

## Appendix A: Early-on (People, Process, Technical) - consolidated 11, 12, 13

<b>Appendix A: Early-on (People, Process, Technical) - consolidated 11, 12, 13</b>					
<b>Tagline</b>	<b>Theme &amp; Tags</b>	<b>Presenter</b>	<b>Abstract</b>	<b>Find It Here</b>	<b>Index</b>
Recognize that architectural decisions have political consequences	System Architecture Analysis - Politics	Doug Stanley	It is a HQ function to have an ESAS-type team of experts that keep setting the agency's direction and program architecture, to get around the NASA centers' politics.	ESAS Video; Time marker: 11:00	11
Recognize and manage Center-Center politics / ensure program-level integration	System Architecture Analysis - Politics and Communication	Doug Stanley	In ESMD, center politics are getting in the way and they are not sharing data with each other. That is unacceptable. You need some top-down system that rewards people for cooperating and sharing data. This is a HQ function, maybe a Directorate Integration Office (DOI) function.	ESAS Video; Time marker: 35:30	11
Recognize and address Center-to-Center cultural and terminology differences	Ares 1-X Project Management - Teambuilding	Robert Ess	The hardest things was to take all these different people and all these different cultures, using all those words together and making sure we ended up on the same page. Do not underestimate the lingo that we use. I would suggest that we speak in examples so we talk about not terms and definitions and acronyms but actually go down two or three or four levels deeper than you think you need to at day one of the project.	Ares 1-X Lessons Learned: Clip: Culture Shock!	11

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Build relationships and trust right from the start on a multi-Center project team.	Ares 1-X Project Management - Teambuilding	Carol Scott	When you're bringing a team that comes together from multiple centers and multiple organizations you've got to start off with building relationships and trust. It takes a good year to eighteen months to get there.	Ares 1-X Clip: Culture Shock!!	11
Establish relationships upfront to enable information flow.	Ares 1-X Teambuilding	Jonathan Cruz	Communication was key. If there was important information that someone had that didn't get where it needed to, that impacted the striving schedule. So some face-to-face meetings, travel at least up front to meet the people, established a lot of those relationships where we were able to call up if you had a question or you had some information that you needed.	ARES 1-X Clip: Communicate, Communicate, Communicate!	11
Build relationships with face-to-face interaction opportunities	Ares 1-X Communication	Jim Bolton	Email is the illusion of inclusion. A mechanism to get people to talk, to really talk to each other, is important.	ARES 1-X Clip: Communicate, Communicate, Communicate!	11

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Get the right people "on the bus"	Ares 1-X Project Management - Organization	Marshall Smith	Get quality people and trust them, so you don't have to revisit their answers and look at yet another option. We're done. It's time to move on.	Ares 1-X Clip: Systems Engineering and Integration	11
Develop clearly defined training objectives up-front	Design / People / Training / Concept of Operations	Ginger Kerrick	For exploration, while it is a noble goal to have everything in place (the hardware, the software, the ops concepts) ready to go so that you can implement your training plan, in reality it is very difficult to achieve. So my advice to you would be to have very clearly defined training objectives and you may choose to meet those objectives differently for the first flight than you would once you have a better understanding of the operations and you're at a more mature level, but you need to make sure to understand the objectives up front.	ISS Video Dashboard Ginger Kerrick Clip 5, 1:17	11
Take your time to select the right people for the right task at the start	Personality dynamics Right skills for the job	Kathy Owen	Make sure you put the right people, with the right skills, and the right personality in the job, because even if they've got the right skills, and they don't have the right personality, it really can be a detriment.	11496 Integrated Vehicle Ground Vibration Testing last clip	11

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Involve hardware owners in the decision making process	Improved Communication, Problem solving	Alvaro Rodriguez	It is important to involve the hardware owners as part of the team structure. Having them involved in decision making decisions informed the team and helped to answer questions that came up quickly.	11934 - On-Orbit Reinforced Carbon-Carbon Repair - Organization and teamwork	11
Assume positive intent	People Success	Jonathan Krezel	Lesson number one is assume positive intent. Assume that everyone on that team, while their perspective may be different than yours, is ultimately committed to the success of the entire endeavor. When you're in a knock-down-drag-out fight with someone over an issue which you feel passionately about and which, obviously, this person on the other side of table feels passionately about its very easy to forget that they are as interested in success as you are. They just have a different take on success. You have to step back and really make a conscious effort to put yourself in their shoes. Assume positive intent.	Space Shuttle Transition and Retirement Lessons CLIP 8 Top Three Takeaways: Time Marker 5:03	11
Communicate with increased frequency the harder the project	People, Communication	Joel Kerns	We found it was really important in such a complex task that affected so many different organizations that we had to communicate frequently about what we knew and what we didn't know, day-to-day, week-to-week and month-to-month.	Space Shuttle Transition and Retirement Lessons Learned; Clip: Time Marker 1:30	11

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Silence the rumors	People, Communication	Joel Kerns	Go out as the leadership and brief people on what it is we knew, what we thought was going to happen, what decisions we thought were coming up, or even what we didn't know, that rumors and uncertainty would creep into everyone's activities and just cause a lot of disruption.	Time Marker: 1:55	11
Co-location is key to rapid development of system architecture	System Architecture Analysis - Project Management	Doug Stanley	Co-locate people if you want a group of people to accomplish something in a short time period.	ESAS Knowledge Nuggets ESAS Video; Time marker: 0:10	12
Use an integrated risk management approach in assessing architectural options	System Architecture Analysis - Risk Management	Joe Fragola	You need an integrated risk management and mitigation approach, so that risk reduction in one segment doesn't increase the risk elsewhere and possibly to the overall architecture risk. Don't have pockets of risk mitigation in isolation. An integrated approach, using one tool with risk, cost and performance included is important.	ESAS Video; Time marker: 4:00	12

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Document and communicate assumptions embedded in trade analyses	System Architecture Analysis - Modeling and Analysis	Doug Stanley	Document your assumptions, so that you can do proper analysis and trade studies.	ESAS Video; Time marker: 5:00	12
Focus on managing the details of the program execution	System Architecture Analysis - Project Management	Bill Blaybaugh	Is well-organized system engineering needed? Anything (i.e. any management/process approach) can be made to work. The details are in the execution, not in the theory of management.	ESAS Video; Time marker: 12:00	12
Maintain a top-level, integrated understanding of risk	System Architecture Analysis - Risk Management	Joe Fragola	Program managers should have a version of this integrated tool that integrates risks, costs and performance, to keep the engineers honest, since they may be driven by local optimization without considering global optimization.	ESAS Video; Time marker: 19:15	12

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Establish a baseline and track multiple performance metrics	System Architecture Analysis	Jay Falker	Use the technique of having multiple performance metrics to make decisions. EMSD should establish a baseline and then fully understand the impact any change has across all elements and aspects (cost, schedule, risk, performance).	ESAS Video; Time marker: 21:45	12
When necessary employ engineering judgment - informed intuition in considering options	System Architecture Analysis - Decision Making	Doug Stanley	Work with good models but also with informed intuition based on experience, since in space exploration we don't have vast amounts of empirical data. We need intelligent drivers/architects using these tools.	ESAS Video; Time marker: 26:45	12
Video-capture critical "know-how"	System Architecture Analysis - Knowledge Capture	Bill Claybaugh	Rockedyne recorded the know-how about the Saturn 5 by video-taping every single person who had worked on the F1 engine, talking about every detail of what they did. The know-how had all been documented and was available. And that is how you do it.	ESAS Video; Time marker: 31:00	12

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Articulate expectations - Orient partner organizations	Ares 1-X Project Management - Teambuilding	Jonathan Cruz	There was some culture shock once we arrived at Kennedy. It had been anticipated and they had actually held Kennedy 101 classes to try to educate other centers on what to expect	Ares 1-X Clip: Culture Shock!!	12
Develop a Program culture that transcends Center-to-Center cultural differences	Ares 1-X Project Management - Teambuilding	Marshall Smith	A center-focused mindset needs to be shed, and you're going to have to come with a system mindset, a system set of organizational goals and standards that you're going to follow as a system, regardless sometimes of your center's wants and needs.	Ares 1-X Clip: Culture Shock!!	12
Clearly define roles and responsibilities and interface details between project phases	Ares 1-X Project Management - Articulating Roles & Responsibilities	Trip Healey	There are differing level of assumptions when determining roles and responsibilities once the hardware actually arrived at the launch site at Kennedy. Design engineers wanted to be involved all the way to the end, but the launch site folks were operating in a culture in which hardware is turned over to them. And there was a level of disconnect between the drawings and the task of assembly.	Ares 1-X Culture Shock!	12

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Early in the project engage technical authorities at HQ and Centers and establish mutual expectations	Ares 1-X Working with Technical Authorities	Jon Cowart	The core team gets that better is the enemy the good enough, but the people back at the centers who aren't involved with us day to day, they're very worried, they see us, in their opinion, short-circuiting process and not following all the guidelines and all the standards and requirements.	Ares 1-X Clip: Better is the Enemy of Good Enough	12
Co-locate key people at the start of a project	Ares 1-X Project management - Co-location	Robert Ess	Co-locating some key people up front during the project formulation phase for 3 weeks to 2 months would have been good.	Ares 1-X Clip: The Importance of Co-location	12
Recognize communication challenges early-on and implement robust processes to address	Ares 1-X Communication	Ed Mango	Start early, get the team down, understand the issues with the team, understand how the team communicates and treat it like a team, not as a number of individuals. Badge-less is definitely the way to go.	ARES 1-X Clip: Communicate, Communicate, Communicate!	12

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Avoid surprises by effectively coordinating and communicating ahead of time	Ares 1-X Communication	Bruce Askins	Communication was the key so when we came up on our major reviews there were very few surprises. It was not like you were overturning rocks at the meetings.	ARES 1-X: Clip: Communicate, Communicate, Communicate!!	12
Develop, document, and communicate the project governance model	Ares 1-X Project Governance	Robert Ess	We at NASA tend to delegate responsibility and retain authority. I was delegated both. This worked well. People are smart and will figure out who the real decision maker is, and they'll concentrate their energies there. We relied on the NASA governance model (technical authority appeal route), which helped.	ARES 1-X Clip: Communicate, Communicate, Communicate!!	12
Establish S&MA requirements up-front	Ares 1-X SMA Technical Authority	Robert Ess	We were late getting the S&MA requirements for this flight test. People used 2 approaches: take the Shuttle requirements and cross off what doesn't apply, or start with a clean sheet and define what is needed. We spent days trying to marry those two approaches.	Ares 1-X Clip They are Guidelines, not Requirements	12

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Establish a clear, streamlined project governance board structure	Ares 1-X Preoject Governance	Chris Calfee	The systems requirements were controlled by the MMO but so was the next level of documents, the elements requirements documents. These latter documents were also contractually controlled documents so two boards were controlling this 2nd set of documents. Avoid that.	Ares 1-X Clip They are Guidelines, not Requirements	12
Start project elements on time, even if it is not perfect. Start finding problems early on	Ares 1-X Schedule-driven, risk informed Project Management	Robert Ess	Start when you have to start, schedule-wise, even if it is not perfect. Don't worry about it. The 80% solution is good enough. That way you will find your problems early and stay on track.	Ares 1-X Clip: Schedule Management	12
Consider advantages of a flat organizational structure	Ares 1-X Project Management - Organization	Robert Ess	Our organizational structure was as flat as you possibly could draw it. It made the lines of communication very clear. There was one control board. By structuring this way, our efficiency of communication, which is key to any project management, increased dramatically.	Ares 1-X Clip: Organizational Structure	12

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<p>Delegate budget and schedule authority to lower-level project teams</p>	<p>Ares 1-X Project Management - Organization</p>	<p>Jeff Campbell</p>	<p>Each IPT had their own budget and schedule authority, and that seemed to make things run smoothly.</p>	<p>Ares 1-X Clip: Organizational Structure</p>	<p>12</p>
<p>Apply the Agency governance model with programmatic, technical and S&amp;MA authority.</p>	<p>Ares 1-X Project Governance</p>	<p>Dan Mullane</p>	<p>The Mission Manager embraced the NASA governance model with a three-legged stool of authority: programmatic, technical and S&amp;MA. All three authorities were part of all decisions.</p>	<p>Ares 1-X Clip: Safety and Mission Assurance</p>	<p>12</p>
<p>Recognize that hybrid, "one-shot" test projects may not need standardized rules</p>	<p>Ares 1-X Project Management - Requirements Management</p>	<p>Dan Mullane</p>	<p>Since ARES 1-X was a one-shot un-crewed flight, we made the maximum use of existing processes, allowing for maximum flexibility versus standardization between project segments. This puts the burden on the folks that had to do the integration function, but I think it was the right approach.</p>	<p>Ares 1-X Clip: Safety and Mission Assurance</p>	<p>12</p>

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Finalize SMA requirements before awarding any contracts	Ares 1-X Safety and Risk Management	Dan Mullane	Do not award contracts before you have the right set of S&MA requirements. This was an afterthought in ARES 1-X.	Ares 1-X Clip: Safety and Mission Assurance	12
Tailor 7120 to your project needs and make sure senior management supports it	Ares 1-X Project Management - Requirements Management	Marshall Smith	Some people think that 7120 is something that actually holds you down, but it is extremely tailorable and people need to do that. Senior management needs to let go of their favorite requirement when it is not related to the mission goal. So, tailoring is a big thing that needs to be recognized and needs to be used and allowed to be used.	Ares 1-X Clip: Systems Engineering and Integration	12
Define clear organizational interfaces, roles and responsibilities up-front	Ares 1-X Project Management - Organization	Dan Dumbacher	When you're setting up a major project like this, spend a significant time up front on what the interfaces are, what the management scheme is, and what those relationships need to be. Minimize the interfaces, make sure that the management scheme and operation is clearly understood by everyone before you get too far down the road, and change the management scheme throughout the project life cycle, as needed.	Ares 1-X Clip: Senior Leadership Part Two	12

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Seek ways to innovate in how we accomplish space missions while managing risk	Ares 1-X	Dan Dumbacher	Most of our work force has been hired since Challenger and Columbia when, from a human space flight perspective, we got much more risk adverse. We have to help bring them along from that risk adverse posture into a posture that's willing to take a little bit more risk. We'll make some mistakes along the way, but I think we can find ways to operate more efficiently and ARES I-X gives us that big key data point to start the conversation.	Ares 1-X Clip:: Senior Leadership Part Two	12
Consider how Ares I-X lessons learned - and the culture battles - may be a precursor for the culture changes necessary to embrace commercial space	Ares 1-X Project Management - Oversight and Commercial Space	Dan Dumbacher	We can apply Ares I-X even to the commercial crew and commercial cargo operations. I think the culture question is the key in my mind and I'm honestly worried that we're not spending enough time really working through the culture of what needs to be done and what does not need to be done.	Ares 1-X Clip: Senior Leadership Part Two	12
Evaluate the applicability of ARES I-X streamlining and management approaches	Ares 1-X Project Management - Oversight and Commercial Space	Doug Cooke	ARES 1-X helps us to understand where we can streamline activities without sacrificing success.	Ares 1-X Clip: Senior Leadership Part Three	12

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Consider how ARES 1-X lessons learned with limited management insight and oversight informs commercial space oversight activities	Ares 1-X Project Management - Oversight and Commercial Space	Doug Cooke	For the commercial cargo and crew plans, we can't be over intrusive into the process or the cost will blow up on us. We can apply ARES 1-X lessons learned in limited management insight and oversight, and in streamlining.	Ares 1-X Clip: Senior Leadership Part Three	12
Have a discussion up-front with all stakeholders to baseline the risk management and technical authority oversight approach	Ares 1-X Project Management - Oversight and Commercial Space	Doug Cooke	If we're satisfied with less insight or oversight for commercial entities, then you have to ask yourself why isn't that good enough for the government developed vehicle. That's a big area of discussion. We have to have good models for implementing this. We have to concentrate on the high risk areas only, stop asking the "what if" questions as engineers, have management discipline, and education for everyone on the new way of operating. This is a culture change.	Ares 1-X Clip: Senior Leadership Part Three	12
Ensure that adequate staffing is in	Organizational Priority	Chris Calfee	DART was proposed as low risk—I'm sorry—high risk, low cost project, so that theme was carried over to the government side as well. So we started. I had no business office. I had no business manager. I had some support but no dedication there. No schedule, scheduler; I had schedule support, but not day-to-day.	Demonstration of Autonomous Rendezvous Technology (DART) Video Case Study: Page 8. Time: 3:31 Dart Overview	12

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Ensure balance between risk acceptance, staffing and budget.	Systems architecture	Mark Krome	MSFC, being a manned space flight center we have a high emphasis on reliability, on safety, on system redundancy and an important aspect of that is to verify that you've met system requirements. On DART, however, there were some initial differences in terms of the project expectations for how this would be done, among the things that would make it a high risk project, were the fact that it was to be largely single string, it was to be low cost.	DART Video Case Study: Page 21, Section: Risk Posture and Verification P2 Time 0:27	12
Drive to closure	Retiring tasks early buy schedule		You need to drive things to closure faster and that will pay off later. You need that time. And I learned that in this mission and there were people already on the mission who knew this—I had people pressuring me that we need to close this trade	KBR -11397 Project Lessons Learned	12
Expand QD limitations with a maximum credible event approach	Hazardous material storage, Overcoming manufacturing limitations and logistics issues	Steve Stover	Limitations of the VAB regarding the amount of allowed hazardous materials and the associated quantitative distance limitations were going to cause assembly and scheduling issues for programs after the shuttle. Using an approach previously developed by the DoD called Maximum Credible Event (MCE), a revised hazardous materials limit was determined for the VAB that could accommodate requirements for future launch vehicles.	2589 Quantity Distance Limitations	12

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Identify long lead items early, including supporting test and launch hardware	Long lead materials Scheduling	Larry Schultz	It is critical for the program to identify all the long lead items early. In this case umbilical plate assemblies were not acquired early enough in the program to support the test and integration schedules. Each team needs to be able to raise awareness within the program of their long lead items early on. Had the issues been raised early the funding would have been available and the time to negotiate acceptable delivery dates for the hardware would have been adequate.	4133 Umbilical Plate Assembly Deliveries	12
Characterize testing facilities and plan with them ahead of time	Planning Test environments	Alvaro Rodriguez	Too often during the project we would run into scheduling, cost, or technical issues with a facility and then have to redirect our focus to another facility. If we had fully characterized our environments and defined our testing needs early many of these challenges would have been reduced or eliminated.	11934 – on orbit RCC repair – Verification planning: facilities	12
Set realistic schedules	Schedule, requirements determination, program set up	Mike Fowler	Instead of putting a more realistic schedule for the first return to flight, we were always pushing the flight back about three months from the previous date. So every time that it got pushed back three months, we were back in that same situation of still not being able to change the hardware, still not being able to change the material, and it was just an endless loop of not being able to change anything and being stuck with a design that really didn't make sense from the initial	KBR 11938 Clip: Context; Lessons Learned -Schedule - Time marker: 0:00	12

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			requirements that were setup.		
Codify your WBS early	WBS Process	Karen Lucht	So I would say early on understanding and codifying that WBS, whatever the architecture is you decide to use, by codifying that early, using that again, that starts to establish how you manage and report expectations to stakeholders, and then it allows you to help manage what they want later in terms of information, level of detail. By having that established early, you can use it as always again reiterating this is the level of detail we have, we established it earlier so we were able to leverage that and keep that consistency all the way through the closeout of the program.	Space Shuttle Transition and Retirement Lessons CLIP 9 Top Three Lessons Learned : Time Marker 0:46	12

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Define your own playbook	Process Program Plan	Karen Lucht	<p>So, in lieu of a playbook, develop your own playbook. Understand, again, once you know the scope, let's talk about what we have to accomplish, the timeline we have to accomplish it in, and let's develop the plays in order to get there, recognizing that it's adaptable as you go through there. So, you can't wait. That decision paralysis of waiting for decisions to be made, the playbook will enable you to actually move, make progress, good timely progress, and then adapt it as you go.</p>	<p>Space Shuttle Transition and Retirement Lessons CLIP 9 Top Three Lessons Learned : Time Marker 2:32</p>	12
Structure your risk program to your needs	Risk Management Structure	Jonathan Krezel	<p>The challenge with a risk management system is how far do you take it? You always need one. It's simply a matter of the details of what kind you want to set up. So I think in guess the lesson learned, my take away from that, is acknowledge that you should handle risks whenever you start a new activity like retirement and give some thought as to what that risk management system should look like for you. The answer is you need some sort of system to manage risks. The issue is just what kind of details you're going to use to set it up, but make sure you think deeply about it.</p>	<p>Space Shuttle Transition and Retirement Lessons CLIP 6 Top Transition and Retirement Risks: Time Marker 3:13</p>	12

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Develop capability to do apple-to-apple trade studies	System Architecture Analysis - Trade Studies	Doug Stanley	Have integrated analysis capabilities with apples-to-apples comparison, using the best methods available.	ESAS Video; Time marker: 1:30	13
Use simple over complex tools in system architecture development	System Architecture Analysis - Modeling and Analysis	ESAS Team	I rather have simple tools that everyone knows how to use, than complex tools and nobody knowing how inputs turn into outputs. I rather have a simple model now that gives me some type of top-down understanding of the overall system behavior, than spend two years developing a integrated platform, web-based, etc., and then be two years too late finding out what I needed to know.	ESAS Video; Time marker: 12:30	13
Use architecture-level risk modeling tools	System Architecture Analysis - Risk Management	Joe Fragola	The risks in the ESAS report are not real risks but coherent sets that allow us to discriminate between designs. We build the risk analysis modeling tool over time, module by module, as funds were available, based on the 1995 Shuttle PRA. If we would not have had this tool, we would not have been able to do this study.	ESAS Video; Time marker: 16:00	13

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Understand and communicated constraints imposed on the architecture	System Architecture Analysis - Constraint Requirements	Doug Stanley	We cut the new technology budget in half because the administrator wants to accelerate the CEV program and he likes the proven and the Keep It Simple Stupid (KISS) approach.	ESAS Video; Time marker: 20:15	13
A perfect model is the enemy of a good enough model	System Architecture Analysis - Modeling	Joe Fragola	The perfect is the worst enemy of the good-enough. ESAS was successful because we were willing to use models that were not perfect in giving us THE risks. They gave us enough discrimination between options to make decisions. Deep simulation models are not needed at this stage.	ESAS Video; Time marker: 23:15	13
Understand acceptable uncertainty in modeling	System Architecture Analysis - Modeling	Joe Fragola	There always is some uncertainty. We use the concept of Expected Value of Perfect Information, i.e. if you reduce the uncertainty, would it change your decision? In many cases it doesn't, so the investment is not useful. Let's not strive for better models just for the sake of having better models. The type of model you need to discriminate is different from the type of model you need for an actual design.	ESAS Video; Time marker: 24:00	13

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Pay attention to infrastructure required to support architecture	System Architecture Analysis - Infrastructure and Facilities	Bill Claybaugh	Give attention to infrastructure. Every building comes with people in it, and fixed overhead costs. You have to knock down buildings in order to have lower infrastructure costs.	ESAS Video; Time marker: 28:30	13
Develop a clear strategy for technology development and technology incorporation within each architectural option	System Architecture Analysis - Technology Management	Jay Falker	There is an issue in NASA of how to deal with technology, because there are two cultures. We have development & flight, and we have research & technology. There is mistrust and there are some barriers that need to be broken down. There are two kinds of research projects. One is on the critical path, and others are looking further out. We need communications on which type you are.	ESAS Video; Time marker: 32:00	13
Establish the acceptable level of mission risk up front.	Ares 1-X Risk Management	Stephan Davis	If you're going to do a flight test program, understand up front what the level of risk is that you're willing to accept in the mission. For example, would an 80% probability of meeting a mission objective be OK?	Ares 1-X Clip: Plan Then Do	13

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Define and communicate success criteria up-front to all stakeholders	Ares 1-X Project Management - Requirements - Success Criteria	Dan Dumbacher	We had to work through a culture change to define what success is for a development flight test. Initially there were many different views on the definition of success.	Ares 1-X Clip: Senior Leadership Part Two	13
Carefully consider redundancy, cross-strapping, and component reliability in deep space mission design	On-orbit mated interfaces and required EVA support	Gregg Baumer	That's one of the things that I think I've learned most about the Russians and the Russians' approach to hardware: we do a lot by analysis - they do a lot by test, mostly by test. They have redundancies. In one particular case, we were looking at a system and they only had an A Side and a B Side to do a particular function, and we said 'No, if this function is lost, it's catastrophic to this Station.' This was on their propulsion system. They said 'That's not an issue because the A Side is really single-failure tolerant and the B Side is single-failure tolerant; and not only that, the individual components within that ORU [Orbital Replaceable Unit] are cross-strapped; actually, we could probably withstand about seven failures on the A Side and about seven different failures on the B Side and still be fully functional.' Redundancy, cross-strapping, and reliability [are some things] that have to be stressed in a long-term vehicle that's interplanetary. That's beyond the two-failure tolerance requirements that we levied for ISS [International Space Station]	KBR 2650 Failures of On-Orbit Mated Interfaces last clip	13

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			safety - because there, they're not going to have the luxury of bringing up spares and fixing something, it's going to have to work and have to continue to work.		
Start early to develop test data and models to support design activities.	Composite Overwrap Pressure Vessels (COPVs) in service now (SSP, ISS, spacecraft, EELVs) and will be used in future space systems (CxP, Lunar)	Multiple Subject Matter Experts	The most important thing that we have learned from this test, analysis and risk assessment program is to generate your data set and your models early in the planning phase for risk assessment. We have really been challenged in this program because we are developing our models for risk assessment after the programs have already selected vessels and are already buying components. It has been very difficult for us provide decision makers an accurate assessment of what the risks are.	KBR 7084 Last Clip : Lessons Learned	13
Set a baseline of mission objectives	Defining spacecraft objections	Chris Calfee	One of the other issues early-on as proposed was really a limited set of mission objectives. We were trying to accomplish in the 'prox ops' phase—in other words, as the DART spacecraft approached the target—what kind of operations were we going to demonstrate?	DART Video Case Study:	13

**Appendix A: Early-on (People, Process, Technical) - consolidated 11, 12, 13**

Tagline	Theme & Tags	Presenter	Abstract	Find It Here	Index
Implement logistics, maintenance, reliability trades up-front	Design / Logistics / Reliability	Anthony Butina	We really didn't come on board until the CD phase. By that time, the design had solidified enough that any ability to influence it for maintenance and for repair was gone... you need to be up there early in the program and considered from the first time a piece of paper hits a pencil ... it takes that engineer to have that in the back of his head as he designs it so that we can get to these things and get them repaired as fast as we can	ISS Video Dashboard Anthony Butina Clip 1	13
Prioritize!	People, Communication	Jonathan Krezel	The great thing about priorities is, even if you're last on the priority list, it's better to know that you're at the bottom than to have any ambiguity about where you stand.	Space Shuttle Transition and Retirement Lessons Clip: 2 Start Up Transients: Time Marker 5:23	13