CAIRNDENE

Course Summary:

Project Risk Analysis

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This course covers the theory and methodology for schedule risk analysis.

Course Aim

The aim of this training is to provide the candidate with the principles and tools which are essential for building a robust and reliable model to analyse schedule risk.

Learning Outcomes

By the end of this training the candidate should be able to:

1. Explain the difference between traditional risk management and schedule risk analysis
2. Recommend and justify the method for building the risk model
3. Analyse duration uncertainty and the effect on the critical path
4. Evaluate the register of risk events in relation to the schedule

1. Introduction to Schedule Risk Analysis

1.1. Definition of Risk

According to Hulett, project risk is defined as 'an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective'.

Because of a (**CAUSE**), the (**RISK**) may occur and if it does some (**IMPACT**) will result.

RISK is the uncertain component of this definition, includes a word such as 'may' or 'might' in the future.

CAUSE, while often confused with the risk, is a fact and without it we might not have the risk. Confusion could lead to inaccurate calibration of the risk's probability and impact and to inappropriate risk responses.

IMPACT is on a project objective such as cost, time, scope or quality. This implies that the impact is a single value, but the risk can have a range of impacts.

1.2. Traditional Risk Analysis

Risk Identification

- Team Workshop to brainstorm all the risks on the project.
- Use a SWOT matrix to assist this (Strengths, Weaknesses, Opportunities and Threats)

Risk Assessment

- Probability x Impact
- Discussed in terms of High, Medium or Low and then inputted in to an Excel Spreadsheet

Mitigation Techniques

- Update spreadsheet with mitigation methods
- Discuss at review meetings

2. Schedule Risk Analysis

2.1. Styles of Schedules

Due to a number of factors (the organisational culture, the personality of the engineer giving the data or external pressures, to name a few); it is vital to realise that there are different styles of schedules, each having an impact upon the level of exposure a project may have to risk.

- **Most Likely (Realistic):** has realistic (most likely) task duration estimates to ascertain the project finish date. However, these estimates may not be as realistic as initially thought: this will be covered later in the Data Collection section.
- **Optimistic (Aggressive):** has task durations which are shorter than Most Likely.
- **Pessimistic (Cautious):** has task durations which are longer than Most Likely
- **Scaled-to-Fit:** driven by a "Drop Dead" project end date: durations are designed to achieve this.

2.2. Duration Uncertainty

It is important to realise that the durations stated in the schedule are not known with certainty.

Instead, activity durations should be thought of as estimates. This is due to the assumptions behind the estimates being subject to error. Assumptions include:

- Similarity to work previously executed
- Expert knowledge of the work to be executed
- The availability of resources
- The productivity of available resources
- The delivery of dependent factors (3rd party contractors)

During the early phases of the project, the estimates should be considered within a wide range (for example -30 percent, +40 percent) while during the later phases, as more information becomes known to the project team, the estimates may be viewed as more accurate (for example, -5 percent, +10 percent).

These enhanced estimates should be reflected in the updated schedule and reported to management and the client, giving everyone a reason to pause for thought.

2.3. The Three-Point Estimate

The Longest or Pessimistic Duration

- This is the duration which would occur should several factors that are important in affecting the duration go 'wrong' simultaneously.
- There is only a 1 percent chance that the duration is likely to be longer than this.

The Shortest or Optimistic Duration

- The duration when several factors go 'right' on the activity.
- There is only a 1 percent chance that the duration is likely to be shorter than this.
- This duration may represent opportunities to improve on the project schedule.

The Most Likely Duration

- Is viewed as more likely than any of the durations in the possible range from shortest to longest.
- The most likely duration does not need to be the duration shown in the schedule.

3. Risk Drivers: An Alternative Method to Risk Modelling, using the Risk Register

The New Risk Driver Approach Process

1. The data collection interviews focus on risks and the activities they effect
2. These risks are prioritised in the risk register
3. They are applied to all the activities they effect
4. Each activity is analysed based upon the probability and impact of all risks assigned to them

The Advantages of the Risk Driver Method:

1. Uncertainty is associated with each risk, not with the activity
2. Demonstrates both probability of occurring and impact on activity durations
3. Risks are assigned directly to several activities
4. An activity can be affected by several risks
5. Risks are measured in terms of importance, such as sensitivity: sensitivity analysis (tornado charts) list in order of importance the risks rather than activities
6. Important risks can be identified for further analysis or mitigation
7. Mitigation actions focus on the risks, not on activities

4. Mitigation Strategies

4.1. Mitigation Strategies for Negative Risks (Threats)

- **Avoid:** need to change the project plan to eliminate the threat entirely.
- **Transfer:** shifting the negative impact and the ownership of the response to a third party: for example, buying insurance, warranties or guarantees.
- **Mitigate:** reduction of the probability and/or impact to within acceptable threshold limits. It is often more effective to take early action rather than have a re-action later in the schedule.
- **Accept:** can be either passive (i.e. take no action) or active (i.e. set aside contingency reserve).

4.2. Mitigation Strategies for Positive Risks (Opportunities)

- **Exploit:** need to eliminate the uncertainty to ensure the opportunity happens.
- **Share:** shifting the ownership of the response to a third party who is best equipped to capture all the benefits.
- **Enhance:** increase the probability and/or impact by identifying key drivers of the positive risks.
- **Accept:** be willing to take advantage of the opportunity if it presents, but will not actively pursue it.

5. Interpreting the Reports

5.1. Distribution Graph

The Distribution Graph shows the number of times a particular outcome has occurred while running the project simulations, this is then used to generate probability data. A graph can be generated for the project plan as a whole or for individual activities, and depending upon the information supplied for the analysis the following graphs can be displayed:

- Finish Dates
- Start Dates
- Durations
- Float
- Cost
- Net Present Value (NPV)
- Internal Rate of Return (IRR)

5.2. Tornado Graphs

There are five sets of Tornado Graphs generated, showing the Project Drivers:

- **Duration Sensitivity:** shows the activities which have the most effect on the duration of the project as a whole.
- **Cost Sensitivity:** shows the activities which have the most effect on the cost of the project as a whole.
- **Criticality Index:** shows the percentage of time an activity was on the critical path during the analysis.
- **Duration Cruciality:** calculated by multiplying Duration Sensitivity by the Criticality Index. By giving greater weight to the activities on the critical path it is a more reliable indicator.
- **Schedule Sensitivity Index:** shows the ranking of the activities most likely to affect the overall project duration and finish date. This is similar to Duration Sensitivity, but is not such a true indicator.

6. Acknowledgements

Project Management Institute: A Guide to the Project Management Body of Knowledge: PMBOK Guide, 4th Edition, 2008

Hulett, D: Practical Schedule Risk Analysis, Gower Publishing Limited, 2011

Wysocki, R.K., Effective Project Management: Traditional, Agile , Extreme, 5th Edition, 2009

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