EM

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Risk Management System for Vestas Wind Farms

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Executive Summary

Improvements to the risk management system(RMS) and the means to implement this RMS within the project management group at Vestas Americas are proposed in this report.

Wind farm construction is a complex process that does not require advanced innovative technology. Therefore this process requires a "qualitative" risk response plan [1]. Vestas' current risk plan is not comprehensive. At present, project managers focus on the critical path and on managing current risks. They look at current risks using probability and impact assessments that vary from project to project and from manager to manager.

This report proposes the following risk management system improvements:

- Perform a broader and more uniform risk response plan prior to project start
- Add the risk log to the risk response plan
- Create consistent probability and impact assessments
- Use earned value analysis for improved schedule control
- Include Monte Carlo analysis for better transportation time estimates
- Use retrospectives to benefit from lessons learned as the project proceeds

A pilot project will put these improvements to work in the Portland, Oregon office. Project managers, functional managers, and others will receive training. The results will be observed and adjusted as they are used over the life time of several candidate projects. Then Vestas will make a determination as to whether or not to phase in changes companywide.

Overall, these changes will result in the smooth implementation of better risk management control at Vestas, more reliable scheduling, additional reporting metrics, and long-term reduced costs.

Our team wishes to thank Mr. Matt Davidson, Vestas project manager, for his kind assistance with this report.

Goal

Our team offers an improved risk management system (RMS) for Vestas focusing on wind farm construction. The understanding of the current RMS comes from a team interview with Vestas project manager (PM) Matt Davidson[5]. The interview questions and summary answers can be found in the appendices. For the purposes of examining certain project management tools, this paper makes some assumptions which may deviate from actual company practices.

Vestas Background

Vestas Wind Systems is the parent company of Vestas American Wind Technology, Inc. which is headquartered in Portland, Oregon. Vestas Wind Systems, a Danish company, has become a world leader in wind turbine manufacturing. It is involved in the development, manufacture, maintenance, sales, marketing, and the occasional installation of wind turbine and power systems. Leading in its appeal is its perception of being 'clean and green'. In Europe, it has become a leader in social sustainability and environmental management.

From a small niche market inspired by the oil crisis of the 1970s, Vestas began to identify ways to create alternative sources of energy. The first wind turbines were manufactured in 1979 and delivered to Danish customers. Soon it expanded into Europe, India, and eventually the United States. By the end of 1985, Vestas had sold 2500 wind turbines to the US. Vestas and the wind energy market have grown dramatically since then, installing more than 9400 turbines in the United States and 35,000 turbines worldwide as of 2008 [3].

As recently as December of 2008, Vestas decided to expand local operations due largely to financial incentives offered by the State of Oregon ($19 million) and the City of Portland ($12.5 million) [2]. However, by February, the worsening economy threatened to jeopardize expansion plans, as the ongoing financial debacle has all but dried up funds for wind farms. U.S. companies are currently waiting on the outcome of the proposed federal economic stimulus package hoping that this package will free up money for the development of new wind energies, thus leading to new orders for Vestas [4].

SWOT Analysis

A Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis of Vestas American Wind Technology is as follows:

Figure 1: SWOT Analysis

Strengths	**Weaknesses**
Product longevity Strong, dominant market position Support of local and state government Local support for green energy Technical support for wind turbines	Lack of product diversification Huge backlog of orders Poor contractor installation quality
Opportunities Highly educated local work force Financial incentives provided by local and state government Customer base for renewable energy	**Threats** Current poor economy Lack of capital for wind farms Infrastructure limitations Highly competitive market Boom/Bust cycle of government funding Environmental concerns

Vestas Project Management Background

Project Managers (PMs) for Vestas are responsible for moving wind turbine generators (WTGs) to the wind farm site. They make sure that people, equipment, and materials are available to erect the turbines. Vestas may install the WTG or they may provide technical oversight on a non-Vestas installation. They do not connect the WTGs to the power grid. The PM's project is complete when the punch list is complete for the final WTG [5].

The major risks concerning project managers are quality and time [5]. The primary quality concern results from non-Vestas WTG installation. Vestas resolves this by establishing a reference WTG to set guidelines for quality. In terms of time, resources need to be available to meet the number of WTGs to be delivered per week as given by the Vestas sales department. In addition, the WTGs must be erected before winter weather sets in or they will suffer degradation. Vestas PMs concentrate on such scheduling issues.

Vestas' Strategy and Risk Management System Alignment

Vestas is a leader in its field. It succeeds by differentiating its product as high quality and high cost. Milosevic (p. 6, [1]) shows that such a strategy has a schedule concentration for project management. This fully aligns with the current Vestas project manager focus on scheduling.

Matching the Project Type with the Risk Management System

Building a wind farm is an administrative type of project according Milosevic's description [1]. It uses established WTG and construction technology, its scope changes do not appear to be a major issue, and it necessitates significant integration between multiple departments (p.529, [1])

Since these are complex projects, they require a "detailed scope", "large WBS", and detailed critical path charts (p. 532, [1]). On the other hand, a "qualitative risk response plan" suffices because the potential risks are well known (p. 532, [1]). Costing is taken to be outside of the scope for purposes of this report.

Current Risk Management System Practices

The current RMS at Vestas matches the differentiation strategy with a focus on scheduling and with recommendations for an administrative project in terms of schedule; it exhibits loose agreement for an administrative project in terms of risk plan. PMs at Vestas make detailed schedules and identify the critical path. For risk response planning, PMs check the elements on the critical path in advance and aim to remove transportation and resource availability issues out of the critical path. Also, PMs assess the qualitative probability and impact of issues. However, these assessments lack consistency from PM to PM and tend to cover problems which have already occurred, not future risks. The team identifies additional issues as they come up and keeps a record of them. They check issue resolution in weekly meetings. Comprehensive risk response planning is not performed in advance at Vestas.

Defining the Scope

This paper develops a risk management system for wind farm construction projects managed by the project management group at Vestas. Risk management systems are examined in terms of time issues, the main concern of Vestas project managers and the main companywide concern given Vestas' differentiation strategy. Both quality and costing issues are outside of the scope. The proposed risk management system and Vestas' success, techniques, tools, and implementation strategies are all examined.

Proposed Risk Management System

How the Risk Management Improvements Will Help Vestas to Be More Successful

The SWOT, found in Figure 1: SWOT Analysis, shows that Vestas has a large backlog of orders. Vestas is also in a very competitive field. Although they have the dominant position, they need to make sure they can maintain their market leadership. Having a large backlog is an opportunity for competitors to offer timelier project completion.

Implementing risk response planning will ensure that Vestas can keep to its schedule with higher confidence. It will give them the ability to make concrete plans to reduce their backlog. They will enhance their current risk control by recording the information from weekly meetings in the Risk Log. They will get a better handle on risks by assessing P-I ahead of time. Earned value will give them a truer picture of schedule progress, allowing proactive schedule control. Monte Carlo analysis will help put a boundary on transportation risks and yield better time planning. Retrospectives will allow teams to implement improvements and reduce risk on an ongoing basis in projects.

The team proposes making the following improvements to the Vestas risk management system:

- Implement a Risk Response Planning procedure prior to project go-ahead
- Add a Risk Log to the Risk Response Plan using current procedures of identifying and recording risks and checking on them in weekly meetings
- Improve the P-I Assessments by:
    - Evaluating P-I ahead of time
    - Work with management to come up with a list of candidates for consistent evaluations of probabilities and impacts
    - Implement consistent formulas for P-I score
    - Work with management to have standardized determinants of what measures to take based on P-I score/location in P-I matrix
- Implement Earned Value Analysis in the schedule control process

- Improve scheduling estimates on transportation with Monte Carlo Analysis
- Implement a system of retrospectives for process and behavior improvements during the project and for transference to future projects

An explanation of each improvement tool and its importance in risk management will be explored next in this paper.

Risk Response Plan

"The risk response plan communicates how specific risks will be dealt with and the action steps that are required to carry them out. It gives team members a clear sense of the actions that they are expected to take and provides management with an understanding of what actions are being taken on their behalf to ameliorate project risk."[6]. The risk response plan helps project managers proactively deal with risk before risks occur.

The first task in developing a risk response plan is to identify risks that may impact a project. A systematic method should be used so that the interaction of risks with other risks can be noted. As the situation changes during the project, risks must be updated. Next, the risks which are most important should be identified and ranked according to the project impact. This plan will use the probability (P) and impact (I) matrix as discussed below. Then, the project manager and other key people need to choose how to respond to the risk. The preventive action, trigger point, and contingent action are developed in case of risk occurrence [1]. Preventive action is the preferred strategy. The trigger point is a means to identify when the primary strategy fails and the company must switch to contingent action or the backup plan. Response strategies fit into four categories. The company may eliminate the risk, shift "ownership of the response" to outside the company, reduce the risk's impact, or accept the risk (for low risk scenarios) [1]. Interactions between risks should be considered when choosing the response. The next powerful, yet simple, requirement is naming an owner for each risk. Owners manage that particular risk and its interactions with other risks. All of the above are documented in the risk response plan.

Creating the risk response plan gets the team on board to manage risks prior to their occurrence. It creates agreement on how to handle problems before they arise. It is a vehicle to be on the lookout for trouble. Part of the risk response plan is continuing to monitor the risks to determine when trigger points call for contingent action. Refer to Appendix: Figure 3 in the appendices for an example of how Vestas Americas would use the risk response plan to document and respond to risks.

Risk Log

The risk log is an extension of the risk response plan. It should be used by a project manager to record, track and manage all the risk identified throughout the project. It is based upon the established Risk Management Plan and Risk Response Plan. The three major steps which fully define the purpose and content of the Risk Log are:

1. Use the risks as established in the risk response plan.
2. Evaluate the current risk mitigation status. This can be done in meetings, such as the current Vestas weekly risk meetings.
3. Determine the next steps to recover and mitigate the risk.

The risk log assists the project manager to ensure that work is ongoing to reduce and track risk. It keeps risks a visible part of the project management process. Appendix: Figure 4 in the appendices shows a sample risk log that could be used at Vestas.

Probability Impact Matrix

A probability and impact matrix (P-I matrix) is the combination of probability of occurrence of a risk and numerically rated impact, or severity. It is used to select which risks need to be addressed in the risk response plan [7].

For creating a P-I matrix, the organization should follow the steps below:

- Define a risk category such as schedule, cost, or quality.
- Determine how probability and impact will be defined in numerical terms.
- Calculate the risk event status by multiplying the probability and impact values
- Using the risk event status value, agree on which risks are severe enough to require response in the risk response plan.

The P-I matrix is a vehicle to choose which risks are most important. Beyond this, achieving agreement on P-I scoring means that the team has a unified understanding of the likelihood and consequences of individual risks to the project.   Appendix: Figure 6 in the appendices shows a sample P-I matrix created for projects at Vestas. Note in Appendix: Figure 6 that the P-I matrix risk event status values can be combined to reflect a number of risk categories by weighted summation.

Earned Value Analysis

Earned Value Analysis (EVA) is a technique used to track the progress and status of a project and forecast the future performance. EVA integrates the scope, schedule and cost. There are three dimensions of earned value. Brandon [8] defines these as:

- The planned value (PV), which consists of the authorized work, along with the authorized budget, within the authorized time-frame, which in total forms the project baseline
- The earned value (EV), which is the authorized work which has been completed, plus the original budget for this work
- The actual costs (AC) incurred to convert the planned value into the earned value

By using earned value metrics, project managers may accurately monitor and measure performance against a firm baseline. Measurement of PV, EV and AC must take place at regular intervals (such as monthly or weekly depending upon the project). This will help the project manager to calculate the true health of the projects. Please reference Appendix: Figure 5 in the appendices for an example of earned value.

Monte Carlo Analysis

Monte Carlo analysis (MCA) uses random sampling to model a project. For example, suppose that each activity in the project is given a probabilistic time function. MCA will take many random samples of these functions to calculate expected time and other statistics for each path within the project [9].

Figure 2 below illustrates how to apply Monte-Carlo analysis to a simple schedule for transporting a turbine from the warehouse to the work site. Even though the maximum time is 180 minutes and the best is 120 minutes, the example shows that it takes between 145 and 164 minutes. The illustration below uses only 3 simulations which are distributed uniformly, but there are many software packages available in the market which could simulate thousands of iterations for better accuracy (illustration adapted from [9]).

Figure 2: Monte Carlo Analysis

Item	Range of time*	Simulation 1	Simulation 2	Simulation 3	Best Case	Worst Case
Load Generator in the truck	10 to 15 minutes	15	11	12	10	15
Drive the truck from warehouse to site	100 to 150 minutes	120	140	130	100	150
Unload the Generator from the truck	10 to 15 minutes	10	13	14	10	15
Total		145	164	156	120	180

Monte Carlo analysis gives more complete information on time and cost. This analysis is an extremely valuable tool for improving project execution and managing risks associated with the schedule [9].

Retrospectives

Retrospectives are a way to look at the lessons learned during project implementation and the lessons learned at the end of the project. Retrospectives are typically used at the start of a project after the planning stage, mid-way into the project, and sometime after the project's completion. They should be led by an experienced facilitator outside the team to bring objectivity and keep comments constructive [10]. An action plan with owners for implementing improvements should come out of the retrospective. Key to this process is the change agent, a committed team member who guides change in the team. Through looking at the lessons learned, it is possible to improve the ongoing project and these improvements can be passed onto relevant projects coming up on similar stages. Appendix: Figure 10 and the retrospectives section in the appendices contain further explanation of retrospectives and give an example action plan output.

Retrospectives keep good practices on track during a project, enable changes for improvements during a project, and pass on key learning as needed throughout the company. The idea behind retrospectives is simple, however, implementation may require expertise. Retrospectives have a powerful potential to proactively manage risks associated with project processes and behaviors [10].

Training Plan

In order to implement a risk management system across a company with over 20,000 employees operating in multiple countries, we recommend a pilot program to be implemented first in the Portland, Oregon office and later spread around the company. Project managers and internal stakeholders will hold an initial day-long meeting to plan the program and assign responsibilities. The methodology for implementing this pilot program follows the risk management process as outlined by Tah and Carr [11]. The phases are as follows: identification, assessment, analysis, control, and monitoring. The specific tools used in this analysis are the risk response plan, risk log, probability-impact matrix, Monte Carlo analysis, earned value, and retrospectives.   Please reference Appendix: Figure 7, Appendix: Figure 8, and Appendix: Figure 9 in the appendix for an example of the breakdown of parties involved, schedule network diagram, and costs incurred to implement such a system. The dollar values presented in the appendix are purely for illustrative purposes.

Identification, Assessment, Analysis, and Control of Risks

Since Vestas has a preexisting non-uniform risk management system, the first step in developing a risk management system is to identify, assess, analyze, and control all risks. We require a two-day meeting with the project managers and functional managers in the Portland office. To expedite this process, we request that the project managers review past performance and come prepared with a list of potential risks.

A high-level sponsor shall pick experienced and confident project managers to form an implementation team to lead this two-day meeting. This implementation team will need one extra half-day to prepare for this meeting. The two-day meeting will ideally be held in the winter, or when the construction season is at a lull. The expected outcome from this meeting is a risk response plan, a standardized probability-impact (P-I) matrix, and a determination of what risks are high-priority based on the P-I assessment. The probability-impact matrix will show identified and assessed risks. The risk response plan will show the analysis and the control actions on the high-priority risks. These tools, along with the implementation of these tools, shall be used on all future projects. Review processes will need to be implemented in order make the risk response plan, risk log, and P-I matrix living documents.

Implementing Monte Carlo Analysis

This same implementation team should use all responses from project managers in order to have input data for the Monte Carlo analysis (MCA). As an example, we can look at the risk of inclement weather on a delivery date. Some project managers may say that if a turbine is shipping 1000 miles on rail lines and a snow storm hits, then that turbine will be delayed two to five days, whereas others may say that it would be a one to four day delay. While the example provided could easily be solved mathematically for one risk, it would prove useful across an entire project to use collected probabilistic functions to develop a more reliable completion date on a project. These functions should be updated with real data and adjusted as necessary.

For the pilot program, one person shall be appointed the task of updating these probabilistic functions and update them from the risk response log from one year of work data across Vestas wind farms. On a company-wide level, we strongly suggest implementing a cost management implementation office (CMIO) that could also track and analyze this data as was detailed by Tah [11] for the Jet Propulsion Laboratory. This CMIO will also be instrumental in ensuring that earned value is effective as is detailed in the following section.

Implementing Earned Value Management

To implement Earned Value Management (EVM), we require a one-day training meeting involving upper management, accounting (accounts receivable and accounts payable), project managers, and functional management. EVM requires a companywide commitment. In the Portland office, we will need one person responsible for earned value implementation. They are to have the complete support of upper management to reduce resistance from the project managers, the accounting department, procurements, and other functional departments within the company (p. 159, [12]). On a company-wide scale, we recommend creating a CMIO section which would be responsible for "EVM training, cost performance reporting independent assessment, audit support and surveillance"[11]. According to Tah [11], the earned value management system is based on nine process areas included "organizing, scheduling, budgeting and authorization, accounting, indirect management, material management, subcontract management, managerial analysis, and change incorporation".

Monitoring Risks (Retrospectives)

Retrospectives will start on the initial candidate project for the pilot and leapfrog onto other projects as they start. The initial project shall be in beginning stage so that the pilot program can cover implementation of all new tools for the full project lifecycle. The team on the selected project must be open to making improvements. They must be willing to buy into making honest constructive and sensitive evaluations. A good change agent is necessary on the team.

There will be an initial half-day explanatory session on retrospectives for certain individuals in the pilot who are: all project managers, functional managers, internal stakeholders for projects, stakeholders for the RMS implementation, and key members of the candidate project will also attend. A consultant expert in retrospectives will hold this session.

The first several retrospectives in the company will use the consultant as the facilitator. Each retrospective will take one day, and three will be held during a project lifetime. The time for a retrospective could be cut to a half day and the number during a project lifetime can be adjusted as experience grows.

Facilitator skill and neutrality are essential. As Vestas project managers understand the process, they will be able to facilitate retrospectives themselves. Facilitators will still need to be outsiders to the project being examined.

Phased Implementation

Several wind farm construction projects over their lifetimes will be needed to see how well these new processes and tools work for Vestas. Training itself will take less than one month (see Appendix: Figure 7 in the appendices). Sometime after a pre-determined number of trials, project team members, functional managers, internal stakeholders, and project managers can evaluate the pilot program results in a half-day meeting with the help of a neutral consultant to make a decision on whether or not to phase in these changes throughout the company.

Conclusion

Vestas will have better risk control with the proposed, more comprehensive, risk management system. They will be able to maintain their market leadership by reducing scheduling risk. Risk response planning will take place prior to starting the project, allowing management to be proactive. Current risk log practices will be enhanced by inclusion in risk response planning. Consistent probability and impact assessment will give all managers a standard method to determine when problems need to be addressed. Earned value analysis and Monte Carlo analysis will mean better schedule control. The training plan will allow leaders to become familiar with the new techniques and implement them smoothly. The use of retrospectives will allow Vestas to learn from any implementation problems and adjust for them on an ongoing basis. The pilot project gives a solid method to test how effective these processes and tools will be for Vestas, giving the company a chance to adjust techniques and make changes in a phased manner.

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Appendices

Appendix: Figure 3 - Risk Response Plan

RISK RESPONSE PLAN

Project name : Vestas | Rev #: 2 | Page #: 1 of 1 | Data : Feb. 1, 2009

Work package/ Task	Description of Risk	Probability (%) (a)	Project Impact	Risk Impact (day, $, etc.) (b)	Risk Event Status (a) x(b)	Impacted Risk Event Number	Plan			Responsibility
							Preventive	Trigger point	Contingent	
Transportation	Road weight capacity	30%	4	2day	0.6 day		Check route	Delivery Day	Change route	Youngkoo
	Bridge height clearance	30%	4	2day	0.6 day		Check route	Delivery Day	Change route	Youngkoo
	Delivery route acceptability for load	30%	4	2day	0.6 day		Check route	Delivery Day	Change route	Youngkoo
	Delivery route and effect on scheduling	70%	4	2day	1.4 day		Check route	Delivery Day	Find another route or transportation	Youngkoo
	Weather	30%	4	$100 or 3day	$30 or 0.9day		Check weather	Delivery Day	Find another route or transportation	Diane
Availability of Wind Turbine Generator	WTG available in storage facility	40%	2	10day	4day		Check the total stock	Delivery Day	Change to fast shipping route	Wendy
	Shipment of WTG available in time	80%	3	$100	$80		Tracking the shipping	Delivery Day	Change to fast shipping route	Wendy
Quality of WTG Construction at Wind Farm Site	Underbidding of contractors	80%	2	10day	8day			Construction day		Todd
	Quality of construction	80%	2	10day	8day		training the contractors	Construction day	change contractors	Todd
	Manpower	90%	1	$300	$270					Rajesh
	Additional Component Availability	70%	2	10day	7day		Monitoring Components		Order Component	Rajesh
	Scheduling Completion of Work	30%	1	$1000	$300		Monitoring all task	Due day	Notice to client	Diane

Project Impact : 1=Very High, 2=High, 3=Medium, 4=Low, 5=very Low

Appendix: Figure 4 - Risk Log

RISK LOG

Project name : Vestas

Page #: 1 of 1

Estimate Data : 2.30.2009

Work package/ Task	Description of Risk	Criticality	Plan			Actual				Responsibility
			Preventive	Trigger point	Contingent	Status	Date of Impact	Risk Impact	Recovery Action	
Transportation	Weather	C	Check weather	Bed weather on road in 2/20/09	Find another route or transportation	Preventive action one day behind schedule	2/20/09	$100 over cost	Using other transportation	
Availability of Wind Turbine Generator	WTG available in storage facility	NC	Check the total stock	No stock by 2/10/09	Change to fast shipping route	Preventive action one day behind schedule	2/10/09	10 day delay	Activate Contingent action	
Quality of WTG Construction at Wind Farm Site	Quality of construction	NC	training the contractors		change contractors	Preventive action 10 days behind schedule	2/25/09	10day delay	Activate Contingent action	

Appendix: Figure 5 - Earned Value

Total unit	30
buget per unit	250000
Planed Unit per day	0.5

Day	Actual complete units	PV	AC	EV	SV	CV	SPI	CPI	BAC	EAC	VAC
10	5	1250000	1650000	1250000	0	-400000	1	0.757576	7500000	9900000	-2400000
20	8	2500000	2650000	2000000	-500000	-650000	0.8	0.754717	7500000	9937500	-2437500
30	12	3750000	4000000	3000000	-750000	-1000000	0.8	0.75	7500000	10000000	-2500000
40	19	5000000	6450000	4750000	-250000	-1700000	0.95	0.736434	7500000	10184211	-2684211

BAC: Budget of Completion
PV: Budgeted cost for work scheduled; budget to date
AC: Actual cost of work performed; Actual cost to date
EV: Budget cost of work performed; Earned value; BCWP= units complete x budget per unit or % x BAC
SV: Schedule variance; SV = BCWP - BCWS
CV: Cost variance; CV= BCWP-ACWP
SPI: Schedule Performance index; SPI = BCWP/BCWS
CPI: Cost Performance index; CPI = BCWP/ACWP
EAC: Estimate at completion; EAC = (ACWP/BCWP) x BAC
VAC: variance at completion; VAC= BAC-EAC

Appendix: Figure 6 - Probability-Impact Matrix

Risk #	Description of Risk	Risk #	Description of Risk
1	Road weight capacity	7	Shipment of WTG available in time
2	Bridge height clearance	8	Underbidding of contractors
3	Delivery route acceptability for load	9	Quality of construction
4	Delivery route and effect on scheduling	10	Manpower
5	Weather	11	Additional Component Availability
6	WTG available in storage facility	12	Scheduling Completion of Work

Probability	Risk Score = P+ 2 x I				
NC	7	9	11	13	15
HL	6	8	10	12	14
L	5	7	9	11	13
LL	4	6	8	10	12
VU	3	5	7	9	11
	VL	L	M	H	VH
	Impact				

High Severity
Medium Severity
Low Severity

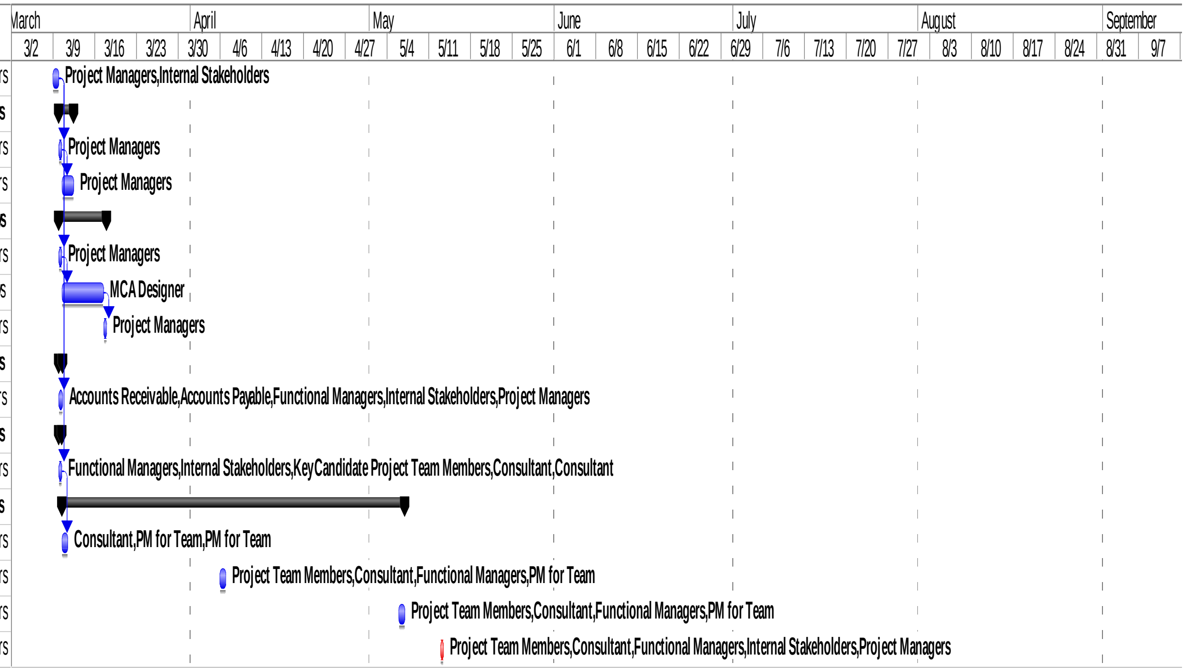
From : Milosevic, D. "Project Management Toolbox" Wiley and Sons, 2003

Risk #	Probability & Project Impact	Risk Score	Risk #	Probability & Project Impact	Risk Score
1	LL&L	6	7	NC&M	11
2	LL&L	6	8	NC&H	13
3	LL&L	6	9	NC&H	13
4	HL&L	8	10	NC&VH	15
5	LL&L	6	11	HL&H	12
6	L&H	11	12	LL&VH	12

Project Impact : VL= Very High, H= High, M= Medium, L= Low, VL= very Low.
Probability : NC= 100%~ 80% HL= 79%~60% L= 59% ~ 40% LL= 39%~20%, VU= 19%~0%.

Appendix: Figure 7 - Training Plan - Work Breakdown Structure and Schedule (Network Diagram)

ID	Task Name	Duration
1	Responsibility Interface Matrix (RIM) for Implementation Process	8 hrs
2	**Standardization Meeting for Risk Response Plan, Risk Log, P-I Assessment**	**2.5 days**
3	Prepare for Meeting	4 hrs
4	Hold Meeting	16 hrs
5	**Monte Carlo Analysis**	**6 days**
6	Initial Planning Meeting	4 hrs
7	Develop Model for MCA Use on Transportation	5 days
8	Model Training Meeting	4 hrs
9	**Earned Value Management Training**	**0.8 days**
10	Training Meeting	6.4 hrs
11	**Retrospectives**	**0.5 days**
12	Training Session	4 hrs
13	**Pilot Project Implementation**	**41.5 days**
14	Retrospective #1	8 hrs
15	Retrospective #2	8 hrs
16	Retrospective #3	8 hrs
17	Review RMS Implementation Procedures	4 hrs



Appendix: Figure 8 - Organizational Cost Breakdown

Resource	Yearly Salary	Hourly Salary	Hourly Salary at 50% Overhead (benefits, etc.)	
Internal Stakeholder	$ 150,000.00	$ 72.12	$ 108.17	
Functional Manager	$ 100,000.00	$ 48.08	$ 72.12	
Project Manager	$ 70,000.00	$ 33.65	$ 50.48	
Team Member	$ 70,000.00	$ 33.65	$ 50.48	
Accounting Member	$ 50,000.00	$ 24.04	$ 36.06	
Consultant				$200 per half day per person trained
Work Hours per Year	2080			

Appendix: Figure 9 - Project Cost Breakdown

			Number of:						COST of TASK
Task #	Task	Duration (hours)	Internal Stakeholders	Functional Managers	Project Managers	Team Members	Accounting Members	Consultant	
1	Responsibility Interface Matrix (RIM) for Implementation Process	8	3	0	10	0	0	0	$ 6,634.62
2	Standardization Meeting for Risk Response Plan, Risk Log, P-I Assessment								
3	Prepare for Meeting	4	0	0	10	0	0	0	$ 2,019.23
4	Hold Meeting	16	0	0	10	0	0	0	$ 8,076.92
5	Monte Carlo Analysis								
6	Initial Planning Meeting	4	0	0	10	0	0	0	$ 2,019.23
7	Develop Model for MCA Use on Transportation	40	0	0	1	0	0	0	$ 2,019.23
8	Model Training Meeting	4	0	0	10	0	0	0	$ 2,019.23
9	Earned Value Management Training								
10	Training Meeting	8	3	4	10	3	2	0	$ 10,730.77
11	Retrospectives								
12	Training Session	4	3	4	10	3	0	1	$ 9,076.92
13	Pilot Project Implementation								
14	Retrospective #1	8	0	4	1	12	0	1	$ 14,357.69
15	Retrospective #2	8	0	4	1	12	0	1	$ 14,357.69
16	Retrospective #3	8	0	4	1	12	0	1	$ 14,357.69
17	Review RMS Implementation Procedures	4	3	4	10	3	1	0	$ 5,221.15
								Total:	$ 90,890.38

Appendix: RETROSPECTIVES

Retrospectives are different from postmortems in that they occur at key points during the project, in addition to after the completion of a project. Their purpose is to "re-use solutions and stop repetitive mistakes across the organization"(p. 3, [10]). An action plan for immediate project improvements, with owners for each item in the plan, is a major outcome. The retrospective also seeks to make sure effective methods continue. The results of the retrospective need to be documented and tracked.

The organization needs a change agent, an identified and committed key team member, who will help with the whole process of switching to improved processes and behaviors. Change agents have good judgment, good communication skills, and "keep the interests of the customer foremost" (p. 15, [10]). They are neutral, flexible, good listeners, and good managers of change. They "guide the group through the details and challenges of the change process" (p. 14, [10]).

The same ground rules apply during the retrospective meeting as with postmortems: be objective, don't attack, be open to learning from your mistakes, and be concise (p. 500, [1]). The facilitator needs to be both skilled and neutral[10]. An outside facilitator would be ideal.

To benefit from retrospectives, the company must have a good change agent on the project team as well as a way to reward individuals for implementing recommended changes.

Retrospective Meeting

To start with, the Vestas proposal has an outside trained facilitator leading the retrospective meetings. This person needs to create and maintain a positive, supportive, atmosphere to discuss success and failure. As time goes on, internal facilitators will be trained and can be pulled in to lead retrospectives on projects where they are not a team member.

The meeting itself needs to have key team members, including a team member who is identified as a change agent, key functional group representation, and stakeholders, as with a postmortem (p. 502, [1]). Meetings typically occur at "three…strategic milestones during the program lifecycle" (p. 5, [10]). That is, just after the planning stage at the start of project implementation, mid-way into the project, and sometime after the project completion.

The objective is to find out what went well, what went poorly, and to determine an action plan. Select the most important items to continue or change, so that effort is productive. Borrowing methods from postmortems, the authors of this paper recommend that the participants would first "review and rank issues" and then for each issue in turn:

- "Ask what went wrong.
- Ask what should be done differently in the future.
- Ask what went well.
- Prioritize recommendations." (p. 503, [1]).

Then develop the action plan based on selected recommendations regarding each issue and document results. Choose an owner for each recommendation. Owners continue to manage the recommendations during the project.

A document of retrospective results might look like this:

Appendix: Figure 10 - Retrospectives

Retrospective Results for Phase I of Project Idaho Wind Farm		
Attendees: Project Leader John, Team Member Kathy, Team Member VJ, Team Member and Change Agent Lin, Transportation Manager Linda, Engineering Representative Peter, Stakeholder Evan Facilitator: Alex from IC Consulting Date: March 12, 2009		
Issue	**Action Plan**	**Owner**
Probability and Impact Assessments Inaccurate	Re-address Risk Response Plan	John
	Pass on Issue Identification and Resolution to Washington Wind Farm Team	Lin
Ongoing Risk Identification During Project	Continue Risk Meetings: working well	John
Earned Value Metrics Inaccurate from Subcontractors	Implement Earned Value Re-training for Subcontractor	VJ
	Pass on Issue Identification and Resolution to Washington Wind Farm Team	Lin
Support from Upper Management Needs Improvement	Increase Visibility with Progress Reports at Upper Management Level	Evan
	Pass on Issue Identification and Resolution to Washington Wind Farm Team	Lin
Communication between Engineering and Project Team Needs Improvement	Invite Engineering to Status Meetings	John
	Attend Status Meetings	Peter
	Pass on Issue Identification and Resolution to Washington Wind Farm Team	Lin

Rewarding the Retrospective's Action Plan Implementation

Top management buy-in will help with finding ways to reward implementation of the resulting action plan. This is a case where additional responsibility or increases in salary would be reasonable as a reward for individuals, depending on the significance of the item the individual implemented.

Appendix: INTERVIEW QUESTIONS

Theme #1: Scope of Projects / Organization

- How is your organization structured?
- How are your projects structured?
- What general activities are involved in your projects?

Theme #2: Risk identification

- What are the risks you often run into?
- What risks do you see in the market?
- How would you rank the above risks?
- Prompt list for risks:
  a. Administrative
  b. Project acceptance
  c. Commercial
  d. Communication
  e. Environmental
  f. Financial
  g. Knowledge and information
  h. Legal
  i. Management
  j. Partner problems
  k. Political problems
  l. Quality
  m. resources
  n. Strategic
  o. Subcontractor
- Other risk possibilities:
  a. Maintenance issues
  b. Environmental issues
  c. Not In My Backyard Syndrome
  d. Government subsidies – changes to them as a risk
  e. Power fluctuations
  f. Wind uncertainties

Theme #3: Methods of handling risk

- What is your current risk management system?
- How do you handle uncertainty?
- How does your current risk management system work?
- How does your current risk management system fit with company goals and visions?
- How do other departments/similar companies handle risk now?

Theme #4: Improvements to handling risk

- What would you implement to handle risks better?
- What would be problems in this new implementation?
- How would other departments see changes in risk management?
- How do you implement changes?

Theme #5: Risk Description

- Do you normally do a Probability-Impact matrix? What can you tell us about it?
- What are the probabilities you associate with these categories?

Category	Probability
Very High	
High	
Medium	
Low	
Very Low	

- What are the qualitative impacts that you associate with these:

Category	Description	Delay	Cost	Quality	Image of Company	Other
Catastrophic/ Very High						
Major/High						
Moderate/medium						
Minor/Low						
Insignificant/ Very Low						

Appendix: INTERVIEW NOTES

WTG = wind turbine generator
PM = project manager

Background on Projects

- Projects are handed down from sales.
- Projects may be in the manufacturing stage or starting with scheduling transportation of equipment to the park from the manufacturing facility.
- For the project Matt would get the wind tower from the manufacturing facility to the site.
- Matt would make sure the resources are available to erect the equipment.
- Sometimes Vestas does the installation, sometime they provide technical advice.
- Vestas does not connect to the power grid.
- Owners are responsible for certain items
- Vestas' involvement ends when the punch list is over on the last wind turbine.
- These are not just-in-time delivery projects.
- Transportation is contracted with a hauler. Cost is per item not per number of days. That is, a unit rate agreement regardless of productivity.

Background on Organization of Company

- Loose matrix organization
- The Project Department is not in direct control of resources. PMs go to functional lines.
- To get manpower, PMs go to operations and ask for a loan of people.
- The people loaned work under the PM's direction.
- People on projects may work for other projects as well.
- Functions:
  - Operations: supplies technical advice and manpower
  - International/Domestic: provides transportation
  - SCADA: provides technological monitoring. They install the system for the turbines so they can be monitored from anywhere in the world.
  - Engineering: PMs go to as needed

Typical Project Management

- Schedule in Primavera
- Ensure delivery of (I assume WTG) components will happen on schedule
  - Eliminate the possibility of not being able to meet the contract
  - Have transportation coordinated for the project.
- Ensure timely delivery of supporting components
  - Example: bolts must all be on site prior to tower installation. Some go in foundation, some on foundation.
  - The Buyer in the Vestas functional line makes sure supporting components are delivered in the fashion needed.
- Eliminate the manufacture of equipment from the critical path
- Build in buffer time

- Deliveries are scheduled at 5 days per week (M-F)
- Buffer is possible Saturday delivery.

Background on Contracts

- Materials costs are locked into the contract.
- Work may proceed knowing contract will be signed
- If contract falls through: typically the contract is part of a frame agreement: buy over a period of time and owner is obligated to buy a certain number from Vestas.

Risks Identified from Sales

Sales identify high level risks they see to the PM.
These risks may include:

- Number of deliveries per week.
- Customer risks in terms of peoples

Risks Inherent in Project

- Transportation risks:
  - WTGs are a superload. Weight, size, may cause problems such as roadways which cannot handle it, bridge height, time of year/weather problems.
- Delivery of components
  - Vestas tries to eliminate this on the sales side so they don't commit to what they can't deliver.
  - If there were a problem, they would have to swap towers within Vestas projects.
- Completion of Park before Winter
  - Leaving WTGs not hooked up before winter degrades the WTGs.
- Poor Installation Quality of Non-Vestas Installers (major risk to image and the warranty):
  - Sometimes Vestas installs, sometimes someone else.
  - Many installers are new to this market.
  - Non-Vestas companies may not understand the scope of the work. They try to change-order their way through the contract.
  - Vestas and Other Installer try to come to an agreement on standards.
    - Vestas certified a reference turbine. All turbines must match the reference turbine. Vestas goes through a step-by-step process in the creation of these reference turbines.
  - Installer holds risk while the turbine is being built; Vestas owns the risk after the turbine is at a mechanically complete stage.
  - After installation, the turbine is under the Vestas warranty

Risk Management Techniques and Vestas

- Current Techniques
  - Time buffer for delivery of turbine with extra unscheduled day of delivery.
  - Get parts ahead of time
  - Set standards
  - Transfer risks to the owner within the contract

        - Vestas is trying to re-evaluate the way they do their contracts. They want to be compensated for risk they undertake. Sometimes by relaxation of schedule, sometimes by additional cost.
    - Risk registers
        - Anyone can add to the risk register. Initiator adds their name
        - Initiator identifies the functional line risk and other functional lines impacted
        - Done at group or project team level
        - Evaluated on a weekly basis by the team.
        - The risk is assigned to an individual who will have the authority to solve the risk issue.
        - Can go back to the functional line and get more help
    - P-I matrix
        - Done in a simplistic fashion with both P and I on scales of 1 to 10.
        - Matt feels this is too subjective; the values are not defined consistently among the project managers. PMs have various levels of expertise.
        - Standardized P and I scale meanings are needed.
        - Past risks tend to be evaluated but not future risks
    - Overall they try to mitigate, eliminate, house, or transfer risks
- Monte Carlo Analysis-not used currently
    - Don't have the data
    - Don't have the variations
    - See below also.
- Earned Value-Matt would like to implement
    - Matt is trying to implement this now for construction of towers.
    - Good for tracking where you are going.
    - Difficult because Vestas hasn't seen this before.
    - Earned Value not useful for the transportation of equipment since the cost is per item anyway.
- Fully resource and cost load schedules ahead of time-Matt would like to implement
    - Objective: determine the optimal path of delivery
    - Could then run Monte Carlo simulation with risks injected. Risks might be late ships, weather.
    - Take both percentage change and dollar value so people can see what they are looking at.
- Challenges for Changes in Risk Management Techniques
    - Project managers would have to be trained
    - Functional managers would need to be convinced that the changes would be worthwhile. Will need functional line backing.
    - Upper management is already on board.