isn't optimal for you or your potential partner. It's always better for both of you if you can establish the relationship before the work begins.

Choosing an implementation partner (characteristics to look for)

As mentioned in the last section, commercial implementation partners aren't standardized service providers. It's a different kind of relationship. This relationship is close and is often long term. Just like you need to research grant opportunities and investors for funding, choose the implementation partners that align best with your business/project objectives and your technical needs, and have a record of demonstrated success in not only flying payloads but delivering the science results you need. They need to care about and understand your science as much as you do. It's up to you to engage in due diligence before you sign on with an implementation partner that will become a critical extension of your team. Every implementation partner has their own approach, technologies, philosophies, and business objectives. Their value to you rests with their:

- Knowledge of the space industry and the process for mission launch.
- Ability to understand your science and demonstrated success in obtaining meaningful results from work in microgravity.

- Relationships with the various agencies that you will encounter as you prepare for your missions.
- Capacity to problem-solve and professionally address problems as they inevitably arise.
- Technical capabilities and in-house know-how in relation to your technical needs (today and in the future).
- Existing hardware, work processes, software, and get-to-space solutions needed to support your work.
- Appetite for rolling up their sleeves and helping hands-on with the workload.
- Capacity to give you the time and attention you need to advance your project and your space knowledge.
- Track record for helping their partners achieve their mission objectives, e.g., valid data collection, timely sample retrieval, successful technology deployment, etc.
- Work process with their partners, are they typically collaborative and transparent, responsive to your needs, questions, concerns?
- Dedication to achieving success -both technical and science - on the mission and a plan to ensure that all variables have been identified and approaches confirmed before flight.
- Approach to your professional development as a member of the space community, do they teach you, mentor you, educate you about the space industry or prevent you from advancing your skills?
- Collaboration style, are you an equal partner in the process, do you have a voice, do they promote you, and your venture along with their own?
- Approach to any future IP development (we'll address this in more depth later).
- Willingness to support you with grant writing, proposal letters of support, and even early in-kind service contributions while you work towards your initial start-up funds.
- Willingness to share their network contacts with you to help you advance your company, science, or project.
- Willingness to promote you and your work to help you raise the visibility of your company.
- Willingness to include in public speaking opportunities, panels, pre-flight media interviews, etc.
- Willingness to co-author papers, publications, and other technical documentation.

It might seem like a new space venture has little bargaining power with established, reputable implementation partners particularly if you are an early-stage company or a concept project with cool ideas but little money in the bank. But in this unique, early-stage ecosystem, everyone is a potential meaningful contributor. There is a lot of creative thinking about how partnerships and collaborations are structured, and some implementation partners have interests well beyond just providing services because they see the future potential in your work/ideas. There are lots of opportunities to build creative relationships beyond just fee for service, transactional interactions. There is a lot of room to negotiate the working terms of the partnership. Is everything cash? Are in-kind services a possibility? Can you have a licensing arrangement? Could you build a royalty structure or equity share into your agreement? Might this be a joint venture? Explore the possibilities creatively, but respectfully, as this will be an important part of your space success.

Smart implementation partners are in it for the long haul. They hope, just as we hope, this is more than a one-mission venture. Good implementation partners get invested in your success (and you in theirs). You may work with more than one implementation partner over time; however, because of the technical needs of your work, it's disruptive to jump from one partner to another too frequently. Approach this as a long-term commitment (assuming the relationship suits your needs). Approach every interaction

professionally and respectfully. Even if one partner isn't right for your needs, they probably know someone who is, and they may be able to provide you with a warm introduction to the perfect partner for you. This is a small community, so you want to build and maintain a professional reputation by always acting with integrity. Complete your due diligence ahead of time, compile your business case, and prepare your value proposition in advance. Negotiating professionally with implementation partners is good practice for future proposal writing and future investor pitches. You want to set a good tone for your working relationship that is fair, but equal, so everyone has a voice in the working process.

Different implementation partners specialize in different things. Make sure you approach companies that align with your specific needs. Biomedical applications are different than agricultural applications, satellites, or advanced materials. Projects take many forms these days and there are many solutions for achieving low gravity orbit. Not everyone needs to go to the International Space Station to achieve their goals. Your options will continue to expand as new small vehicles with re-entry capability come online, and satellites that collect and transmit data without return become commercially available. Some of you may be interested in lunar Artemis missions or other exploration related, national security or defense ventures. Just as you must evaluate a funding solicitation, an investor's portfolio, or an agency's mission to determine a suitable match for you, apply the same principles to implementation partners. Ask lots of questions and conduct market research as you would with any new venture. Ask for references and talk to them in advance. Work with your team to devise a list of questions related to your specific scientific, technical, or commercial needs so you are ready to engage in implementation partner questions at initial stages of discussions and later in the process at a more detailed level. Every list must be tailored to your areas of interest. We've provided you with some basic, general questions for a variety of payload types below to get you started; however, as there are many different areas of interest, you must create your own list that is customized for your needs:

- Does your research include live cells? If so, what's needed to keep those cells contained and alive?
- What are your storage needs?
- What types of chemicals, materials, or other substances do you need and how can they be handled safely?
- Once you are in space, will you need human intervention to complete your objectives, or can you use self-contained cube-labs that are autonomous?
- Is it necessary for you to be on the ISS National Laboratory® or can you utilize low gravity by other means, e.g., autonomous labs that achieve orbit without crew and then return to Earth.
- What equipment do you need to achieve your objectives? NOTE: Don't assume that equipment is currently available on ISS unless you get explicit, confirmed assurances. And ensure that you understand the accessibility and timelines for use of equipment on ISS NATIONAL LABORATORY®(e.g., furnaces have a significant backlog and glovebox resources are always in high demand)
- How much power, crew time, etc. do you need?
- How long do you need to be or want to be in space? Can you accomplish your goals with suborbital flight?
- Are you putting something in orbit permanently?
- What are your scientific/technical success criteria for your project? Must-haves? Nice-to-haves?
- What data do you need from a mission to meet your objectives and advance your project or business? Validate your project milestones? Show and validate space-related benefits?

- Are you planning to manufacture in space, if so, what are the process requirements?
- If you are deploying technology, where does it need to go and what does it need to do once it gets there?

Once you have your list of questions ready, come up with a list of potential implementation partners that align with your needs and start contacting as many as possible so you can educate yourself and gain comparison data. If you are at events or have contacts with ties to the space industry, ask for introductions. Talk with companies or project groups who have existing relationships to get their perspectives as well. Gather information from multiple companies and ask for multiple quotes so you have comparison data. Pursue the companies that feel like the best fit. Remember to start these conversations early because you don't want your first conversation with a potential partner kicking off three weeks before your grant is due. This relationship may last for a good long while so make sure you are confident in your choice.

Crafting a memorandum of understanding (MOU) to set the terms of your partnership

Once you've made your choice, and you are planning to establish a long-term relationship, the next step is to set up work parameters for the partnership using your vendor contract and what is called a memorandum of understanding (MOU) that outlines the terms of the working partnership between you and your implementation partner. While this is a particularly important partnership, this is also an important and significant business relationship. Make sure to set terms that are fair and appropriate for your partnership up front while everyone is on good terms. A reminder, you are establishing a PARTNERSHIP, not trying to "win" one over on the other party. These relationships run deep and signal intent and interest from both sides in the development of a future commercial space economy. Look for win-win solutions that protect everyone and set the stage for a long-term, productive partnership that recognizes everyone's contribution.

NOTE: if you are associated with an academic institution, you would likely work with your institution's representatives to complete this negotiation. Depending on the experience of your institution's tech transfer team, they may have had little to no contact with the space industry so even though your agreement will be between your institution and your implementation partner, you will need to be an active participant in these discussions. Your project's technical needs and your long-term interests should be the basis for the partnership agreement and the MOU, and those needs should be clearly outlined in these documents. Your agreements may well set precedent and become the standard for your institution so take it seriously and engage in the process on your own behalf but also for all who come behind you.

Keep in mind that defining space agreements for long-term commercial partnerships is a relatively new process and the space industry landscape is continuing to evolve. Acknowledgement of this from both sides will go a long way in setting the tone and willingness of both sides to revisit and refine these agreements as the partnership and the space landscape progresses. This is uncharted territory where the traditional agreements and terms generally apply, however, pay close attention as there will be unique features that will require thoughtful consideration in the early days of the emerging space markets.

If you are an early-stage start-up just launching, you also have an opportunity in these negotiations to shape the engagement in important ways. First, anticipate negotiations will be part of the process, do not be intimidated. This is a normal, healthy, and necessary part of the process. Educate yourself and come

to meetings prepared with questions. If you do not have an attorney, now is a good time to get one so you have legal counsel that can provide knowledgeable assistance if/when you need it. Yes, there is an associated cost, but many times fixing problems later is expensive and disruptive. So, one way or another it will cost you in the end. Complete your due diligence in advance and be clear on the working terms that are right for you. If the implementation partner provides the contract and MOU drafts to start, you can request edits, so the agreement provides for your needs as well as the partner's. And if you are sensing that the implementation partner isn't playing fair for any reason, point this out to them then monitor their reaction to your feedback. This could be a big red flag. Do you want partners you can't trust? Or does the partner listen to the feedback and adjust their approach? Is there a rational reason for their position?

Remember that anything you sign is a legally binding agreement. That's why legal advice early on can save you many headaches (and possible heartaches) in the future. You want to ensure that the deal you sign aligns with your research or business interests, as well as the overall strategic goals of your work. If not, you may need to walk away from the deal and explore other options. We know from experience walking away isn't easy, but better to do so and start over rather than bind yourself to a contract that you will regret later.

NOTE REGARDING POTENTIAL DEVELOPMENT OF SHARED INTELLECTUAL PROPERTY (IP): Very often we remind ourselves that what is happening today with the burgeoning private space sector has never happened before. This is all additional territory without existing precedent. We are creating the future with our actions today. The commercial space twenty, thirty, or forty years from now will look vastly different than it does now. All of us working in this emerging space economy today are literally writing the new rules that will shape that future. This includes establishing who owns the IP for ideas, products, and materials produced in space as well as any terrestrial uses that may result from these inventions. As you negotiate your contracts and MOUs with your implementation partners, make sure to include language that stipulates IP ownership of any new process, product, material, hardware, software, etc. that gets developed because of your work with your implementation partner. Consider the nature of these partnerships and the space ecosystem and think about everyone's contribution. If you are working in academia or accepting government funds be sure to educate yourself in advance on the institutional policies and procedures surrounding IP rights as you sign agreements with all your stakeholders, including the flow-down clauses that exist for working on the ISS National Laboratory® mandated by Congress (which are similar to other government science agencies and developed prior to the idea of commercial market creation in low-Earth orbit so a continuing topic for revision at the Congressional level).

Establish working parameters, process, and workflows early on

Once you work through the business details, it's incumbent upon you to implement the details of your contract and MOU by establishing a working timeline for your mission plan and familiarizing yourself and your team with the requirements of getting things to and from space. This is a learn-as-you-go exercise, and you will feel overwhelmed at first. This is natural and happens to all of us. Given the complexity of a space operation, the many stakeholders involved, the overwhelming number of acronyms, and all the dizzying number of rules and regs, accept it will take you a while to acclimate. This is where a strong implementation partner is critical. They will guide you through this process and how to navigate any challenges that may arise. Get comfortable with being uncomfortable. Avoid trying to micromanage the process, let your implementation partner do their jobs, but ask lots and lots of questions. Don't pretend to know as that isn't going to do anyone any good. Invest the time you need to learn the basics and stay

actively involved. Request timelines and then accept timelines in this environment are relative. Prepare to be flexible as there are many factors that impact a mission flight plan including some beyond even NASA's control, like the weather.

Working in this environment is very much an exercise in controlling what you can and accepting what you can't change within the NASA process – at least for now. NASA, as a space agency, has an outstanding and impeccable record of supporting human habitation on the ISS and fostering space exploration but the process was never built for commercialization. The process can be slow and the risk tolerance for new processes or procedures is low. It doesn't help that the regulations that govern the process are as old as NASA so often not up to date with state-of-the-art technology. In this transition moment, patience and thoughtfulness is required. By building relationships and learning some of the "whys" behind existing processes, you are better equipped to work with your implementation partner to build a compelling business case for proposed process changes that better suit commercial practices.

While there are many variables currently beyond your control, you can control your work process, ask for routine updates from all parties, establish a working meeting cadence that keeps you aware, and make your working expectations known to all parties. You can't control the launch schedule or the weather. For our work defining an in-space manufacturing process in low-Earth orbit (LEO), we meet with our implementation partners weekly, even between missions, because there is always something going on that may affect our plans. We have a standing meeting agenda that we use to guide these meetings, so the team knows what is required in the short term as well as what is coming in the near and far future. This is particularly important if you are juggling multiple missions in a calendar year. Teams with multiple missions manage many work streams simultaneously. Keeping track requires a clear working process as there are a myriad of essential details that occur with tight deadlines. Miss one of them and you risk losing your place on the integrated payload list (IPL). We will discuss this in more detail in the Effective Meeting Management section.

We recommend you work to build a templatized work process that includes all the predictable steps necessary to prepare for a successful mission flight. This may be a new concept for academic groups and more typical for commercial teams; however, the process can work equally well for both. By creating a template workflow, you create a consistent baseline to measure against that reduces the variables to account for when analyzing flight results. Template workflows establish protocols and work tasks that will help you build a library of reuseable content that you can leverage for efficiency over time. Following each flight, debrief with the team and review your templates for effectiveness. Experienced implementation partners may have their own processes, and that is okay, but be prepared to customize your own procedures and processes, too. Don't be afraid to respectfully challenge and even build your own from scratch depending on your own unique needs. Create your documentation so it aligns with your objectives. For instance, manufacturing in space is a new concept and documents for manufacturing (e.g., batch records for biomedical products) require a different level of detail. This makes it much easier to onboard new team members while retaining work consistency as we can teach them using existing documentation that aligns with your work process template thus creating standardized operating procedures (SOPs).

NOTE: This type of approach is more typical for commercial groups and less so for academic ones. However, even academic groups will benefit from adopting consistent work practices particularly if you plan to engage in translational research or fly multiple missions. For fundamental or translational work,

not only will a templatized process be more cost effective, but it will help you collect data that is more meaningful when it is time for publication of your results or gain FDA approval for biomedical applications.

Preparations for your mission

Implementation partners understand the requirements and they function as your point person with the space agencies controlling the mission flight activities. Some implementation partners have built so much integrity that they now own a lot of the process. Let them do their job, but actively engage with them as they work through the execution. Ask for information and educate yourself as much as possible so you can proactively manage your team as you learn the ropes and become familiar with the process. If you are a senior leader in your group or organization, we know you already have plenty to do, but we recommend you take the time to immerse yourself in your first mission (at minimum) so you have a sense of the scope, learn the players, and get a feel for the process and the required procedures (and note that critical skills require training for those engaged in direct communications or mission operations). We aren't suggesting you do it alone, you need a team as this is a lot of work. But your firsthand knowledge of the mission ops process will provide much needed team guidance and put you front and center when important go-no-go decisions need to be made.

After you have a sense of the environment, then you can cultivate appropriate point people on your team and empower them to actively participate in the process alongside your partners. Yes, implementation partners are paid for their work. Be assured they will earn it. They do a lot, much more than you realize, and like you, they take risks and have a lot at stake. In addition to mission readiness coordination, some of them have the required training to direct mission operations that we don't have, or they may provide private astronaut crews to help you get work done on an accelerated timeline. These relationships work best when each party respectfully and professionally holds themselves and each other accountable to defined roles and responsibilities as well as the terms of the partnership agreement and MOU by showing an active interest. If you are new to space, invest the time and make a sincere effort to learn the basics, so you know in advance when things are on track and when they aren't.

Determine the implementation partner's capability to support you technically. They don't have to be experts in your field, that's your job. But they do have to have some understanding of science, and how to get your project to space and back safely by the end of the mission. Set up effective communication protocols and avoid assumptions, be as explicit as possible particularly at the beginning of the project. If something doesn't make sense to you, speak up, and make a point to check in with your project team frequently as well. Your question or your team's questions may highlight a crucial detail that needs special consideration because it is poorly defined or misunderstood. It's best to get into this habit early so you can tackle potential problems before they become future disasters.

As smart and capable as they are, don't assume your implementation partners know your work as well as you do. The more your partners understand your business, product, technology, and science, the better. If you have a great partner, their knowledge will come over time as you work through problems together. Make sure to add confidentiality language into your partner agreements so you can confidently share intimate details openly. Transparency and trust make for good teamwork. For your part, don't make assumptions about space. The space environment is quite different than the Earth environment. The more you and your people learn about space conditions the better. Things act and perform differently in space. Be open to learning, ask lots of questions, and challenge your implementation partner to educate you

about launch, microgravity, reentry conditions, etc. Keep in mind your goal is to gain useful data from each of your flights. Build in time for brainstorming in your flight prep, then add in time to de-brief after a flight so your team gets smarter over time, and you build on your successes as well as your failures.

Finally, discuss team roles, responsibilities, and shared expectations during your contract and MOU discussions. Find out what the implementation partner needs from you to ensure your success. Ask them what they need from you as well. This is a relationship that exists to solve complex problems. Because these problems are often unique to the space environment, a variety of skills are required. Problem solving takes place at every stage of the process against very regimented timelines with many complex milestones along the way. Be clear as to what you need technically as well as what you need to feel confident and comfortable that you are getting the full value of the partnership and consider your partner's position as well. Holding each other accountable is easier over time if you have a good solid foundation laid from day one.

This is about building a healthy, joint team culture where all team members feel valued and are invested. That's when magic can happen. Highly productive teams with a high degree of trust between team members are more resilient and able to stay focused and adapt to changes quickly. And no matter how well you plan, it's impossible to cover everything and everyone needs to be ready to adjust as needed along the way. Working in space to create emerging markets, like working in any successful fast-paced start-up, requires the ability to be agile, flexible, and adjustments when needed, to achieve success. It's easier to do this when the base framework for your working relationship is sound.

NOTE: This may seem like a lot of work if you are a small startup or an academic team. But it is an investment well worth the effort. These are skills that will last you a lifetime and help you avoid unnecessary chaos and headaches. Realize that your "team" is bigger than your immediate employees or lab staff. Once you are getting ready to fly a mission, your team includes everyone in your organization, your implementation partner's organization, your government partners, and other vendors working with you. If you want your "team" to care about your payload, technology, or experiment as much as you do, then you must work to develop trust and shared vision between all the team members. Team members will extend themselves more when they feel kinship and camaraderie towards you and your group. And while the pace may seem hard, the progress will fuel the continued ability of all to accomplish the impossible ahead of schedule.

Establish good meeting management practices up front

Efficient and professional meeting management is a crucial skill, but sadly, many professionals struggle with meeting basics. In a normal business setting, bad meeting management leads to misunderstandings, loss of productivity, low team morale, and missed business opportunities. In a space environment, it can spell disaster. If you wish to succeed, work on your meeting management skills so you can develop a team culture that can withstand the stress and inevitable changes that occur along the way. Meetings are the primary forum for status updates related to mission readiness and information sharing. They are also an opportunity to develop that cohesive team culture we described earlier by cultivating a sense of shared objectives among the many stakeholders.

These team meetings are usually virtually out of necessity. Most teams are distributed, meaning they don't work together in the same physical space, so virtual meetings are the only cost effective and time effective way to stay connected. As space teams are multi-disciplined and often span different time zones,

locations, and organizations, you need to decide on meeting technology that is accessible to everyone. We recommend video rather than audio conference calls as it helps "humanize" the distributed team members. We accept that some people are unable or uncomfortable coming on camera, but we always encourage them to do so. Some may not have the technical bandwidth to support full video. Consequently, we don't force anyone to turn on their camera. However, we ask the meeting facilitators and key leaders to be on camera for the entire meeting so the team can see their body language and facial expressions and we encourage younger team members and new team members, and we give them lots of positive feedback when they do so. More on virtual meeting best practices below.

This is an important team building technique. It is likely your meeting participants may speak multiple languages, come from multiple cultures, have diverse backgrounds/expertise, and have various levels of social and emotional intelligence. It's to your benefit to have the team leaders and meeting facilitators stay on camera to remind people in the meeting of their humanity and to set a positive, yet professional tone. We have found these small actions help encourage loyalty and help bring a team together. Teams with high levels of commitment to each other have greater resilience, extend each other more trust, are better problem solvers, and tend to highlight issues quicker and work together more cohesively to resolve them. Familiarize yourself with meeting best practices (both virtual or in person) and discuss your meeting format with your implementation partner during your contract and MOU discussions so expectations are set early and there are no surprises later.

NOTE: While virtual meetings may be the most practical and cost-effective way for your team to meet frequently and consistently, look for ways to connect with some or all your team in person when time and circumstances allow. Make arrangements to visit your implementation partner's facilities, meet their extended team, and learn about their business. Use conferences, events, symposiums, and other public events strategically to schedule one-on-one or small group meetings whenever possible and make an effort to be a good host when one of your extended team members travels to your area. Finally, get to know each other as people. We reserve time to celebrate individual and team achievements, birthdays, life events, and we support/acknowledge each other however we can.

Virtual meeting management best practices – Operational Logistics

Virtual meetings require advance planning to gain maximum productivity. Decide on the technology you will use for your video call by polling your team to get their preferences. Choose your video tool carefully and make sure your meeting invitees can fully access it. Some companies restrict software and sensitive security filters can block applications. Video takes more internet bandwidth than audio calls. If someone is having bandwidth problems, have them turn off their camera as it may help them to stabilize their connection. This all may seem obvious, but you can waste a lot of the team's time if the connection is poor and team members have difficulty participating. Once the group decides on a technology, the meeting facilitator distributes a calendar invite with login information to all invited participants. Set up the meeting as a recurring event so that participants can mark their calendars for the same time each week. Keeping a consistent meeting cadence helps build team cohesion and integrity.

<u>Establish the rules of engagement/meeting etiquette, then communicate them to the group in advance:</u>

- Identify the meeting objectives in advance and devise a meeting agenda that clearly states the meeting's purpose to the group.

- Distribute the meeting agenda in advance to the participants and indicate what participants need to do to prepare in advance.
- Assign a meeting facilitator to chair the meeting and a note taker to capture key decisions so you can create a record of the meeting minutes for future reference and team accountability.
- Make sure the key members of the team come on camera and stay on camera for the duration of the meeting so the team can see their facial expressions and body language.
- Require all meeting participants to display their full names so everyone gets to know each other.
- Save a few minutes at the beginning of the meeting for informal conversation. The meeting facilitator can introduce any new participants and indicate their role, as well as welcome the group.
- Establish rules of engagement and communicate them to the group. Rules of engagement aren't a way to censure group participation. Rather, they help meeting attendees to participate comfortably and fully. We keep things simple. Participants are asked to raise their hands or indicate in the chat when they have a comment to share, so the facilitator can invite them on mike to address the group one at a time. We also ask participants to come prepared to provide updates, to ask for help proactively rather than wait until a problem is critical, and to always address each other respectfully.
- The facilitator addresses all participants by name and avoids general, non-directed questions, e.g., "Brandon, do you have any suggestions for the science team?" verses "Does anyone have any suggestions for the science team?"
- If the group discussion is veering off topic, it is the facilitator's job to a) poll the group to see if the new topic is a priority to be immediately addressed or b) redirect the group discussion back to the agenda topics. NOTE: If the new topic is important, but not a priority, the facilitator can ask the note taker to capture the topic in the meeting recap notes so the group can discuss it in future meetings or in separate offline discussions.
- The facilitator is the timekeeper. Always start and end meetings on time. It shows respect for everyone's busy schedule. If you have covered the agenda topics fully before the end of the scheduled time, end the meeting early, don't keep the group together unless there is a compelling reason to do so. Never keep a meeting going past the scheduled time unless it is necessary to do so, then consult with the group to gain consensus for going past time and accept that some folks may have to leave because they have commitments elsewhere.
- Throughout the meeting and towards the end of the meeting, the facilitator can check in with junior team members, calling them by name, to ask if they have questions or anything further to add. Routinely inviting junior team members to speak empowers them to share their thoughts and helps build their confidence. Their contributions elevate the team's effectiveness and provide unexpected and helpful observations.
- After the meeting ends, meeting notes generated by the meeting discussion are reviewed, revised as needed, then distributed via email to all attendees plus key stakeholders. We keep the same mission-related subject line with our official project name plus the meeting date for easy searchability later. These notes are a crucial part of project reporting related to key milestone achievements. We maintain a consistent distribution list that includes our core team members, a select group of key stakeholders that attend our meetings periodically plus our agency program director and technical advisors. We get permission from everyone first, so we aren't spamming inboxes with unwanted information. NOTE: Make this a non-negotiable part of your work process.

Identifying the note taker early on is important and in some cases, you may want multiple people or one from each side.

Stakeholder management

When you are prepping for a mission, weekly meetings are vital, but when you are working on a difficult problem or trouble shooting issues, weekly may not be enough. In addition, you must plan to strategically create visibility for your work through direct action on your part or else you and your team will remain invisible. This is a crucial part of the process as distributed teams don't work in one central office where people have physical contact with you and can "see" you at work every day. Also, working collaboratively with so many stakeholders from different organizations requires a lot of stakeholder management that happens behind the scenes to keep things working smoothly. In distributed, virtual teams, this is incredibly important as building professional relationships, getting work done effectively, creating a culture of trust, and sharing information appropriately all happens electronically.

We build time into our workplan and actively work at this with everything we do. In addition to our standing weekly meeting, we have access to key stakeholders through cell phones, text distribution lists, and other electronic channels, e.g., Teams, Slack, WhatsApp, email, text messaging, Box, Dropbox, Google Drive, etc. There are a million different options, and those options are changing daily. Appreciate there is no one standard. Come to consensus with the people you work with as to which communication channels, work tools, file sharing, communication protocols will be used for what, well in advance so you can set them up technically and ensure everyone can access them and knows how to use them. We do this with our work teams, our agency program director, key members of our implementation partner's team, key subject matter experts, and others and the protocols are a little different for each of them.

We've worked through these issues early on and we have designated protocols for what tools we use and how we use them. In addition to our process documentation and templatized workflow, we leverage existing documentation formats whenever it makes sense to do so. Reporting to our key stakeholders is a necessary part of our workflow. Rather than reinvent new report formats, we integrated NASA's preferred report format into our update process so we can share information that's meaningful to our partner. NASA happens to use a simple Quad Chart with a one-page science update sheet that helps us deliver content that has impact. Our goal is to create a documentation trail that captures accomplishments in a concise, but meaningful way so there is a clear record with historical perspective once the project is completed that will help all our partners see the value of our work

Whether we are dealing with typical team activities, writing a proposal together, working on a mission, or troubleshooting a problem that requires escalation, we already have a system in place to execute quickly. New people joining the team get a quick overview, with access set up in advance. Channels are specific to different stages of a mission, levels of urgency, and work activities, e.g., we have one distribution list for our core team just for mission ops when we are observing crew work on station that is a little less formal and we have a separate, more formal channel to keep high level stakeholders informed, engaged and fully informed of the science while work is in progress. This means we are juggling multiple channels, tools, and protocols between stakeholders, but keeping a clear channel of communication for mission specific operations that are time sensitive. Yes, it's a lot to manage but it's a reality of this environment. Plan for it. Don't fall back on your own preferences. Be explicit and proactive, ask people their preferences and prepare to adapt. There is nothing worse than finding out six months into a project that a key stakeholder

never looks at their email or all the work you've done setting an online content library is for naught as the online tool is inaccessible to the people who need it most.

It's also typical for senior team members to have standing meetings with more senior members of their implementation partners' team to discuss matters that aren't directly related to operations. Joint PR for upcoming events, supporting partner initiatives, joint fundraising efforts, support for upcoming events are part of the extra partner benefits you can leverage to advance your work. We have standing update meetings with our program managers, funders, and other stakeholders to inform, update, alert, educate, negotiate, and solicit support as appropriate. We build it into our timelines and work calendars. We also consider the audience when crafting messages, reports, presentations, and other communications as separate groups have different styles, vocabulary, and protocols. Watching your language choices as a payload in one context means something entirely different in another. Finally, remember space is a global community. Learn your time zones (which include calculating UTC offset times for various geographic regions), stay attuned to cultural nuances, and continue to educate yourself so you can become a skilled and respectful interstellar citizen.

As mentioned earlier, build in-person time into your plans whenever it is physically and cost-effectively feasible. Even as you develop your skills as an effective virtual professional, occasional face-to-face meeting, even quick visits, go a long way to cementing an already strong relationship. If you are heading to an event, off-site meeting, or even traveling on holiday, be strategic and deliberate. Set up time in advance that includes meals and other informal contact as well as formal meetings times to take care of business. Then be a generous host when someone comes to your area as well.

Team cohesion comes from positive partner accountability

For some of you, all this preliminary preparation we have suggested in the previous sections may seem like a lot of work. Admittedly, it takes diligence and effort on your part at a time when you have lots of things happening. It might be tempting to skip the steps we have discussed to this point. Resist this temptation. Complete your due diligence and set your ground rules in place. Invest the time. All this pre-planning, establishing expectations, completing due diligence, negotiating terms of engagement, etc. are going to pay you back many times over throughout the course of your space career. Eventually, this investment early on makes your life so much easier overall.

Partnerships with clear directives, a foundational understanding of share goals/objectives, an agreed upon operating process, and a communication framework that is defined from the beginning are better able to navigate misunderstanding, schedule changes, missed deadlines, missteps, stress, and other unexpected factors that will inevitably arise from time to time. Be assured, no one wants you to fail. Your success is in everyone's best interest as it advances the space economy for everyone. Achieving these positive results and good forward momentum takes active participation on your part. It doesn't happen on its own. You must deliberately and consciously work at it.

When your partnerships are sound and everyone is working cohesively towards the same shared goal, it's a beautiful thing. Teams that are coordinated get things done with less chaos, meet each day's challenges focused on identifying a solution, and have high levels of positive engagement. When partnerships are strained and trust is absent, it is a very different story. Dysfunctional teams find it hard to do clever work and achieve great outcomes. The level of effort it takes to get anything done is exponentially harder, much riskier, and more expensive. The likelihood of failure is compounded, team stress runs high. The more you

can do to establish team cohesion and encourage high levels of trust early on between team members the greater your chances of success.

Shared accountability is one key component to successful teamwork. For a mission to go well, lots of people must work in unison, meeting their responsibilities on time, and executing to agreed-upon standards. In crewed missions, this is crucial as astronauts' lives are at stake. Even resupply missions with no crew have serious ramifications if they fail. Holding yourself, your team, and your partners accountable is necessary when you engage in space flight as the consequences of failure are real. It's easier to gain commitment among the partners when expectations are defined early, and all parties agree to the terms. But even high functioning teams run into unexpected problems that can derail them if not addressed immediately. As a team leader, you must prepare to hold yourself and your partners accountable quickly, so issues are addressed early on while things are easily rectified.

Accountability seems like such a negative word for some as many people interpret accountability with conflict. Ironically, the preliminary work you do to create a working framework and defined expectations make it a lot easier to manage accountability in a healthy and professional way. If expectations are set and agreed to early, then accountability is built into the process. As part of our early contract negotiation and MOU discussions, we lay out the steps we expect the team to follow when expectations aren't met. We do this early on when everyone is on good terms and things are running smoothly. We take a similar approach to mission integration and operations where roles and responsibilities are critical across the expanded teams, and rapid adjustments need to be defined/implemented when expectations aren't met to ensure mission success.

At the first sign of concern, we role model the agreed upon steps and address the issue immediately, but professionally, to ensure all team members understand we are ready to live up to our agreement. Assume positive intent. Trust, but verify. Everyone makes mistakes. If the team learns from them and gets better over time, that's all that matters. But if there is a real issue, you want to catch it early. Fix the problem and move on. This includes acknowledging our own obligations and commitments and taking personal responsibility for our failures as well.

Our rules for addressing accountability:

- Establish expectations, roles, and responsibilities up front. Yes, they will change over time, but pick a starting point then negotiate along the way.
- Communicate them to all team members and reiterate them frequently.
- Teach junior team members how to speak up and address concerns professionally, then role model these expected behaviors through direct action. NOTE: This is particularly important in academic teams or technical teams that have innate power dynamics and hierarchical tendencies.
- Highlight concerns quickly and privately – seek out the senior point of contact first to raise the issue and gain understanding.
- Seek to understand and get the facts first before coming to a conclusion.
- Stay focused on the issue, avoid personalizing, address the behavior or action, not the person.
- Coach junior team members through the process and encourage them to resolve misunderstandings on their own when it's warranted so they learn how to do it themselves.
- Use the team meetings to remind the team of the shared objectives, upcoming deadlines, and the importance of asking for help as proactively as possible.
- Praise individuals and the group when issues they follow the process and issues resolve positively.

- When team stress and tension run high, work to de-escalate emotions, and keep the team focused on solving the problem rather than pointing fingers and blaming behavior.
- When an individual or a specific subset of the team continually misses deadlines, address the specifics immediately in a private conversation away from the full group.
- Focus on the agreed upon expectations, gather the facts, look for barriers to success, and prepare to extend the party the benefit of the doubt. We always believe in a team member's good intentions until proven otherwise.
- Is this a first strike or a recurring theme? Everyone makes mistakes. If the team learns from them and gets better over time, that's all that matters. But if the same people continue to make the same mistake repeatedly, look for the root cause of the failure and address it quickly.
- Identify barriers to execution, provide resources, and training as warranted, but prepare for more serious action as necessary, e.g., removing a team member for the project, withholding payment for contracted work, review of contract terms, etc.
- Fix the problem, learn the lesson, move forward – avoid holding grudges. Once an issue is successfully resolved let it go.
- Practice these steps so you master them, then role model them for the rest of your team. Be patient and coach individual team members as needed and be prepared to continue to uphold accountability on an ongoing basis to keep the team sharp.

Recovering successfully from a misstep or working together to overcome an unanticipated or unexpected challenge, strengthens a team and builds team trust overall as long as the focus stays on fixing the problem rather than laying blame. When feedback and open, transparent, respectful communication becomes the norm within your team, then personal accountability becomes part of the team culture. Strong individual accountability in a distributed team is particularly important as it's easy for misunderstandings to go unnoticed because team members are separated by distance. Team leaders need to stay vigilant for any hint of a problem and tackle it as quickly as possible before it starts to affect team trust. Missed deadlines are one obvious indicator, but team leaders need to also be attuned to changes in typical behavior. If something feels different, make a conscious effort to check it out. Follow up and verify within 24 hours before you get caught up in other things.

NOTE: When new people join your team, make sure to alert them to these expectations so there are no surprises. Don't assume the new person will understand what's required of them unless you explicitly tell them. No one can read your mind. Take the time to explain things outright.

Mission Activities

Keep in mind that the best way to build your standing as a credible commercial company utilizing space to achieve your business objectives is to make every mission count. This means building a strong, functional template for mission prep that emphasizes meaningful data collection that advances your business objectives with every flight, so you establish a solid professional reputation and achieve the commercial goals that have been set. Developing a comprehensive mission plan, utilizing all members of your mission team to their fullest (both your people and your partners), and developing your skills so your capabilities improve and expand with each mission and flight. Collaborate with your partners to help promote the mission and its larger picture objectives. Keep in mind the build out of a sustainable space economy is currently subsidized by both government and private sector funding. Getting the public and

the commercial Earth market excited about the possibilities of space activities helps build momentum and much needed support for ongoing funding.

Per usual, you will be very dependent on your implementation partner as you prep for your first flight. Push yourself and your immediate team members to ask questions, request explanations, and build your skills so your capacity to contribute and direct the action expands with each mission flight. Invest in the development of a document library to help you templatize the process, so every flight is building on the efforts of the previous flights. Not only will this help with post-flight analysis, but it will also provide a framework for more accurate resource allocation and budgeting over time. The more you standardize, the less disrupted the team will be when changes in the flight plan occur. Standardization also helps when new people join the team and with team accountability as it provides a frame of reference, processes, and procedures you can easily train or hold team members accountable day-to-day.

Unless you are working with secret technology that is in stealth mode, there are a lot of media opportunities before, during, and after a flight. If you are working with significant agencies like NASA, ISSNL, etc., leveraging their PR capabilities is a terrific opportunity for you to generate cost effective positive press for your venture and for generating visibility on the ongoing development of future applications that will shape the expanding space economy that is happening today. The same can be said for your implementation partner. They also have highly active media teams that feed information to the space media that often lands in the mainstream press. These opportunities are worth their weight in gold. Speak with your agency program managers, implementation partners, and other network contacts early on before each flight to identify ways you can a) support their PR efforts while also advancing your own and b) gain access to approved images, press releases, and other content generated by each flight so you have them on hand to include in scientific white papers or any media interviews you may get as a result of your ongoing space work.

NOTE: You need approval from agencies and other key partners BEFORE you can share images or content. Learn the process for gaining approval early on as gaining approval can take a little time.

Joint Intellectual Property (IP) Development

Joint IP can take lots of different forms. Any new device, material, process, protocol, therapeutic, etc. that is patentable or that can be produced and sold is a potential revenue source. If you negotiate well at the start of your space engagement and factor joint IP development into your agreements and MOUs, great! If not, open the discussion as quickly as possible BEFORE something gets invented. It's easier to broach this subject and have a rational discussion when everything is a concept, and the market value of an idea is low. Everything happening in space right now has potential. As soon as folks start pouring money and time into something, things change.

Even with an agreement in place, don't be surprised if there is a need to revisit it later if something in the technology doesn't go as planned and needs adjustment, or suddenly gets super successful. When that happens, the stakes are MUCH higher, and negotiations are much different. Protect yourself while recognizing that any development will come from collaborating with lots of other partners and/or stakeholders. You don't have to give away everything, but all parties feel much more motivated if they stand to gain something because of their efforts. It's also hard to build a real sense of team if everyone is so exclusively focused on their own gains that they fail to recognize the risks taken and contributions made by others. Not a great way to motivate others to work on your behalf.

And lastly, remember that just like with technologies developed here on Earth, sometimes trade secrets are every bit, if not more important, in creating value and market leadership. Patent filing and maintenance of applications is expense so ensure that you have also identified how you plan to pay for patent filing whether it is your own or developed jointly with a partner. Another advantage for small companies when negotiating an MOU upfront is the possibility of the larger commercial company providing funding for joint IP costs. When creating partnerships with implementation partners ensure that joint IP opportunities are clearly defined as well as who is responsible for the patent costs.

Expand your network and build relationships with other space partners along the way

When you first start your space journey, you are heavily reliant on your implementation partner's relationships with major stakeholders in the space community. This reliance is natural at first, but it won't serve you well over time. You need to develop a network of your own so you can elevate the visibility of your company and have opportunities to share your work progress. The space community is a small one. If you remain dependent on your partner to do all the networking, you will pay a heavy price over time. Expanding your network provides potential collaborators, funders, supporters, and even future employees. Invest in doing this early as it's always better to build a network before you need it. Invest time in seeking out conversations with a wide variety of folks as you never know what skills you may need in the future to advance your work.

This is a critical moment in history. Access to space is becoming more routine and there is large-scale investment in the development of the space economy, including low Earth orbit (LEO), future lunar and Mars colonization, asteroid mining, etc. Building a robust commercial space economy in LEO, not only maintains U.S. leadership in space as the ISS National Laboratory® is retired at the end of the decade and we transition to commercial space stations, but facilities the creation of future lunar space economy in high Earth orbit. With decreased launch costs, increased access, and a variety of commercial companies investing in infrastructure and applications we are at an inflection point for creating a robust commercial space economy in LEO. Be an active voice in the process and utilize your implementation partners to help elevate your company and your work. By joining coalitions working to advance areas of interest to you, you can learn more about the process and gain greater momentum as there is strength in numbers. You can accomplish this by attending major space events, participating in panel discussions, presenting technical papers related to your work, offering to participate in advocacy activities, and seeking media opportunities that highlight your space affiliations.

NOTE: We realize networking may be difficult for some, but this is a necessary skill for any commercial company leaders. Start small and keep at it. Eventually, you may find yourself enjoying it.

When Something Goes Wrong

Inevitably, things will go wrong. It is unavoidable. Control what you can control, build buffers into your plans. Seek help from your network early on, particularly for technical problems beyond your expertise. Alert your key stakeholders asap so they hear things from you and not from others. They may be able to make useful calls or suggestions on your behalf. Think through problems carefully as a group and be as thorough as possible but stay focused on finding the least disruptive solution to any challenge that arises rather than laying blame. Simple is always best. Keep a level head and your team on task, avoid pointing

fingers (save the debrief for after things calm down). Then learn from each mistake and elevate your skills and your team's skills so everyone gets better over time. Finally share your lessons learned as broadly as possible through publications, presentations, and talks at space industry events. The more knowledge we share with each other, the better.

Welcome to the future

Space is an incredibly rich and dynamic sector that stands at edge of an important historic inflection point. No one person will make it alone. The collaborative work and partnership investments that form today will have a direct impact on what is to come. We are building the future as you read this. Your skills, ideas, and talent are needed to make this grand vision a reality. Welcome to the future. Wishing you the best success in your space journey!