

# Measuring Changes in Risk Exposure

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The final phase in the project risk management process (called “Risk Monitoring & Control” in Chapter 11 of the PMI® Guide to the Project Management Body of Knowledge PMBoK® 2000 Edition) is really important, since this is where planned actions are implemented in order to achieve the intended changes to risk exposure, minimising and avoiding threats while maximising and exploiting opportunities, in order to increase the confidence that project objectives can be achieved. The effectiveness of the risk management process (and particularly of risk responses) is also monitored and reviewed at this point, and changes in the level of risk faced by the project are assessed, to ensure that the expected benefits are being reaped.

Despite this statement of intent, it is not always clear how to measure changes in risk exposure. Several alternative metrics can be defined for this purpose, although they often provide only a gross indication of risk trends. Nevertheless even the most basic metrics can be useful in assessing the effectiveness of the risk management process. A number of simple risk-based metrics are outlined below, followed by a proposed composite metric which combines several of the more simple measures together.

## Simple Metrics

The most common simple metrics used to determine risk management effectiveness are the number of active risks, the number of closed risks, distribution of risks between priority categories, and use of Probability-Impact (P-I) Scores. Each of these is briefly described below:

1. **Number of active risks.** This involves simply counting how many risks have been identified and remain unresolved on the project at a given point in time. Although this is the simplest metric possible, clearly it is very crude since it takes no account of how significant the risks are. For example at the beginning of a project there may be 50 risks identified, of which only five are assessed as high-risk, with the remainder being either medium or low. Partway through the project there may only be ten risks outstanding, but if they are all assessed as high-risk the overall risk exposure of the project would be higher than at the start. However a simple count of

“number of active risks” would show a misleading reduction. Another complication here arises when a project is including opportunities within the risk process as well as threats (as recommended by PMBoK Chapter 11). In this case it is important to monitor the number of each separately, in order to be able to identify trends in both threat reduction and opportunity enhancement.

2. **Number of closed risks.** Similar to counting the number of active risks, it is also common to count how many risks have been closed, either because they have “timed-out” and can no longer affect the project, or because they are threats which have been proactively addressed and resolved during the risk management process, or opportunities which have been captured and turned into benefits. As above, a simple count of closed risks can be a misleading indicator of risk management effectiveness, since all the easy risks may have been addressed first, leaving the more intractable ones.
3. **Risk priority distribution.** The use of Probability-Impact Matrices (as described in Chapter 11 of the PMBoK) allows identified risks to be grouped by the two dimensions of probability of occurrence and level of impact, leading to categorisation for prioritisation purposes. For example risks can be divided into red/amber/green or high/medium/low priority groups, based on their position within the P-I Matrix. This allows calculation of risk metrics such as the numbers of risks in each priority category, with the distribution of risks across these categories giving an indication of the overall level of risk faced by the project. It is then possible to monitor the movement of risks between priority groups to track trends in risk exposure. For threats the aim is to move them from red/high to green/low, whereas green/low opportunities should be improved towards the red/high zone if possible. A simple example is presented in Figure 1, showing changes in numbers of threats and opportunities between one risk assessment and the next. The preferred distribution is high opportunity/low threat.
4. **Use of Probability-Impact Scores.** The above metrics count numbers of risks, but take no account of their relative significance. One way of improving the ability to track risk management effectiveness is by using the Probability-Impact (P-I) Score. This

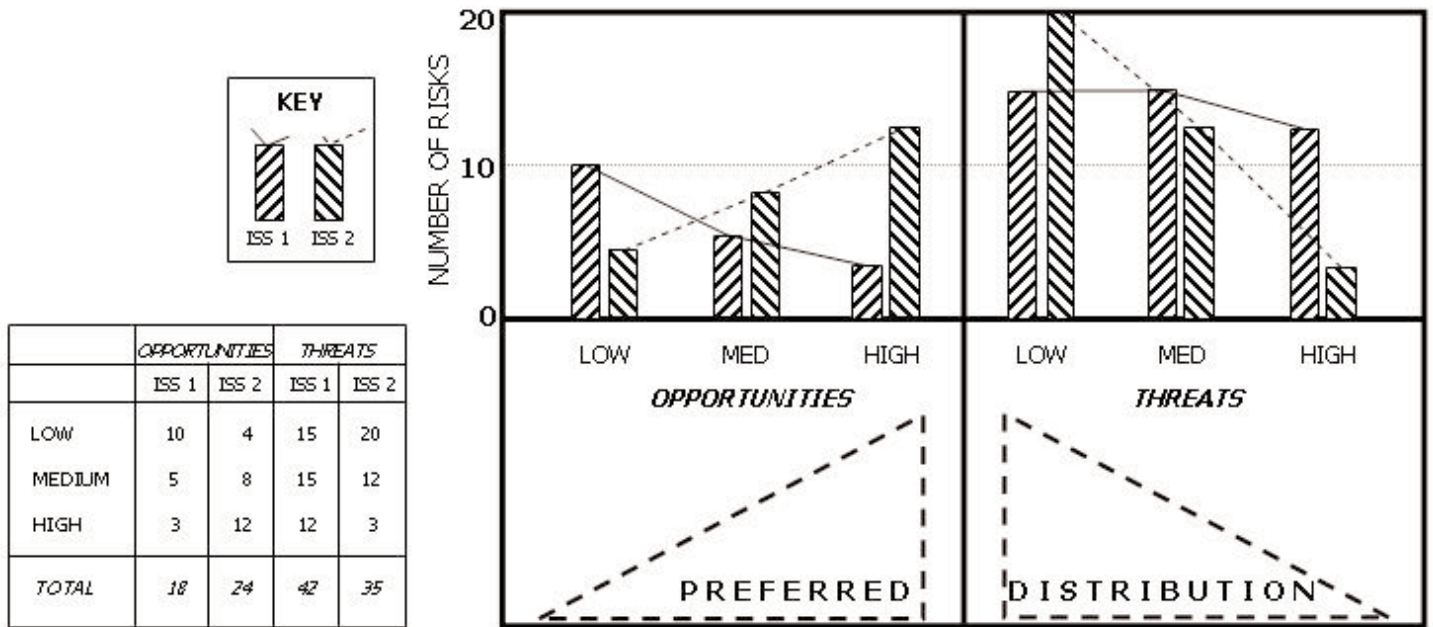


Figure 1: Risk distribution by priority category

involves associating numerical scales with the two dimensions of probability and impact. For example for probability the typical qualitative scales Very Low/Low/Medium/High/Very High might be given scores of 0.1/0.3/0.5/0.7/0.9 respectively, and impact scales Very Low/Low/Medium/High/Very High could be scored 0.05/0.1/0.2/0.4/0.8 (this sample scoring system is presented in PMBoK Chapter 11). Multiplying the two scores associated with the assessed probability and impact of a given risk produces a non-dimensional number called the P-I Score (between 0.005 and 0.72 using the above scoring scheme), which reflects both dimensions of how likely the risk is to occur and how significant its effect might be. This P-I Score can then be used to rank risks, or to assign them to priority categories (for example high/red priority might be defined as P-I Score >0.2, and low/green priority <0.1, with medium/amber priority between these two bounds). The same scoring scheme works equally well for both threats and opportunities. Having calculated a P-I Score for each identified risk, two other metrics can then be defined :

- Total P-I Score for active risks. This is a simple sum of the P-I Scores for all risks remaining active, and is an improvement over simply counting the number of active risks. Plotting changes in Total P-I Score demonstrates the trend in risk exposure. It still however suffers from the same weakness as the simple count of active risks, because the same Total P-I Score can result from many small risks or few large ones. These two situations are however distinguished by the next metric based on P-I Scores.
- Average P-I Score for active risks. Here the Total P-I

Score is divided by the number of active risks to give an average, which reflects the overall significance of the set of active risks.

### A Composite Metric

The last two measures described above (i.e. Total P-I Score and Average P-I Score) can be combined into a measure known as the *Relative Risk Exposure Index*. The idea is that true risk exposure is more than just the total “size” of the risks which face the project, but it also needs to take account of their “weight”. Thus a project might be more at risk with twenty small risks than with three large ones. Relative Risk Exposure Index ( $I_{RR}$ ) accounts for both number and significance, and is calculated by taking the product of Total P-I Score (T) and Average P-I Score (A) at the current point in time ( $T_c * A_c$ ) and dividing it by the baseline value ( $T_b * A_b$ ). Thus :

$$I_{RR} = \frac{(T_c * A_c)}{(T_b * A_b)}$$

The resulting value of  $I_{RR}$  is 1.0 (one) if the current level of risk exposure is the same as the baseline, with less than one indicating reduced risk exposure compared to the baseline, and higher than one meaning increased risk exposure over the baseline.

This only works however if all the risks included in the calculation are of the same type, and  $I_{RR}$  is usually calculated for threats only. When calculating P-I Scores for threats and opportunities, a high P-I Score for a threat is unwelcome since this represents the possibility

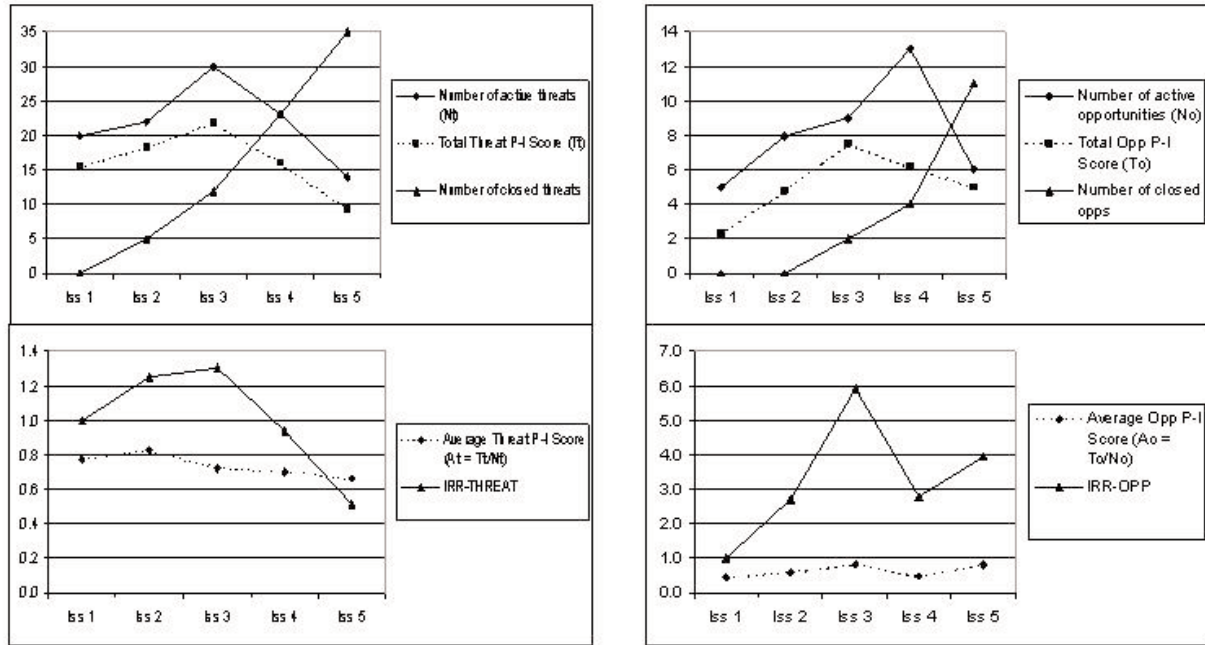


Figure 2: Risk metrics and trends

of a serious negative effect. Conversely, high P-I Score for an opportunity is a good thing, since this means the potential for bigger benefits. Clearly a mixture of threats and opportunities cannot be combined in the calculation of  $I_{RR}$ , as it would be impossible to interpret the result. It then becomes necessary to calculate two values for  $I_{RR}$ , one for threats and one for opportunities. In this case, changes in  $I_{RR-THREAT}$  can be interpreted as usual, with higher values meaning worsening exposure to threats compared to the baseline situation. Changes in  $I_{RR-OPPORTUNITY}$  have a different meaning, since higher values mean increased opportunity.

Having defined various metrics for risk exposure and measured them as the project proceeds, it is then possible to perform trend analysis on the results to provide useful management information on the way risk expo-

sure is changing on the project. This might also indicate the need for modifications to the risk management process based on the direction and strength of trends.

Examples of risk metrics and trends are given in Table 1, with separate figures for threats and opportunities. The data in this table is presented graphically in Figure 2. This shows that the trend in overall threat exposure ( $I_{RR-THREAT}$ ) follows the change in number of active threats since the Average P-I Score remains nearly constant, whereas the shape is different for opportunity exposure ( $I_{RR-OPP}$ ). The main difference is between Issue 3 and Issue 4 of the risk assessment, when threat exposure is seen to reduce from above one to below one (a good thing), but the opportunity index halves from nearly 6 to below 3 (a bad thing). This result may suggest a need to refocus the risk process on

	Threat data					Opportunity data				
	Number of active threats (Nt)	Number of closed threats	Total Threat P-I Score (Tt)	Average Threat P-I Score (At = Tt/Nt)	Relative Risk Exp Index IRR-THREAT	Number of active opps (No)	Number of closed opportunities	Total Opp P-I Score (To)	Average Opp P-I Score (Ao = To/No)	Relative Risk Exp Index IRR-OPP
Issue 1	20	0	15.5	0.8	1.00	5	0	2.3	0.5	1.00
Issue 2	22	5	18.2	0.8	1.25	8	0	4.8	0.6	2.72
Issue 3	30	12	21.7	0.7	1.31	9	2	7.5	0.8	5.91
Issue 4	23	23	16.1	0.7	0.94	13	4	6.2	0.5	2.79
Issue 5	14	35	9.3	0.7	0.51	6	11	5.0	0.8	3.94

Table 1: Sample risk metrics data



opportunity management. The closing position at Issue 5 shows threat exposure about half that at Issue 1, while opportunity exposure is about four times higher.

### Conclusion

Despite the attraction of numerical metrics, the temptation to over-interpret

must be resisted, since these figures are manipulations based on values which involve several levels of judgement. For example  $I_{RR}$  uses the Average and Total P-I Scores, which depend on the efficiency of risk identification (how many identifiable risks were actually identified) and the objectivity of risk assessment (how their probabilities and impacts were perceived). Changes in these base values could have a significant influence on the calculated value of the metric, with unpredictable results.

Nevertheless some attempt should be made to assess the overall effectiveness of the risk management process, and risk metrics such as those described here offer one way to achieve this goal.

### About the Author

Dr David Hillson PMP, FAPM, FIRM is an international risk management consultant, and Director of Risk Doctor & Partners ([www.risk-doctor.com](http://www.risk-doctor.com)). He is a popular conference speaker and award-winning author on risk. He is recognised internationally as a leading thinker and practitioner in the risk field, and has made several innovative contributions to improving risk management. His recent emphasis has been the inclusion of proactive opportunity management within the risk process, which is the topic of his latest book.

David is an active member of the global Project Management Institute (PMI®) and was a founder member of its Risk Management Specific Interest Group. He received the 2002 PMI Distinguished Contribution Award for his work in developing risk management over many years. He is a member of the core team responsible for updating the risk chapter (Chapter 11) of the *PMI Guide to the Project Management Body of Knowledge* (PMBOK®). He is also a Fellow of the UK Association for Project Management (APM) and a Fellow of the UK Institute of Risk Management (IRM).

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