ABSTRACT
In this paper, we present two patterns that are part of an evolving Pattern Language intended to document practices used by risk managers that are beyond what is thought in risk management textbooks and refer to some sensitive points of the work in an organization.
These patterns are better suited for risk managers working in large organizations and long-term projects.

Categories and Subject Descriptors
K.6.3 [Management of Computing and Information Systems]: Software Management – Software development, Software process

General Terms
Management, Measurement, Documentation, Economics, Standardization.

Keywords

1. INTRODUCTION
In a perfect world, an organization would plan a budget for a development project, that would include the costs of the expected development activity, the costs of activities designed to correct problems and changes that may happen during work, plus a budget reserve for unexpected failures, just to be safe.
In reality however, an organization usually does not have a big enough budget for all these, and also it is humanly impossible to predict all the things that may happen during the life of the project.
Instead, optimally, an organization would like to know what budget should be dedicated for the project and that the project will not exceed it, or it’s schedule.

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can deal with it without organizational help) are: (1) Cost, (2) Schedule and (3) Performance (or Technological) risks. Risks that are "external" to the Project (i.e., the Project needs the organization help in mitigating the risk) such as closing down the project, cutting Schedule or Budget, Legislature Strike, Single Supplier, and more are called (4) Programmatic Risks.

Risk Interactions – For each action there is a reaction: Mitigating a Performance Risk is likely to affect project Cost and Schedule. Reducing project Cost may affect the system’s performance and so affect performance risk. When our project is late the Schedule Risk is high and the project costs rise, so the Cost Risk is higher.

Traditionally risk is evaluated by the probability of the negative event times the Impact (consequence) of it. These two parameters are statistically independent.

When the negative event happens (i.e. the probability equals 100%) we no longer call it a risk, and we define (and resolve) it as a problem.

We can then list the risks from the highest ranking ones (i.e. higher Probability times higher Impact) to the lower ones (i.e. lower Probability times lower Impact), as in the following Risk Assessment Matrix:

<table>
<thead>
<tr>
<th>Probability</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost Certain</td>
<td>5</td>
</tr>
<tr>
<td>Likely</td>
<td>4</td>
</tr>
<tr>
<td>Possible</td>
<td>3</td>
</tr>
<tr>
<td>Unlikely</td>
<td>2</td>
</tr>
<tr>
<td>Rare</td>
<td>1</td>
</tr>
</tbody>
</table>

The following patterns address the issues presented in this illustrative story and they also represent the beginning of a pattern language for practitioners in the risk management problem domain, providing guidelines for reducing and managing the risks that any project may encounter.

In general, we can assume to have three (3) zones of risks:

The Green Zone (Accept) - means that the risks within this zone are been accepted by the project and nothing should be done actively.

The Yellow Zone (Watch) - means that the risks within this zone are been watched by the project and an objective criterion of risk evaluation should be developed for each and every risk to be tracked.

The Red Zone (Mitigate) - means that the risks within this zone are been mitigated by the project (and also watched), and that for each risk a Mitigation Plan must be developed.

Mitigation Plan (future pattern) is a plan that should be derived for each risk in the red zone and some risks in the yellow zone which are closer to the Red Zone.

Optimally, a Mitigation Plan should be integrated into the project work plan and should be reviewed periodically.

This plan should reduce or eliminate the risk by using a variety of methods: analysis, demonstration, simulation, testing, etc. However, for many reasons, there are times that a Mitigation Plan doesn’t reduce the risk(s) or reduces it too slowly.

Contingency Plan is a plan that should be derived for each Mitigation Plan as a substitute in the case of failure of the Mitigation Plan. The Contingency Plan pattern is described in this paper.

### 1.1 Illustrative Story

Imagine an average size project planned for 5 years. In the planning stages risk assessment identifies 150 risks of differing severity. 60 of the risks are tagged Red, 70 are tagged Yellow and the rest are tagged as Green.

A Mitigation Plan is prepared for each of the Red tagged and some of the Yellow tagged risks and these Mitigation Plans are integrated into the work plans for the project, so the normal work will also aim to reduce these risks. Hence, these plans get a budget as part of the project.

An adjoining Contingency Plan is set up for all the risks that have a Mitigation Plan, but these plans are not part of the project budget, as they will only be activated if the Mitigation Plan fails to eliminate the risk or to reduce it at an adequate pace for the success of the project.

One of the major issues is deciding if and when it is necessary to abort any of the Mitigation Plans. Since it involves many considerations such as budget, adjoining projects, and other organizational issues, the decision maker is typically at least a level above the project manager, controlling the budget reserve relating to Contingency Plans.

As part of the work plan the decision maker is scheduled to hold quarterly discussions to assess risks and needs, but if you remember the number of all possible risks that were identified, a short math will show that in these limited hours the decision maker can only go over a small part of the risks, and not all of them.

In projects, the normal risk management practice of using the Risk Assessment Matrix could create a situation where the most severe Red risks will tend to take most of the decision maker attention and time. The Risk Assessment Matrix ignores the timeliness of the risks shown on it – risks which may materialize next week and in 5 years from now can be listed in the same category.

This can lead to a situation where risks could be slowly growing into major problems but will not appear in the periodic risk management reviews.

The following patterns address the issues presented in this illustrative story and they also represent the beginning of a pattern language for practitioners in the risk management problem domain, providing guidelines for reducing and managing the risks that any project may encounter.

Note for the reader: a Different Font marks pattern names – patterns covered in this paper and future ones.
2. PATTERN: CONTINGENCY PLAN

2.1 Context
Project schedule is laid out with goals, tasks and Mitigation Plans prepared for risks that were identified. As work progresses, Mitigation Plans are put into action when needed and help reduce the risks for the success of the project.

2.2 Problem
While we put our hopes into them, Mitigation Plans may fail to live up to our expectations: Either they do not reduce the impact or the probability of the risk, or reduce it at a slower pace than expected, or they turn out to be more expensive than the budget allocated them or they may even expose new risks.

Now the project may be facing a very critical problem, without means to alleviate it.

2.3 Forces
We want to implement full-strength mitigation for all the risks but the project's budget and schedule are limited.

We need to reduce the project's risks in a timely manner for the project to succeed but our plans may be slower than expected or may fail.

We want to reduce the severity of the risks inherent in our project but we also want to meet the project’s goals – such as expected or required system performance.

2.4 Solution
During the planning of a project, define a Contingency Plan for each of the Mitigation Plans that will be triggered if the Mitigation Plan for it fails.

Put into the project schedule dates for assessment of the need to decide upon activation of the Contingency Plan.

A Contingency Plan is the activation of an alternate action plan to reduce the same risk within the same time frame, but is usually more expensive in resources or system performance. The Contingency Plan might also require actions that are more expensive in terms of organizational politics - such as using in-house solutions compared to buying them from an external supplier.

This Contingency Plan should include a Time Frame for its activation - determined by the latest date it may be successfully activated without affecting the project's critical path.

It is important not to wait for a failure to occur, which is why there are scheduled points for assessment of tell-tale signs pointing at a need for Contingency Plan activation.

2.5 Resulting Context
Activation of a Contingency Plan at the correct time will mobilize the necessary actions and resources to bring the project back to its schedule to meet its goals.

On the other hand, it will also involve resources that were not part of the project plan, and may require re-planning so the project can continue.

Of course, a Contingency Plan may also be delayed, fail or be activated too late to be effective.

2.6 Discussion
Note that you only activate a Contingency Plan for a case in which the Mitigation Plan failed to reduce the probability or the impact of a risk at the expected pace or that the risk already materialized (became a problem). Contingency Plan should serve as a “second line of defense”.

In the best scenario, a Contingency Plan will never be activated, as the Mitigation Plan did its job and the risks were handled and reduced.

2.7 Related Patterns
At the scheduled dates for assessment of Contingency Plan activation, refer to the pattern Imminent First to help you in presenting risks to the organization decision makers.

3. PATTERN: IMMINENT FIRST

3.1 Context
After performing risk identification, initial risk assessment and risk prioritization, some of the prioritized risks already have Mitigation Plans and all of them should have Contingency Plans.

Activation of a Contingency Plan requires using more expensive resources than the project is currently assigned, so typically, higher levels of decision makers should deal with them.

3.2 Problem
With limited time to address dozens of top priority risks, decision maker's attention may go to the most severe risks as they appear in the Risk Assessment Matrix (upper right corner of the Red Zone) instead of the most urgent ones and miss a critical time to activate the appropriate Contingency Plan.

This can create a situation where a Mitigation Plan is critically failing, the Contingency Plan wasn’t set into motion to take over the situation to alleviate the risk and now the project has a serious problem.

3.3 Forces
The Risk Assessment Matrix helps to highlight the relative impact and probability of the identified risks but lacks any indication of their timeliness.

A project ideally reserves budget for unexpected events and it faces conflicting motivations: Not spending can save money for the project and help the profit line, versus spend money wisely on relevant Contingency Plan in order to deliver on time a good quality product.

Activating the Contingency Plan too early significantly impacts cost and project risk mitigation budget.

Activating the Contingency Plan too early may disrupt the Mitigation Plan or cause waste of project resources.

Activating the Contingency Plan too late will defeat its purpose or impact project schedule and possibly costs.

For all these reasons only a high-ranking decision maker can activate a Contingency Plan but their schedule is often too limited to review all the risks.
3.4 Solution
Present the decision maker with a list that shows the Imminent First, ensuring activation of Contingency Plan in the critical time.
To create this short list of Imminent First, look at risks that have Contingency Plans defined for them, disregarding their impact and probability.
Then, separate Time Frames for activation of the Contingency Plan into Imminent, Near and Far:
-Imminent is used for risks where the Contingency Plan is on the critical path and failing to activate it within a short period of time will cause delay of project delivery, including the time required for starting up the Contingency Plan.
- Near is used for risks where we are near the decision point, but not on it.
- Far is used for risks where we are far from the decision point.

The authors note that the decision as to when to approach and involve higher management in order to activate a Contingency Plan could be related to and influenced by national and organizational culture and therefore calls for sensitivity of the risk manager.

3.5 Resulting Context
By putting the risks with imminent Contingency Plans for discussion first, the decision maker's attention is focused on those risks that require more urgent decisions.
This mode of prioritizing also allows more time for attempting Mitigation Plans in order to avoid activating the more expensive Contingency Plans too early, thereby putting less of the project's budget or performance reserve at risk.
However, it is important to remember and not underestimate the lure of cognitive bias that can influence the decision makers into continuing investing resources in the Mitigation Plan in hope that “just a little more would do the trick”, thus missing the critical time to start the Contingency Plan

3.6 Discussion
The Time Frame for Near and Far are determined relative to the project schedule. We define T to be a time used to differentiate between Near and Far. For projects with duration of years, T may be several months. For projects with duration of months, T may be weeks (or days when we are in more critical phases).
Near is any time less than T and Far is any time later than is defined for the Near scale.

Use the time frame to prioritize risks in the same risk zone (i.e. Red Zone and Yellow Zone) for discussion with the decision authority.

4. FURTHER PATTERNS THUMBNAILS:
(These will develop as the pattern language expand)
Mitigation Plan - Built to reduce, control and or solve foreseen risks.

Hurricane - Risks type. Medium Impact. (i.e. 3 on a 1-5 scale), Very High Probability that it hits a specific location (i.e. 5 on a 1-5 scale), so the risk is 3*5=15.

Tornado - Risks type. Very High Impact (i.e. 5 on a 1-5 scale), Medium Probability that it hits a specific location (i.e. 3 on a 1-5 scale), so the risk is also 3*5=15. How to differentiate the two: using the pattern Imminent First.

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6. REFERENCES