



PRECISION RADIAL VELOCITY SPECTROMETER

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APPLICABLE DOCUMENTS

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1. INTRODUCTION

The environment surrounding the building of one-off, facility-class, state-of-the-art instruments inevitably involves significant amounts of risk. Although many unknowns will occur, at least some problems or opportunities can be anticipated and their effects managed to the advantage of the project. This document describes how the PRVS project will manage a systematic process of identifying, analysing and responding to such known project risks. The project will maintain, and regularly update, a separate risk register that will address responses to individual risks.

The objective of the risk management process is to improve the probability of project success, not just measured in terms of specification but also in time and cost. It does that by anticipating possible problems, identifying opportunities and then taking cost-effective actions to minimise the impact of problems and maximise opportunities. The process can also be used to allocate sensible allowances of working margin and contingency for these known problems, though there will always also be a need to retain something for the unknown problems yet to arise.

The process described herein will indicate separately those items which it believes should be held as contingency reserves by the Gemini Observatory.

The key activities in the risk management process are:

- Risk management planning, as set out in this document;
- Risk identification;
- Qualitative assessment and scoring of the identified risks;
- Quantitative analysis for selected risks;
- Risk response planning and identification of cost effective Risk Reduction Actions (RRAs);
- Risk monitoring and control, particularly regular auditing of the Risk Register to ensure that evolving circumstances are taken into account.

2. METHODOLOGY

The implementation of risk management on the project will be based upon the following assumptions:-

- Adoption of the PPARC marking schemes as modified by the UK ATC standard procedures
- Use of quantitative methods to set those markings as unambiguously as possible
- Risk identification is “bottom up” by work area and should involve all team members
- Risks to performance may be mitigated by restricting final performance to requirement rather than goals. They may also help identify scope contingencies that would also de-risk the project
- Schedules will exist at Project and Work Package levels such that the impact of risks and subsequent options for mitigating schedule impact can be understood easily
- The Institute Project Managers will have working allowances that will allow suitable decisions to be made about the most effective resolution of cost or resource risks
- The complete risk register will be analysed at project level to identify efficiency improvement actions and provided to work package teams so that everyone is aware of the key issues.

3. ROLES AND RESPONSIBILITIES

All project staff have a pivotal role in risk management as it is only by the successful and continuous identification of risks that the process can succeed. The key to success is also the appointment of risk owners whose responsibility is to ensure that

- the qualitative (and if appropriate quantitative) risk analysis is performed on the risk

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- mitigation actions are identified and carried out
- triggers that may exacerbate the risk marking or indicate the termination of the risk are monitored.
- the Project Support Office at the ATC is notified of all outputs from these activities so the register is maintained

The Project Manager, Institute Workpackage Managers and Systems Engineer (for risks impacting performance specifically), will be expected to act as auditors ensuring that the overall process is pursued according to this plan. As such and because, by the very nature of their marking, they may have a significant effect on the Project, the Project Manager will own the top 10 project risks and continuously monitor all the high risks. Of the remaining risks, Institute Workpackage Managers will own their top 10 local risks. The remaining risks will be owned by either lead engineers or Sub-system Workpackage owners as appropriate.

4. THE RISK PROCESS

4.1 RISK IDENTIFICATION

Risk identification sessions will be enabled by:-

- Brainstorming, involving participants reflecting the appropriate range of skills and knowledge in a particular work area.
- Review of other previous and current projects risk lists.
- Assumptions analysis, first the underlying assumptions within the project management plan are identified and then the risk that these are incorrect is considered.
- Network analysis and System architecture examination to review the interfaces between activities and complete coverage across the project lifecycle. Critical path activities will receive particular attention.
- SWOT (Strength, Weaknesses, Opportunities and Threats)
- Cause and effect diagrams.
- Design issues known to need resolving, particularly in the early design stages will be logged as risks until resolved.

Each risk identification session will provide:

- A record of all risks identified, including brief description and date identified.
- The reference for each risk to the relevant system architecture component or WBS activity.
- An assigned Risk Owner for each risk.

4.2 QUALITATIVE RISK ASSESSMENT

The Risk Owners (supported as necessary) will perform the risk analysis outside of the risk identification sessions. These sessions will take place at both project level and work package level.

Each risk assessment session will provide:

- A ranking of the risks on the basis of perceived impact and probability.
- An assessment of the potential costs, schedule, performance implications of the risk occurring.
- A shortlist of the major risks.
- An indication of any risk triggers (sometimes referred to as risk symptoms) that may be an early warning sign that a risk has or is about to occur.
- Likely date when risk could impact project.

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- Proposed risk responses as defined in section 4.4 and cost associated with those responses.

4.2.1 Risk Scoring

The risk scoring methodology will follow the impact-probability system as outlined below. This is based on well established PPARC and UK ATC procedures. This process describes the effect of each risk on a numeric scale from 1 to 20, with high risks being those marked above 8. The mark is obtained from the product of the Impact and Probability markings.

4.2.1.1 Impact

The Impact marks assess the effect a particular risk might have on the Project by consideration of three areas, Time, Cost and Specification (also known as performance, scope, quality). Each risk will be marked against all three categories. The Risk impact mark will use the maximum of the three figures, so a zero mark will be allowed against a category if there is truly no impact in this category.

Table 1: Risk Impact table

| Impact Mark | PPARC Designation | Quantitative Implications for Project | | | |
|-------------------|-----------------------|---------------------------------------|-------------------|--------------------|-------------------------------------------------------------------------------|
| | | Cost | Time | | Scope / Quality |
| | | | Work Package Slip | Critical Path Slip | |
| 1 (Low) | Insignificant / Minor | < \$10k | Up to 4 weeks | Nil | Minor change to functionality requiring remedial action. |
| 2 (Medium) | Moderate | \$10k to \$30k | 4 to 8 weeks | 1 month | Risk of Minor loss of performance (change to Specification) or functionality. |
| 3 (High) | Major problem | \$30k to \$100k | 9 to 16 weeks | 2 months | Risk of Major loss of performance (change to specification) or functionality. |
| 5 (Severe) | Catastrophic problem | >\$100k | >16 weeks | 3 months | Risk of Unacceptable loss of performance or functionality |

Notes:

(i) there is no '4' marking to ensure that 'severe' impacts are properly captured

(ii) Costs impacts based on assumed project cost of approx \$10M, then

$$1 = 0.1\% = \$10k,$$

$$2 = 0.3\% = \$30k,$$

$$3 = 1\% = \$100k ,$$

$$5 = > 1\%$$

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4.2.1.2 Probability

Markings against risk probability of occurrence are scored using only integer values 1, 2, 3 or 4. No other values are allowed.

Table 2: Risk Probability Definitions

| Level | PPARC Designation | Definition | Equivalent probability |
|-------|-------------------|------------------------------------|------------------------|
| 1 | Rare | Occur in exceptional circumstances | 10% (1 in 10) |
| 2 | Possible | Might occur | 20% (1 in 5) |
| 3 | Likely | Quite likely to occur | 50% (1 in 2) |
| 4 | Highly likely | Will almost certainly occur | 75% (3 out of 4) |

4.2.2 Risk Exposure Product (Mark)

The table below indicates the product of risk impact and probability, and thereby indicates, for each risk, the level of attention required to mitigate the risk to the project.

The thresholds for risk exposure are:

- <3 Low
- 5-8 Medium
- >8 High

Table 3: Risk Impact and Probability Product

| | | | | | |
|------------------|---|------------|---------------|-------------|---------------|
| Probability Mark | 4 | 4 | 8 | 12 | 20 |
| | 3 | 3 | 6 | 9 | 15 |
| | 2 | 2 | 4 | 6 | 10 |
| | 1 | 1 | 2 | 3 | 5 |
| | | 1 (Low) | 2 (Medium) | 3 (High) | 5 (Severe) |
| Impact Mark | | | | | |

By comparing risks against this table, a course of action will be initiated. Those areas in the upper right corner require immediate action. Those in the diagonal require attention and action in the near future. Those in the lower left corner should be monitored and action taken when appropriate. This evaluation is reasonably objective but common sense should be used in evaluating the risk. For example, if there are thirty low impact / medium probability risks in one area of the project, this could identify a larger problem which might be of medium or high severity.

In addition, for each identified risk, a separate 'flag' will be maintained indicating whether a risk is associated with a Critical Path activity and the effect on the total and free float of that activity.

4.2.3 Risk Thresholds

Risks with an exposure product > 8 will be classed as "immediate response" and must be brought to the attention of the Project Manager, Institute Workpackage Managers and the work package owner as soon as identified.

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For medium risks between 3-8 the Project Manager, Institute Workpackage Managers and the work package owner will be informed at the next available opportunity.

Risks below 3 will be reviewed at the next risk audit meeting.

4.2.4 Schedule Risk

Risks which could impact schedule will require more extensive analysis and regular update each time the schedules themselves are updated. To get maximum value from the process the Project needs schedules with clear demonstration of the critical path and information on “total slack” for each Workpackage. This will focus Management activity on key areas. Minimisation of risk on the project critical path will receive the highest attention, but sub-critical paths will also undergo regular review.

As noted in the Management Plan, the Project scheduling may well use the concept of nominal (or most likely), pessimistic (duration of activity if risk rises) and optimistic (minimum duration) scenarios for some critical schedules. This will clearly be informed by the risk process.

4.3 QUANTITATIVE RISK ANALYSIS

For specific selected risks, quantitative analysis may be performed using methods such as simulation or decision tree analysis. These risks will have a high score on the risk exposure matrix. The type and benefit from such an analysis must be clear before a quantitative analysis is started.

4.4 RISK RESPONSE PLANNING

The objective of risk response planning is to implement cost effective risk reduction actions (RRAs) that reduce the probability and or effect of the risk. The entire spectrum of risks will be assessed.

There are different action types to be invoked, depending on thresholds and the risk exposure to the project.

- **Avoidance:** This is where proactive measures are taken to avoid the risk.
- **Mitigation:** Measures are taken to reduce the probability or impact of the risk to an acceptable level should it occur.
- **Transfer:** The risk impact is transferred to a third party who is better placed to manage the risk or consequences if the risk occurs.
- **Acceptance:** Accept the risk on the basis that it is most unlikely to happen, it is beyond the Project's control or that it is too expensive to avoid.

The first three actions will usually require some additional expense, the cost of which will be balanced against the expected impact should it occur.

4.5 RISK MONITORING AND AUDITING

4.5.1 Risk Register

The risks will be logged in a Risk Register. Appendix A shows a sample of the proposed PRVS Risk Register along with field descriptions. The risk register will be maintained by the PRVS project support office at the UK ATC. As shown, it is presently in the form of a spreadsheet similar to that used on SCUBA-2. The UK ATC is in the process of implementing a web-accessible database developed from the existing VISTA system but with additional features. The PRVS register will be transferred over at that time. Either way the register will allow risks to be sorted in a variety of ways suited to the needs of different managers and risk owners. Such sorts might be by overall mark, system architecture, risk owner etc

4.5.2 Tracking

The risk register will be audited every alternate month by the following procedure:-

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- (i) High level risks will be discussed at the very least on a monthly basis.
- (ii) Identification of new risks will be a standing item on all project progress meetings.
- (iii) All major technical reviews will include a comprehensive appraisal of risks relating to that workpackage
- (iv) Risk only meetings will be held every 2-3 months for which a list of all active risks will be distributed in advance to the Project Management Team, workpackage owners and risk owners. Prior to the meeting an updated schedule will be used to update schedule impacts for known risks. The meeting itself will be a teleconference held one week after distribution of the risk list. The meeting will discuss the status of all active risks and identification of any new risks. A revised risk list will be distributed to the attendees listed above and made available to the whole team via Livelink.
- (v) The revised Register will be saved as a new document with revised issue/date reference. Once the Web based tool is running this will be automatic.

4.5.3 Reporting parameters

The status of the Project risks will be reported regularly to Site Management, Customer and oversight committees by listing :-

- Number of new risks since last report
- Number of risks closed since last report
- Number of 'High' risks – this may include a split by schedule, cost and performance
- Mean risk mark, compared to last report
- Summary details of at least top 10 risks

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APPENDIX A: PRVS RISK REGISTER FIELDS

| Field Name | Value | Description |
|---------------------------------|-------------------|---------------------------------------------------------------------------------------------|
| Risk ID | Numeric | Unique Identifier |
| Risk Description | Text | Brief description of risk |
| Status | Open, Closed, New | Open, Closed, New |
| Management or Technical | M, T | Simple Classification for overview purposes |
| Gemini Contingency? | Y, N | Is this risk Identified with Gemini as a potential call on Contingency? |
| WBS Code | Alphanumeric | Work Breakdown Structure Code |
| SA Code | Numeric | System Architecture Reference |
| Owner | Name | Risk Owner |
| Date Identified | Date | When First logged |
| Performance Effect | Text | Summary of possible impact on performance, spec or functionality to assess Spec Impact mark |
| Poss WP Delay | Weeks | Indicates possible delay to workpackage if occurs |
| Total Slack on WP | Weeks | From latest schedule |
| Nett effect on Project Schedule | Weeks | Will it delay project? |
| Cost of Risk | \$k | How much will it cost if it occurs |
| Probability | 1,2,3,4 | See above for probability marks |
| Impact – Spec | 0,1,2,3,5 | Impact mark for performance per table above |
| Impact – Time | 0,1,2,3,5 | Impact mark for delay per table above |
| Impact – Cost | 0,1,2,3,5 | Impact mark for performance per table above |
| Max Impact | 1,2,3,5 | Max of above three elements |
| MARK | up to 20 | Product of Probability and max impact |
| Category | Low, Medium, High | Categorise |
| Risk Triggers | Text | Points at which risk may be triggered or identified |
| Likely Impact Date | Date | When risk will occur if at all |
| RRA summary | A, M, AC, T | Avoid, Mitigate, Accept, Transfer |
| Risk Response Action | Text | Details of planned action |
| Cost of RRA | \$k | Estimated/Actual cost of pursuing RRA |