Spring Shortfall Ranking Process Lessons Learned

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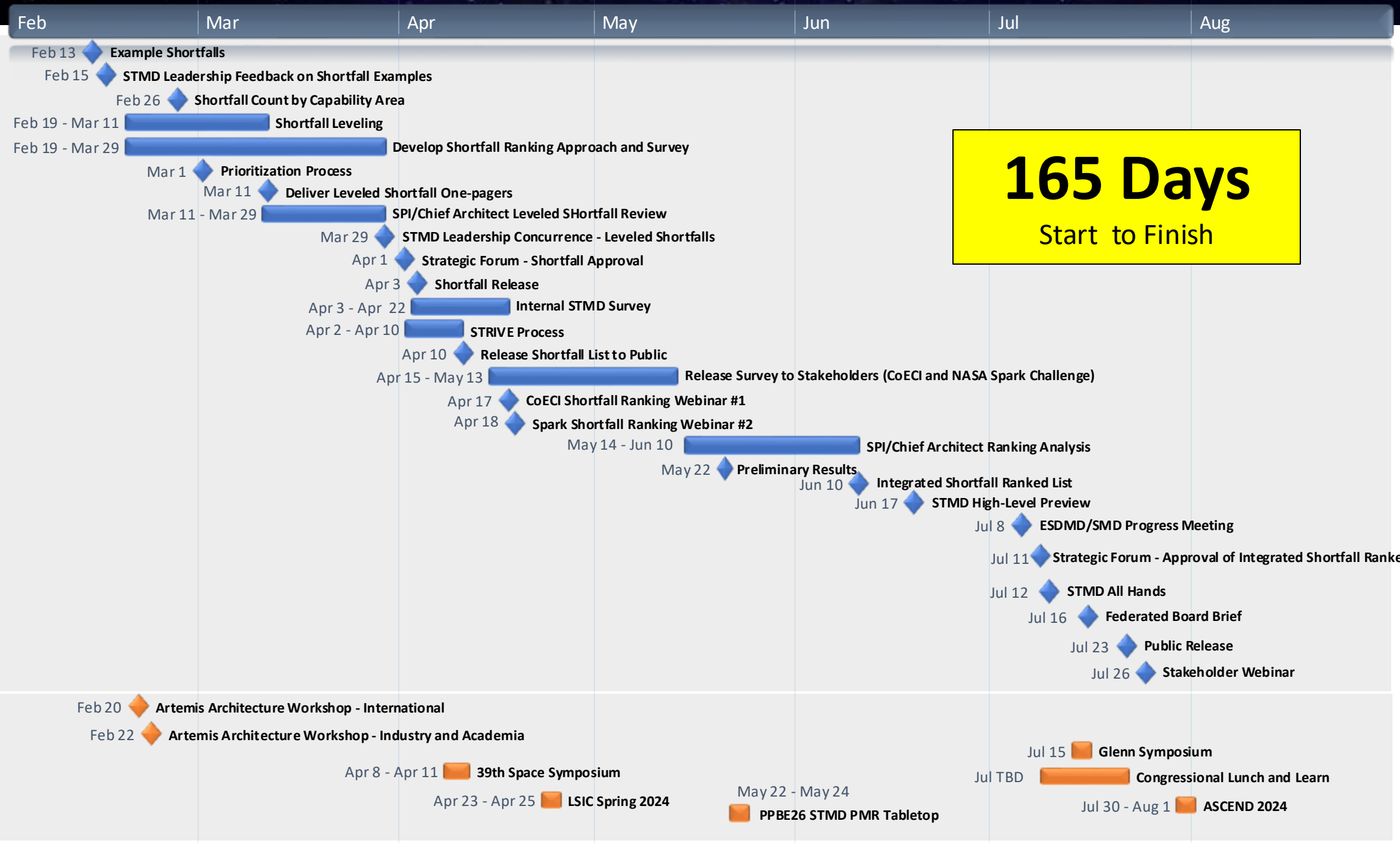
Shortfall Ranking Schedule

2024



165 Days

Start to Finish

In school, you're taught a lesson and then given a test. In life, you're given a test that teaches you a lesson.

- Tom Bodett Radio Personality on NPR

Positives

- Team mobilized swiftly to:
  - Generate 187 shortfalls summarizing the previous 800+ gaps
  - Survey development, execution, and data analysis accomplished per highly accelerated schedule plan
    - Required much parallel work rather than an ideal step-by-step process
- Engaged a broad swath of the community
  - 1,231 responses!!!
- Mostly transparent process - great communication internally of process as defined
- Produced quantitative data to help with decision making
- Excellent communication strategy for webinar and rollout – clockwork

Delivered the Inaugural Civil Space Ranked Shortfall List

Lessons-Learned Listing

Lessons Learned

1. Level set shortfall construct and provide context
2. Use a shortfall Identifier to allow for easy capability area reference
3. Standardize survey construct
4. Revise data analysis methodology to be applied consistently across stakeholders
5. Determine analytical approach prior to analysis tool development
6. Provide more structure for open-ended comments
7. Revise international respondent approach
8. Vet survey respondents

Sampling of Open Comments Recommendations

Top Lessons Learned

Lesson Learned #1: Level set shortfall construct and provide context

- Limit shortfall definition to problem space only. Lower levels can capture the possible solution space which should be detailed in the roadmaps.
  - e.g. Rotating Detonation Rocket Engine (167), Additive Manufacturing for Propulsion (163), Cross-Discipline Cryogenic Fluid Management Technologies (164) are potential solutions to the problem, *Increase Payload Mass Capability* (with children related to reducing engine mass, reducing propellant system mass, etc.)
  - e.g. Solar Sails for Propellant-less Propulsion (113) is a potential solution to the problem, *Increase Earth Warning Time for Adverse Space Weather Events*
- Restructure/combine shortfalls to portray more holistic definition of the problem space
  - e.g. Radiation Countermeasures (15), Radiation Monitoring and Modeling (16), Crew Medical Care for Mars and Sustained Lunar (30), Situational Awareness Sensors and Tools for Astronauts (59), and Crew Health Countermeasures (91), could be restructured to include, *Protect Crew from Over-Exposure to Radiation* (with children related to monitoring, measuring, tracking, forecasting, countermeasures, and treatment)
  - e.g. Power and Data Transfer in Dusty Environments (34), Passive Dust Mitigation (47), Active Dust Mitigation (56), Advanced Modeling and Test Capabilities to Characterize Dust (63), Robotic Actuation… Extreme Environment Operation (5), Extreme Environment Avionics (6), Robotic Mobility… Harsh Environmental Conditions (75), Long-life thermal control… extreme access (97) could be restructured to be captured within *Survive and Operate through the Lunar Night (1)* and including *Increase Life of Hardware Operating in Dust*
- Assign a single person the responsibility of coordinating the definitions of shortfalls from a holistic perspective, with significant input from relevant PTs/SCLs
- Work with ESDMD and SMD counterparts to ensure 1-to-1 mapping for consistency and clarity.

Lesson Learned #2: Use a shortfall Identifier to allow for easy capability area reference

- Use category names in the gap numbers, e.g. ISAM-708 not just “708”.

Top Lessons Learned

Lesson Learned #3: Standardize Survey Construct

- Have one survey for both internal and external stakeholders.
  - If there must be separate surveys, then maintain the same format in both.
    - Maintain the shortfalls in the same sequence, with the same titles/numbers.
    - Have the same instructions for all surveys.
- Research best practice methodologies for surveys to determine optimal scoring scale for next survey.
- Evaluate best practice methodologies for very large surveys, such as randomizing the order, etc.
- Design survey to collect ALL data that will be used in analysis.
  - For example, a pull down for organization size.

Lesson Learned #4: Revise data analysis methodology to be applied consistently across stakeholders

- Keep the data call the same – all questions to stakeholders need to be the same.
- If rankings from key stakeholder groups are desired, treat this as a separate, complimentary exercise.
  - Used to inform decisions in addition to the “pure” survey results and other factors.
- Reconsider collecting consolidated responses.
- Communicate stakeholder weightings with the survey release.

Other Lessons Learned

Lesson Learned #5: Determine analytical approach prior to analysis tool development

- Obtain customer feedback on tool development early and often to ensure tool is addressing analysis approach.
- Build a tested and validated analysis tool before the survey is released.
  - Define rollup process before tool development.
  - Create the list of all the outputs at the beginning, so we can design a tool to efficiently create them.
  - Define stakeholder groups prior to tool design.
- Keep this tool as static as possible, and configuration controlled.
- Avoid having a single point of contact for using, debugging, and (if necessary) modifying the tool.

Lesson Learned #6: Provide more structure for open-ended comments

- Provide a comment box at the end of each capability area (and organize shortfalls by capability area).
- Open ended comments….limit character count. Have one question at the end rather than three.
- If you have open comments, provide a specific form to enter data. Example, Missing shortfalls? Yes…and give a list or fixed options to choose. (drop down matrix with choices).

Other Lessons Learned

Lesson Learned #7: Revise international respondent approach

- Determine acceptability of international submittals
- Determine what international entities will be accepted – for example, an international company can have a US subsidiary. Do you allow the subsidiary but not the parent company?
    - And if so, determine how to flag internationals.

Lesson Learned #8: Vet survey respondents

- Screen for non-relevant stakeholders and apply a lower weighting to their score (labor intensive)
- Maintain cognizance of this and other similar impacts to rank when considering future investments (undocumented)

Open Comments Lessons Learned - Sampling

Prioritization Approach:

- **Industry events should be organized by category of technology** and the NASA SMEs should run the meetings.
- Subjective scoring of shortfalls will not provide sufficient insight to adequately understand the priority in a complex system. Dividing into **urgency, criticality, breadth of applicability,** etc., would provide better insight, and would combine subjective and objective metrics together.

Shortfall Construct and Context:

- I think that it would be better to look at these shortfalls in terms of **use cases/missions**, describing examples of ideal missions and pointing out which parts of those missions are currently impossible or too difficult.
- Identifying the **end-state objectives**, whether Moon-2-Mars or otherwise, would increase the ability to normalize the assessment of importance.
- **Shortfall descriptions** would have benefited from being edited to make them all more **similar in structure**, using more bullets and answering similar questions about each shortfall. For example, each description could address for each shortfall 1) who are the stakeholders, 2) what technology-applicable benefit could it provide, and 3) is it near-term, mid-term, or long-term in applicability and benefit.
- **Temporal:** I would like to refine the questions asked...Not "what is the level of importance to NASA", but rather "Are these technologies important to NASA in **the near-, medium-, and long-term**?" and "How long is the development expected to take?“
- Use the **NASA Tech Taxonomy**, rather than introducing another new strategic product that must be maintained.

Survey Tool:

- A **down-loadable Word table or Excel spreadsheet** would be useful for off-line group discussions or company aggregation of individual inputs.
- Suggest adding a **search function**, where a reviewer can go directly to the shortfall item of interest.
- Having to **crosswalk between the description in the slides and the survey** was harder than expected. I think the titles will need to be more descriptive or there will need to be a sentence or two description of each shortfall in the survey here (or both).
- Consider **making raw data gathered available to the participants** so the interested parties get an understanding of the vast interests of the stakeholders who contributed. Further transparency on how the data will be processed and collapsed down would also be beneficial.

Summary

- The survey achieved its intended goal
  - Developed an inaugural ranked list of shortfalls to help inform and guide investment decisions
  - Engaged the community
- Great effort by all involved
- Learned many lessons that will turn into future “positives”