When Risk Management Meets Risk Realized: Mitigating Project Impact[1]

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ABSTRACT

Most project managers are familiar with the practice of developing risk registers, and the need to evaluate and plan for risk in a major project. But what happens when a risk is realized in spite of your best planning? How we respond to a crisis when one occurs is vital to limiting the potential impact of a realized risk to the outcome of the affected project.

This paper will emphasize the importance of performing detailed emergency response planning *before* a problem occurs. We will explore tools and techniques for preplanning for the known risks. Using construction project risk management as a framework, we will also look at multiple case studies where a potential risk occurred, causing damage to infrastructure and/or injury to workers. This exercise will illustrate how cost and delay impacts can be mitigated through the decisive application of preplanned contingency and response plans.

The Project Management Institute's PMBOK Guide 5th Edition describes Project Risk Management as "the processes of planning, identification, analysis, response planning and controlling risk on a project." It further states that "the objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events on the project. In this paper, we will focus on identification of risks, planning for risk responses, and controlling risk through execution of response plans.

RISK MANAGEMENT

What is risk management? Project Risk Management Processes as defined by PMI:

> **11.1 Plan Risk Management** – defining how to conduct risk management activities for a project
>
> **11.2 Identify Risks** – process for determining which risks may affect the project
>
> **11.3 Perform Qualitative Risk Analysis** – prioritizing risks for probability of occurrence and impact
>
> **11.4 Perform Quantitative Risk Analysis** – numerically analyzing the effect of identified risks

[1] *Editor's note: Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally presented at the 11th Annual UT Dallas Project Management Symposium in August 2017. It is republished here with the permission of the authors and conference organizers.*

11.5 Plan Risk Responses – developing options and actions to reduce threats to project objectives

11.6 Control Risks – process of implementing risk response plans

Source: PMBOK Guide, 5th Edition, Page 309

A key component of any risk management exercise is identification of risks that could impact the project. *"Identifying Risks is the process of determining which risks may affect the project and documenting their characteristics."* Source: PMBOK Guide, 5th Edition, Page 319

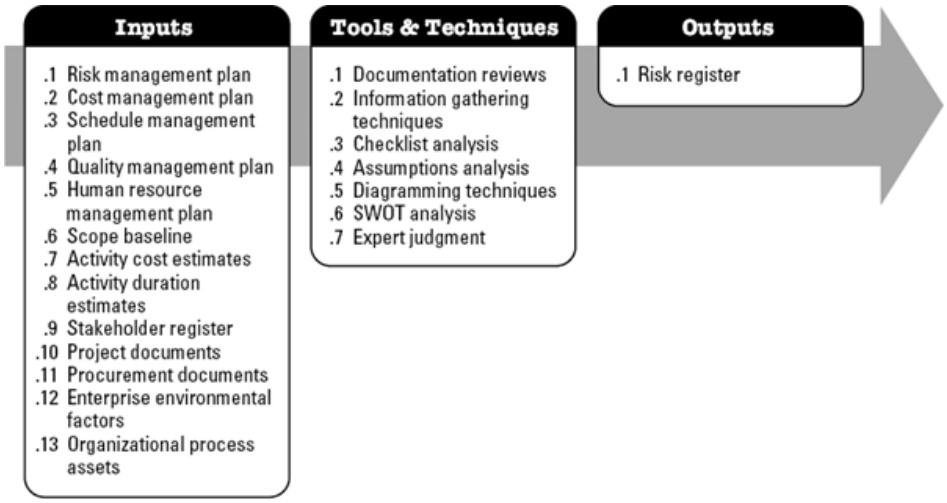

Figure 11-5. Identify Risks: Inputs, Tools & Techniques, and Outputs

How do you determine what the potential risks are to your project? PMI recommends a number of tools and techniques designed to help you answer this question:

<u>11.2.2 Risk ID Tools & Techniques</u>

11.2.2.1 Documentation Reviews – structured review of plans, assumptions, and other information

11.2.2.2 Information Gathering Techniques –

Brainstorming, Delphi technique, Interviewing, Root Cause Analysis (RCA)

11.2.2.3 Checklist Analysis – developed based upon historical data, quick but may not be comprehensive enough

11.2.2.4 Assumptions Analysis – explores the validity of assumptions as they apply to the project

11.2.2.5 Diagramming Techniques – cause and effect diagrams, process flow charts, influence diagrams

11.2.2.6 SWOT Analysis – strengths, weaknesses, opportunities and threats (SWOT)

11.2.2.7 Expert Judgment – expert relevant project experience

Source: PMBOK Guide, 5th Edition, Pages 324 - 327

The output of the Identify Risks Process is the Risk Register. The risk register begins as a list of possible risks that the project could encounter. Some recommended best practices:

- Research similar external projects
- Include risks realized on previous internal projects
- Consider relevant environmental and cultural risks unique to the project
- Include Subject Matter Expert (SME) input (i.e. expert judgment) when developing

The risk register should also include a list of potential responses to the identified risks. Best practices include:

- Include historical data from previous internal projects where similar risks were realized
- Incorporate lessons learned and other historical information from similar external projects
- Subject Matter Expert (SME) input (i.e. expert judgment) when developing response plans

Now that you have defined the risks, the next step is to develop response plans to address the risks should they occur.

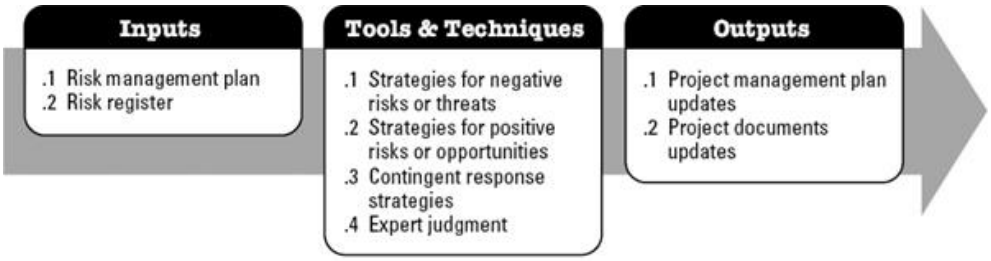

Figure 11-18. Plan Risk Responses: Inputs, Tools & Techniques, and Outputs

The PMBOK Guide notes strategies for planning and responding to risks, both negative and positive.

11.5.2.1 Strategies for Negative Risks or Threats

- **Avoid** – project team acts to eliminate the threat (examples include extending the schedule, changing the strategy, or eliminating scope). Most radical avoidance strategy is to shut down the project.

- **Transfer** – project team shifts impact of a potential threat to a third party, together with ownership of the response.
- **Mitigate** – acting to reduce the probability of occurrence or impact of a risk.
- **Accept** – project team decides to acknowledge the risk and not take any action unless the risk occurs.

Source: PMBOK Guide 5th Edition – Pages 344-345

11.5.2.2 Strategies for Positive Risks or Opportunities

- **Exploit – eliminate the uncertainty associated with a particular upside by ensuring the opportunity definitely happens.**
- **Enhance – increase the probability and/or the positive impacts of an opportunity.**
- **Share – allocating some or all of the ownership of the opportunity to a third party who is best able to capture the opportunity for the benefit of the project.**
- **Accept – being willing to take advantage of the opportunity if it arises, but not actively pursuing it.**

Source: PMBOK Guide 5th Edition – Pages 345-346

So why don't we plan for the inevitable? Since we know that risk is inherent to the project management process, shouldn't planning to minimize or eliminate threats be the standard operating procedure? Some reasons why we fail to complete risk planning include:

- Fear
- Desire to be positive versus pessimistic
- We don't know what we don't know
- Lack or resources (staff, time, funding, etc.)
- Expediency (i.e. politics or cultural norms)
- Appearance of weakness
- Low probability of occurrence equates to low priority to plan for event

What are some of the different types of response plans?

- Emergency Action Plans (EAP)
  - First Response Plans
  - Emergency Drills (Practicing responses, analyzing results, refining plans)
- Contingency Plans
  - Time (Schedule – project float, pull-planning, etc.)
  - Cost (Contingency budgets)
  - Scope (Bid alternates, phasing, shell space, etc.)
- Recovery Plans
  - Business Operations Continuity Plans
  - Impact Analysis (expert judgment)
  - Remediation Plans

Now that we have our plans in place, we are ready to deal with an actual risk occurrence. PMI defines this process as "control risks:"

> "Control Risks is the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project."
>
> Source: PMBOK Guide 5th Edition – Page 349

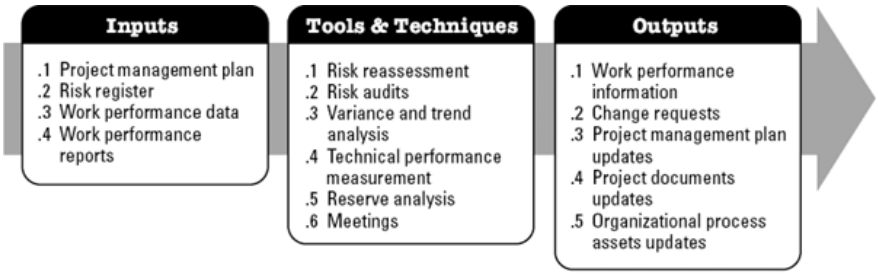

Figure 11-20. Control Risks: Inputs, Tools & Techniques, and Outputs

11.6.2 Control Risks: Tools & Techniques

- **Risk Reassessment** – identification of new risks, reassessment of current risks, and closing of risks that are outdated
- **Risk Audits** – examine the effectiveness of risk responses in dealing with identified risks and their root causes
- **Variance and Trend Analysis** – comparison of planned results with actual results
- **Technical Performance Measurement** – comparison of technical accomplishments to the schedule of technical achievement
- **Reserve Analysis** – compares amount of contingency reserves to the amount of risk remaining to determine adequacy of reserves
- **Meetings** – regular meetings to review risk status of project

Source: PMBOK Guide 5th Edition – Pages 351-352

You have planned the work – *now you need to work the plan.* When a major risk has been realized, you need to react accordingly:

- Activate Emergency Action Plan (EAP) – protect life first, then stabilize the situation to prevent additional damage or loss
- Employ SME evaluation of damage conditions & remediation recommendations
- Resolve roadblocks to moving forward
  - Regulatory holds (i.e. OSHA project shut down)
  - Investigative holds (i.e. forensics, insurance, etc.)
- Divide and conquer – **run activities in parallel** where possible to mitigate project impact
- **Reassess risk** – modify processes as needed to prevent recurrence of similar risks

- Make "Lessons Learned" versus "**Lessons Heard**" – *shared knowledge is only useful if acted upon by the hearer and incorporated into the organization database*

The only thing more tragic than a risk realized is when the **valuable knowledge** gained by the Project Manager in dealing with that risk *is not passed on to the PM community.* Most mature PMOs maintain a database or library of Lessons Learned as an organizational process asset. The same is true for many professional organizations.

Yet there are obstacles to open sharing of lessons learned:

- Hesitancy to air "dirty laundry" that may adversely affect PM professional reputation
- Potential legal ramifications
- Potential E&O insurance ramifications
- Perceived threat to career advancement
- Workload limits review and adoption
- Poor communication
- "Convenient memories" of management

So how do we overcome the obstacles to open sharing of lessons learned in the Project Management Community?

A few suggestions:

- Focus on **team** performance improvement
- Don't make it personal (or take it personally)
- Regularly refocus on your core mission (i.e. the project)
- Reward team members for sharing information (you get what you reward!)
- Make lessons learned a formal part of your project close-out process
- Make open information sharing part of your organizational culture

RISK REALIZED

Risk management is of critical importance on construction projects. The University of Texas System is committed to exceeding OSHA safety requirements, and maintains a robust safety program and rolling owner controlled insurance program (ROCIP).

Incidents on construction projects may still occur despite our best efforts, but we continually strive to improve safety by applying RM best practices and sharing "Lessons Learned" across the State.

The following examples provide insight into using contingency and emergency response planning to respond to realized risks, thereby minimizing the impact to the affected project.

- Example #1 – Spontaneous Combustion
- Example #2 – Drilling for Copper
- Example #3 – Drilling for Copper (revisited)
- Example #4 – Catastrophic Collapse

Case Study #1 – Spontaneous Combustion

At approximately 3:00 am on **November 30, 2016**, the City of Richardson Fire Department responded to a **fire** at the construction site for Student Housing Phase VII project at the University of Texas at Dallas. The fire was confined to the surface of the roof on the east wing of the new wood-framed apartment building, and was (thankfully) quickly extinguished before the wood-framed structure could become fully involved. The building structure at the time of the fire was topped-out, but the building was not dried-in. As such, the interior finishes had not yet begun. While there was water damage on all four floors of the affected wing from the firefighting effort, the damage to the interior was minimal, affecting mostly batt insulation in the corridors and minimal gypsum wall board.

The fire/arson investigator for the Texas State Fire Marshal's Office (SMFO) met with the construction team on 11/30/2016. In consultation with the first responders (C.O.R. Fire Dept.), the SFMO determined the cause of the fire to be **"spontaneous combustion of a used cotton roofing mop left on the roof overnight."** A copy of a 2003 Interface article was provided to the team. The article by Derek A. Hodgin, a forensic engineer, is titled "Spontaneous Combustion of Roofer's Mops – A Review." According to the article, "While conventional built-up-roof assemblies can provide years of dependable service at a competitive price, concerns regarding the use of hot asphalt have been expressed by building owners and insurance companies with primary concerns regarding fumes and fire. One particular cause of fire is the spontaneous combustion of roofer's mops.

Spontaneous combustion of roofing mops can occur when oxygen from the air slowly unites with the flammable asphalt. As oxidation takes place, heat accumulates in the mop. The **solidified asphalt** on the exterior of the mop head **retains the heat** inside of the mop, and smoking of the mop begins. Under the right circumstances (mop head material, the mass of asphalt available, ambient air temperature, etc.), the mop will eventually catch on fire. **If the mop remains on the roof or is adjacent to other flammable building components, *this process can be disastrous."***

Our investigation confirmed that a used cotton roofer's mop was left in a tar-filled Georgia buggy on the roof overnight. The previous day, roofing work was completed on a modified bitumen base ply around 9:00 am in the morning. At the close of the work day, the roofing Superintendent checked on the roof, found that the tar in the Georgia buggy had solidified, and left assuming there was no further fire risk to worry about. Per the previous quote from Derek Hodgin, the risk was still there and in fact resulted in a fire about 16-hours later.

The article continues by providing recommendations for avoiding spontaneous combustion of roofer's mops:

1. Consider the mop head material (fiberglass vs. cotton)
2. Remove excess asphalt from roofing mops at the conclusion of use
3. Consider quenching the mop head in a bucket of water
4. Store used mops in sealed metal containers
5. Keep used mops off the roof and away from combustible materials
6. Comply with applicable standards / ordinances regarding worksite safety and fire protection

Following the fire, our team immediately put the above recommendations into practice. The roofing subcontractor then attempted to use fiberglass mops, however; the specified roofing kettle temperature caused the mop heads to dissolve in the asphalt. As such, we authorized the subcontractor to return to the proven method of using cotton roofing mops, with the proviso that all used mops needed to be removed from the roof ***daily*** and all used mop heads be stored in metal containers with lids placed well away from anything combustible.

Steps taken to mitigate the impact to the project:

- **11/30/2016** – AE Team / Structural Engineer of Record conducted full investigation
- **11/30/2016** – CM@R elected to immediately reorder 24 wood roof trusses
- **12/1/2016** – Insurer collected evidence and damaged equipment was removed
- **12/1/2016** - Roof was tarped down ahead of severe storms
- **12/6/2016** – damaged roofing, decking and 14 roof trusses replaced as EOR directed
- **12/12/2016** – project restored to pre-fire condition **(12 days elapsed since incident)**

The Construction Manager at Risk (CM@R) was able to resequence the work such that no delay to the opening of the apartments in mid-July 2017 is anticipated.

What Processes Failed:

- **Understanding the risk** of spontaneous combustion – the roofing Superintendent was unaware of the potential fire risk
- **Housekeeping best practices –** many roof manufacturers recommend removing used cotton roofing mops at the end of every work day
- **Communication** – the project insurance underwriter had published info in June of 2016 that was not shared with UTD

What Processes Worked:

- UTD Police regular driving **patrol** spotting and calling in the fire to the local Fire Department
- Contractor's **quick response by** removal of water, damaged insulation and drywall limited the spread of damage to adjacent areas

- OFPC issued new guidelines for remainder of roofing work that **eliminated the risk of recurrence**

Thanks to a team effort to mitigate impact to the project schedule, the building is on schedule to open for the Fall 2017 semester.

Case Study #2 – Drilling for Copper

During foundation work for the new Math Science Engineering & Teaching Building (MSET) in February of 2009, a pier-drilling rig penetrated a buried medium-voltage duct bank, knocking out power to (15) buildings. Fortunately, no one was injured in this dangerous incident. However, the associated damage to affected switch gear involved repairs that took six-weeks to complete.

What Processes Failed:

- **Adequate supervision** of equipment operators could have prevented the incident
- General Contractor (GC) insistence that all subcontractor supervisors attend a meeting while site work continued contributed to the lack of field supervision
- **RFI process failed** – the drilling subcontractor working with the GC should have pointed out the utility / structure conflict to the Owner and Architect, and requested direction to resolve the conflict

What Processes Worked:

- Breakers worked as designed (no injuries)
- Subsurface Utility Engineering (SUE) successfully located all utilities within the building footprint
- High risk utilities were located and visible - the concrete encased duct bank containing 500 MCM cable in conduit was not exposed but the manholes on either end were so the risk was visible to workers
- Emergency Action Plan was given a "real world" test

Case Study #3 – Drilling for Copper (revisited)

The OFPC team applied the lessons learned from the previous pier-drilling incident with the entire statewide team. In spite of application of that knowledge, a similar incident occurred the following year, also at UT Dallas. The good news – no one was injured, and only (3) campus buildings were affected. The bad news – one of those buildings was the Central Energy Plant providing chilled water to all buildings for air-conditioning. In other words, the incident shut-down the entire campus for a day.

What Processes Failed:

- Pier drilling subcontractor **did not ask for assistance** when he encountered unexpected rock while drilling the pier (it was actually the duct bank)
- After cutting into the duct bank but before damaging the conductors, water was encountered. Again, had the contractor asked for assistance at this point, conductor damage could have been avoided

What Processes Worked:

- UTD FM was able to shed loads and switch primary feeders to the Central Plant, restoring full cooling capacity in less than 24-hours.
- Construction Manager's decision to quickly repair duct bank and reorder new 750 MCM conductors resulted in restoration of normal power in just six-days
- CM@R resequenced the work so that the incident did not delay opening of the critically needed housing project

OFPC now requires use of ground-penetrating radar surveying of utilities. Where feasible, in lieu of pot-holing, **completely exposing duct banks** where they are in close proximity to planned building structures is recommended. For S.U.E. – we require "locating "of utilities in three-dimensions including **depth** (Level A). All as-built or record information provided on new construction projects is carefully reviewed prior to acceptance to **increase accuracy** of these vital records.

Case Study #4 – Catastrophic Collapse

On a sunny Saturday in July 2012, a tragic incident occurred during dismantling of one of two tower cranes on the Arts & Technology Building (ATEC) project. Following the safe removal of the counter weights, jib, boom and turntable earlier in the day, the remaining mast section collapsed onto the new building during dismantling efforts, resulting in two fatalities.

Timeline

- **7/7/2012 Saturday** - Crane Subcontractor dismantling crew begin Series 4 tower crane dismantling in the early morning hours
- Boom and turntable safely removed by early afternoon
- At 3:20 pm, the mast section collapses during 45+ mph gusty winds preceding a storm
- Mast section falls due west landing entirely on the ATEC roof (2) Crane Subcontractor workers that are tied-off on the upper mast are killed
- **3:25 pm** – first responders on site / cordon off site controlling access to officials
- **5:30 pm** – OSHA inspector arrives and interviews witnesses
- **7:00 pm** – EMS completes recovery operations and releases control of the site to the CM@R

- **7:40 pm** to dark – OFPC conducts initial forensic investigation

The crane subcontractor's Job Hazard Analysis (JHA) indicated plan to remove the mast in 40' sections (2 – 20' tall sections in each pick). Investigators discovered that 6 of the 8 bolts between every other section were removed all the way down to ground level, leaving only 1 bolt on diagonal opposite corners holding the sections in place. The remaining bolt on the east side could not resist the lateral load and sheared during the wind event, resulting in the collapse of the mast

What Processes Failed:

- Assumption by Owner and CM@R that as the subject matter experts, the dismantling crew "knew best" how to safely execute the work
- Adequate supervision of dismantling crew by CM@R safety staff could have prevented the early removal of the bolts, especially as this deviated from the approved Job Hazard Analysis
- Normalization of deviation – the early bolt removal practice, although extremely dangerous, had become the "normal" way of dismantling for the seasoned crew

What Processes Worked:

- Area treated as a crime scene, secured and evidence protected – this allowed the OSHA inspector to quickly release the "hold" on continued construction
- AE team conducted a thorough impact analysis allowing safe removal of damaged steel
- CM@R reordered damaged steel members immediately using previously approved shop drawings
- In addition to review and approval of JHA's, OFPC's safety staff now know to look for these kind of "short-cut" practices and head them off early

OFPC now employs a **third-party crane inspection service to supervise** the erection (and dismantling) of all cranes on OFPC-managed jobs. Our staff has shared the lessons learned from this incident state-wide to ensure it never happens again.

SUMMARY

Start with the basics – understand and apply risk management best practices to all of your projects. Make sure that you include response and recovery planning – know and understand the risks unique to your projects. When a risk is realized, assertively execute your response plans, measure the results of your execution, and make refinements as needed. Lastly, ensure that the valuable lessons learned on your projects become organizational assets, and share them with openly with your PM colleagues.

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Vince Yauger, AIA, CCCA, CCM, LEEP AP, PMP has 36-years' experience in design and construction, working as a project manager for both private industry and the government sector. His construction experience covers a broad spectrum of building types, ranging from small residences to multi-million dollar multi-family high-rise, airport terminals, and higher education projects. Vince currently serves as a Resident Construction Manager / PM for the University of Texas System Office of Facilities Planning and Construction - managing new construction and major renovation projects at the University of Texas at Dallas campus since 2007.

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Past speaking engagements include a keynote address at the 2015 UTD PM Symposium, 2016 Virtual Construction and Field Technology Conference, UTD Applied Project Management Forum, 2013 Texas Society of Architects Convention, 2013 UTD Facilities Management Conference, and multiple UT System OFPC annual conferences. He also serves as a guest lecturer for UTD's PM core curriculum program, speaking to groups of foreign graduate students visiting UT Dallas, and conducting construction site tours on campus.

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