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QUANTIFYING ‘GUT FEEL’ A DECISION-SCIENCE APPROACH TO ASSESSING UK SPACE CAPABILITIES

**THOMAS HUDSON AND
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INTRODUCTION

How do you turn ‘gut feel’ into evidence to support decisions in a sector as complex as space? Decisions in this domain carry enormous weight. They influence national security, technological innovation, and economic growth. For the UK, space is far more than satellites: it underpins services that, in 2022/23, supported industrial activity worth 18% of UK GDP (£454 billion) [1]. Yet, because

boundaries blur across industries and technologies, space policy often involves navigating uncertainty where expert views play a critical role. This is where collaboration becomes critical, specifically bringing diverse perspectives together to shape evidence-based decisions. To help realise the ambitions of the National Space Strategy [2], the Space Partnership was established in 2023, bringing together industry, academia,



and government around shared priorities to accelerate progress.

When decisions rely solely on expert instinct, they can be hard to justify or compare.

BACKGROUND: THE CHALLENGE

The Department for Science, Innovation and Technology (DSIT) oversees space policy. Policymaking in space faces distinct challenges: unclear sector boundaries, outdated industry classifications, and limited data for strategic planning (especially in emerging markets). When decisions rely solely on expert instinct, they can be hard to justify or compare. Other innovation-intensive sectors – such as quantum and artificial intelligence, also overseen by DSIT – face similar challenges.

To understand the UK space sector's collective view for the outlook for different space capabilities, in 2023 the

Space Partnership brought together representatives from across industry, academia and the public sector. In total, 235 representatives from 110 organisations produced 22 capability roadmaps.

These co-designed roadmaps provide a useful input to inform developing government policy on capabilities. For example, they were one of the many inputs to the 2024 Space Industrial Plan [3], building on the National Space Strategy (published in 2021).

Each Space Partnership roadmap is short (2 pages), so they are necessarily top level. As a result, it is not possible to directly quantify benefits and feasibility of each one. However, the UK space sector holds deep expertise that can provide informed views on each of these measures. To turn this 'gut feel' into something that can be tested, shared, and examined alongside more robust evidence, the Space

Partnership opted to use a Decision Conferencing process.

WHY DECISION CONFERENCING (MCDA)?

When faced with complex choices and limited data, traditional decision-making can lean heavily on instinct. In the UK space sector, that instinct reflects deep expertise, which is often hard to capture, share, or test. Decision Conferencing, which consists of facilitated workshops underpinned by Multi-Criteria Decision Analysis (MCDA), offers a structured way to do just that. By scoring options against agreed criteria, participants' intuitive judgements become structured, comparable evidence. MCDA is a trusted government method for tackling complex choices when evidence is scarce and opinions differ.

The HM Treasury Green Book [4] outlines how government can use

structured, transparent methods – such as MCDA – to compare options and make evidence-informed judgements. While this project was not an investment appraisal, the Green Book provides useful principles for handling uncertainty and systematically assessing expert views.

this approach offered a systematic way to examine each capability roadmap

The benefits of this method include capturing multiple viewpoints without forcing consensus. It also provides a practical, repeatable way to frame conversations around complex choices in an inclusive, rigorous setting. Rather than making final decisions, the aim is to develop a shared understanding and common sense of purpose [5]. By scoring options against agreed benefit and deliverability criteria, participants can visualise trade-offs and explore assumptions openly. This transforms ‘gut feel’ into a transparent evidence base, helping stakeholders see where views align and where they differ.

For the Space Partnership, this approach offered a systematic way to

examine each capability roadmap, ensuring dialogue was grounded in shared understanding and supported by structured analysis.

METHOD: RUNNING THE DECISION CONFERENCES

To explore future capability plans in a structured way, the Space Partnership commissioned Space4Sight to design and facilitate two Decision Conferences. These were held in-person at the Harwell Science and Innovation Campus, bringing together 52 participants from across the space sector. Individual expert judgements were captured anonymously, with all participants weighted equally.

On the day, the process began with a briefing on the workshop aims, evaluation criteria, and scoring system. Each capability roadmap was introduced prior to scoring, to ensure a shared understanding. Participants used an online tool to assess 22 roadmaps against 13 agreed criteria, grouped into two categories (see Table 1).

Scoring followed a simple 0 to 100 scale, broken into bands of 10 where 1 to

10 meant ‘Virtually not’ and 91 to 100 indicated ‘greatest extent’. Descriptors for each band, such as ‘moderate extent’ (61 to 70) and ‘small extent’ (31 to 40), helped participants calibrate responses without complex calculations.

Voting speed improved significantly through the conferences, from around nine minutes per roadmap at the start to under two minutes by the end, reflecting growing familiarity with the process. In total, the conferences generated over 14,000 data points (52 participants, 22 roadmaps, 13 criteria). These were aggregated to visualise trade-offs between benefits and deliverability, providing a transparent evidence base for discussion.

RESULTS: INTERPRETING THE ‘GUT FEEL’

When the 14,000 data points were aggregated, clear patterns emerged. These revealed areas of consensus, uncertainty, and trade-offs between ambition and deliverability. This approach made complex judgements accessible, enabling stakeholders to see where confidence was high and where further analysis is needed.

TABLE 1 BENEFIT AND DELIVERABILITY CRITERIA, SCORED ON A 0 TO 100 SCALE – SPACE PARTNERSHIP DECISION CONFERENCES

Benefit criteria: to what extent will investment in this roadmap...
1. ...enhance UK national security through greater space capabilities 2. ...mitigate UK national risks through greater space capabilities 3. ...deliver wider societal benefits to UK citizens 4. ...enhance UK’s geo-political influence beyond the space sector 5. ...increase the number of UK technological developments up to & including proofs of concept 6. ...enhance UK space academic and scientific reputation worldwide 7. ...enhance industry engagement with academia 8. ...increase net investment attracted into the UK space sector 9. ...increase jobs in the space and supporting sectors in the UK 10. ...increase the overall space sector contribution to UK GDP
Deliverability criteria: to what extent will investment in this Roadmap...
A. ...draw on existing technology and infrastructure B. ...not require undue political support C. ...be deliverable within existing resources

these outputs provided a transparent foundation to improve discussion

Some high-level insights that can be drawn from Figure 1:

- **Top right quadrant:** Highlights the areas that the UK space sector is confident in the potential benefits and ability to deliver. These are generally areas where the UK is already actively delivering capability.
- **Bottom left quadrant:** Highlights areas of greater uncertainty, although potentially still contains some higher reward areas. This is not necessarily a consensus view; it was often because they are the areas where there is the greatest difference of opinion.
- **Space Science:** Clustered in the middle, reflecting indirect benefits and challenges in university funding despite strong research capability.
- **Space Exploration:** Recognised for intangible benefits (e.g., inspiring the nation). Direct benefits were higher for low Earth orbit exploration due to links with In-Orbit Servicing, Assembly and Manufacturing (ISAM,

previously IOSM), a technology area focused on repairing, upgrading, or building assets in-orbit.

The process exposed underlying assumptions and clarified areas of agreement and contention. Rather than prescribing decisions, these outputs provided a transparent foundation to improve discussion, helping participants explore trade-offs and identify where further analysis or investment might be needed.

DISCUSSION: LIMITATIONS AND LESSONS

The Decision Conferences turned informed opinion into structured data and provided a shared evidence base that helped participants see where views aligned and where they diverged. This transparency supported more informed conversations and strengthened collaboration through the Space Partnership.

Several lessons were identified:

- **Criteria clarity matters:** Earlier approval and clearer definitions would have improved confidence.

- **Representation needs careful balancing:** Participation was varied but not proportionally representative; weighting could help reduce bias.
- **Sequence randomisation reduces bias:** Adjusting the order of criteria in the second conference helped avoid pattern effects.
- **Participants valued the process:** 87% wanted to take part again, and 79% expressed confidence their vote would be listened to and mattered.

The approach aligns with key Green Book principles for handling uncertainty and structuring judgements, although it is not a full MCDA implementation because swing weighting was not included. Swing weighting assesses how much each criterion matters by comparing its full range of impact. As such, while the method supports evidence-based discussion, further refinement would be needed for full alignment with government standards.

This case study demonstrates the broader value of Decision Conferencing to analysing expert judgement

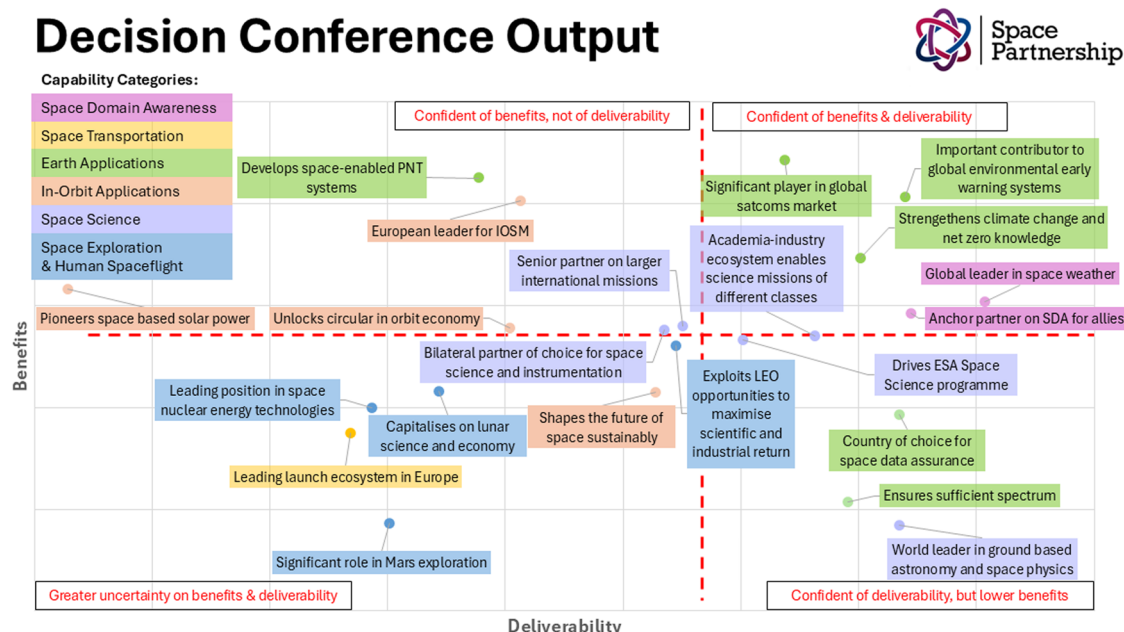


FIGURE 1. CHART SHOWING THE AVERAGE (UNWEIGHTED) COMBINED SCORE FOR THE DELIVERABILITY CRITERIA PLOTTED AGAINST THE SAME FOR THE BENEFIT CRITERIA - SPACE PARTNERSHIP DECISION CONFERENCES

There were several limitations of the approach:

- **Captures opinions:** Results depend heavily on the choice of criteria and the diversity of participants.
- **Polarised views:** Average scores can mask wide variations, revealing ‘marmite’ issues (topics that polarise views).
- **Policy alignment:** Capability roadmaps are an input into government policy but have diverged since their formation. Although, the upcoming Space Publication may be an opportunity to realign insights with official priorities.

The outputs should therefore be seen as a starting point for discussion rather than a substitute for detailed analysis. This first application of Decision Conferencing in the UK Space sector was informative. With further improvements (refined criteria, including swing weighting, and integrating cost data), it would be more useful. For now, it helps to provide a basis for discussion.

CONCLUSION: IMPACT AND NEXT STEPS

This case study demonstrates the broader value of Decision Conferencing to analysing expert judgement. By transforming intuition into structured inputs, this Operational Research technique provides a clear foundation for dialogue in areas where evidence is

incomplete and choices are complex, helping decision-makers navigate uncertainty with greater confidence. The insights generated through the Space Partnership exercise are not intended to replace formal policy decisions. Rather, they provide a transparent reference point to inform decisions and enrich wider discussions on the UK space sector.

Looking ahead, the potential for these techniques extends well beyond space. Structured approaches to capturing and visualising expert opinion could support decision-making in other domains facing uncertainty and competing objectives, from emerging technologies to public service innovation. For DSIT and the Space Partnership, this work provides a

springboard for deeper collaboration and more refined analysis. It reinforces that rigorous, inclusive methods can turn ‘gut feel’ into evidence, helping decision-makers navigate complexity with greater confidence.

Dr Joanna Hart is the Director of the Space Partnership, which brings together industry, academia and government to deliver on the UK's space ambition. Joanna is a particle physicist turned investment banker, with over 12 years working across the UK space sector.

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