

**LOCKHEED MARTIN CORPORATION**

**Moderator: Courtney Chambers**  
**July 17, 2012**  
**12:31 pm CT**

Courtney Chambers: Okay, and at this time I'd like to give you today's speaker on risk management. Dr. Charles Yoe is a professor of economics at Notre Dame of Maryland. He has extensive experience with the Corps planning process and related activities. As a formal corps employee, he has worked on over 40 different corps projects. He has worked with nearly two dozen district and division offices, gaining a valuable perspective on issues concerning the corps. He has worked on ecosystem issues, beginning in the late 1980s on submerged aquatic vegetation in the Baltimore district and he's included several Section 1135 studies and a number of multipurpose projects with an ecosystem restoration purpose.

Dr. Yoe has written several of The National Economic Development Procedures Manuals, the Planning Manual and numerous other IWR reports. He has authored two textbooks on risk analysis and one on natural resources planning, as well as numerous papers and manuscripts. He is currently active in the development of the corps risk management activities and the smart planning initiative. As an instructor for the corps, Dr. Yoe's participated in a wide variety of prospect classes, seminars, and workshops. He has developed numerous models used by the corps and has developed successful analytical techniques for use by field personnel. Dr. Yoe is a world renowned expert in risk analysis, having worked on risk analysis issues in 23 countries and we are very thankful to have him sharing with us today.

For more information about Dr. Yoe, you can find his bio posted on the learning exchange with the rest of today's meeting documents. Okay, at this

time Charles, I'm going to give you the presenter rights and you can feel free to begin.

(Charles Yoe): Okay, (Courtney), thank you very much and hello to everybody. But, I did see a note from MVD that they can't hear. I don't know if it's possible. If you can hear, can you raise your hand? There's a raise your hand button and I just clicked on mine. If you can hear, can you raise your hand just so we have an idea how widespread the problem might be? I see more hands than not.

(Courtney Chamber): Yes, and I've received several messages myself that say that they can hear. Just clarifying for us, so that may have been an isolated incident, I hope.

(Charles Yoe): Okay, well then we hope so and we'll move along then.

(Courtney Chamber): Okay. And if not, we are recording this meeting successfully today, and we'll have a transcript as well. So hopefully if anybody's having an isolated issue with sound, they would have access to this presentation at a later date.

(Charles Yoe): Okay, good deal.

(Courtney Chamber): Okay, and MVD just said that they redialed and they can hear now.

(Charles Yoe): So, we'll spend the next 30 or so minutes talking about integrated risk management, and this is actually kind of an interesting time, a bit of a perfect storm brewing in the corps. And here's the basic point, risk is everywhere. Even when you live behind a multimillion dollar project as this post Katrina picture suggest, there's no escaping the fact that there's -- there is no such thing as a risk free world. And so a bit of the point has become, especially in this post Katrina world to the corps, it's become essential that the corps develop a risk management process, and so that's what we're going to be

talking about over the next 30 minutes or so, just what this process might look like.

Earlier, (Courtney) said to feel free to type in your questions and I would certainly encourage you to do that. And by the way, (Courtney), if someone does and I happen to miss it, please just break in.

(Courtney Chamber): Sure will.

(Charles Yoe): Feel free to question at any time. Let's start off with a couple of definitions though so that we can all kind of have the same starting point and we'll begin by defining risk. Notice here, it says risk is a measure of the probability and the consequence of uncertain future events. There are three important ideas there and the first two are probability and consequence.

If you look in the literature, you will frequently see a little equation that says risk equals probability times the consequence. It's not that simple to estimate or calculate a risk but it's a really nice little mental model and it's essentially telling us this, if probably is zero, it doesn't matter how big the consequence is, there ain't no risk. And if the probability is very large, and the consequence is zero, again, there ain't no risk.

This equation kind of - if you think of it as yielding a number, it also gives us another couple of insights. If probability is very small and consequence is big, we get a medium size risk and if we flip that and the probability is big and the consequence is rather small, we might get the same medium size risk.

But people respond to risks very differently. The corps and scientists, people who deal with facts and knowledge and things that they think about, we tend

to emphasize probability more than the public does and so that's going to come up briefly when we talk about risk communication in a moment.

So we begin with an idea that if risk has those two pieces, there's a consequence, an undesirable thing that happens, and it may or may not happen. We'll return to uncertainty in a minute.

But let's consider that there are two kinds of risks that the corps generally faces. The vanilla version is exposure to losses or hazards. That's the flood risk management, the storms and the infrastructure failures and things. But those of you working in ecosystem, you might be more familiar with the other kind of risk, the chocolate flavor that doesn't come up quite as much where there's a potential for a gain and opportunity for a gain.

So, you know, in that if we build it will they come kind of world, that's quite a different kind of risk than we find with a risk of loss. And in fact, the corps' job is different in these two.

So we're going to proceed with this notion that there are two different kinds of risks, a risk of a loss and uncertain potential for gain. We'd also like to parse the idea of risks a little finer. We'll talk about different kinds of risks that are of interest to the corps and we would begin obviously with an existing risk, and this could be a risk to a species in a locale or even globally for that matter. There could be risks to nutrient cycles, hydrologic cycles, other kinds of natural cycles or significant resources in a project area. And then, of course, there are again those uncertain gains that would be another example of existing risks. So that's one dimension of risks that's going to be important to us when we talk about risk management.

The next idea then is the corps assumes a role as a risk taker often in ecosystem restoration, and that's very different from risk reducing. Ordinarily when we're talking about flood risk management and storm damage reduction and those sorts of things, the corps' job is to try to avoid risks, but in ecosystem, the corps' job is to prudently take risks.

So risk taking involves what we can gain or achieve and that is contrasted with those risks where we're trying to avoid or prevent or mitigate losses.

So we've got existing risks and risk reductions, we'll call them for the moment, and the third idea then is the residual risk. If you have an existing risk and you reduce it but don't reduce it to zero, there's a residual risk.

That picture that we saw on the very first slide is a dramatic example of a residual risk. That's what remained after a mitigation effort. So we might do things to try to protect the species but there would still be some local extinction risks that might remain even after our best efforts to protect the species.

A fourth risk concept is transformed risk. This is when we change the nature of a risk. In flooding, when we go from a slow rise of fluvial floods to a levee, we transform the risk from a slow rise to a potential overtopping.

In ecosystems, we might make control strategies as an example where we transform risk or when we begin to dredge sediments, we transform risks. They pose one risk lying at the bottom of a channel and quite another when they become suspended in the water column.

And the last idea about risk that we want to review here together is the idea of a transferred risk. Again, with flood risk management, the examples come

more easily. If we build a levee on the left bank, we force more water onto to right bank communities.

In ecosystem, perhaps when we reduce the risk to one species, we might be increasing risks to another. So that's a lot to throw at you quickly but there are the basic ideas about risks that'll be useful to bear in mind as move forward here.

Now let's turn to that third concept in the definition where we were talking about uncertainty. Uncertainty, we're going to divide into two broad types. And the first I'm going to call from the 75,000 foot level, this is we look down on earth and we see increasing social complexity.

We have more and more social relationships and those relationship become more complex. At the same time, we have an increasingly rapid pace of change. Part of that, of course, is led by technology but the other parts are geopolitical and all sorts of other kinds of value changes that are taking place on the planet. And then we might add to this global view, global effect, things like climate change for example.

And so at this level, what we're saying is we operate in a very uncertain environment because it is changing so fast and we don't know what the views of the stakeholder are going to be in a study that we're working on now, much less how they might change in the next 10 or 20 years.

The SERP project that everybody's restoration project in the Jacksonville district, it was being - it was built as it is in response to the values of a different age and it makes a great example of how this uncertainty of the 75,000 foot level can change values and that value of what the corps does or doesn't do.

There's a second level though at which uncertainty becomes important and I'm calling that the project level. That's the stuff on your desk right now, the work that all of you attending this webinar at the moment do. And here's a little schematic here that I'm going to refer to again in a few minutes, it shows three boxes. There's a scenario or the stories that we tell about risks or the stories that we tell about the systems that we're working with. There are inputs that we use to try to measure and evaluate effects of our actions and then, of course, there are models as well.

And any of these things can be subject to uncertainty. We might not know this story, the theory of how things - how a stressor actually ends up affecting an endpoint. Our models can be imprecise and, of course, we've always got data problems, we never have enough data so there's uncertainty. And if we take this uncertainty, here's one way to think about it. In every study that you're doing, in everything that you do, all the work that's on your desk, there's always a pile of things that you know. There are things that we can measure well. We can measure distances and we can, you know, identify problem areas and we can inventory existing conditions and do those sorts of things rather well. But with everything we're working with, there's also a pile of things that we don't know, and it's because of those things that we don't know that this risk management, this risk analysis, a perfect storm that's brewing, has become so prevalent in the corps right now.

So what we can do, and we won't do it today, but what we can do is we can take that pile of things and we can begin to split it up. Here it showed two other sub piles. Knowledge uncertainty would refer to facts in the world, just facts that we happen not to have.

What percent of the channel bottom happens to be made of rock? Well, that's a fact, it's just something that we don't know until we gather - until we do some analysis and gather that data. But in addition to facts, there's natural variability. We're working with complex ecosystems and complex physical systems and the flow on the screen one day is going to be different than the flow on another day.

Even if we've got all the facts, even if we know what the mean - what the peak daily flow is and, you know, if we got the frequency data, there's still natural variability.

And we can go further than that, we can take that knowledge on the certainty and here are the three piles we break this into corresponds to that little diagram I showed you just a minute ago where, you know, we might - there might be facts about the - how risks work, the scenarios and the theory that are missing.

There might be facts about our models that are uncertain, and there can be facts about the quantities as well. And so we can continue to parse this and break it down further, and I hope that you begin to get the idea that uncertainty is the critical piece here, and it's dealing in an intentional, purposeful way with uncertainty that distinguishes risk analysis from everything else.

In the past, we may have pointed more toward the pile of things that we know and maybe tried to take that pile of things we don't know a little bit out of view. But in risk analysis, we're trying to shine a spotlight on that pile of things we don't know and to address it in our decision making, and that's what gives rise to risk, this existence of uncertainty.

So if we apply the principles to ecosystem, I could ask these questions and if we had an easier format, perhaps we could discuss this. But there are things that you know with certainty in an ecosystem restoration study, but there's always stuff in the pile of things that you don't know. And if nothing else it's that natural variability that assures that that pile is always going to be substantial.

But here's the deal then. Risk analysis is basically decision making under uncertainty. So risk analysis is the overarching concept and we're going to describe it as comprising these three tasks.

First there's risk management. Risk management is where the values enter into the process.

So that 75,000 foot level where stakeholder values, and policy changes, and those sorts of things come into play, they all enter the process through the risk management decision making.

On the left we show risk assessment. And we show it separately and try to indicate that it is analytically based. Risk assessment is where we do the good science that we can do. And the two are kept as separate as possible so that they don't interfere.

But you see there's some overlap there. And that's just to indicate the - it's a practical matter. It's impossible to cleanly separate the two.

Excuse me, I have a bit of a cold so I'm going to occasionally - I'll sip my water here.

We show the risk assessment and the risk management floating in this great sea of risk communication. Remember this is a Webinar. We're not saying this is the way the world really works. This is the way we would like to see it work. This is the direction we would like to head. But what we'll do over the next couple of minutes is unpack each of the three tasks that comprise risk analysis, risk management, risk assessment and risk communication.

And then we'll wrap up by focusing in on risk management and talking about how the corps envisions doing risk management in the near term.

So we'll begin with an informal definition of risk management. And I would say that if you look in the literature you will see many different models and many different ways of doing this. But essentially they all come down to some version of asking and answering these questions about the work that's on your desk. What is the problem?

Risk management starts with identifying the right problem. And then it goes to include identifying the information that you need to solve that problem.

So when we say what questions do we want risk assessment to answer this is really indicating that risk managers need information to solve their problems and they need to ask for that information.

Now in well-established programs like flood risk management, corps folks go on autopilot. The H&H people know what they need to do. And the cost estimators and design engineers know what they need to do. And everybody knows what they need to do. It's been well institutionalized those questions that we need to have answers to.

But when we run into something new like GLMRIS the aquatic nuisance species there is no format to tap into. And there it becomes important to identify the questions that we need to answer to solve these problems.

It's the risk managers' job to let staff and risk assessors know what information they need to solve the problems.

The next two questions get at that definition of risk. The first says what can we do to reduce the impact or the consequence of the risk? Second question says what can we do to reduce the likelihood or the probability of the risk? And that's just a commonsense way of thinking about risk.

If you think of driving there are things we do to reduce the impact of an accident. We're basically saying accidents happen. But if we put seatbelts, and air bags, and shock trauma helicopters out there we can reduce the consequence of accident. And then of course there're things we do to try to reduce the likelihood of accidents. We use traffic controls. We encourage people to drive slowly, not to text, not to drink when you drive. So part of the risk managers job then is to identify options for addressing risks that are not acceptable. And you see in the next bullet here the risk manager has to identify the tradeoffs of these available options.

And this is where values enter the process. Values are a very important part of the risk analysis process. And they enter in the risk management stage of the process. Risk manager has to decide the best way to address the described risk. And that would be after considering the different options and their tradeoffs.

The last question is not trivial. It kind of changes things. It basically says we're not done when the project is completed. What we want to know is, is it

working? Are we seeing the risk reductions that we desired or in the case of ecosystem restoration are we realizing the potential gains that we wanted? So is it working is an important part of the risk management paradigm way of thinking.

We can raise some risk management strategies here. On the left you see risk reduction strategies. Sometimes the corps wears a risk reduction hat when we are trying to avoid risks. On the right column you see a risk taking hat when we are trying to prudently take risks. In the ecosystem restoration probably more than in other business lines you do a bit of both.

The very first question that a risk manager has to answer is, is the risk that we identify is it acceptable? Is it something we can live with? If it is there's no need to reduce it or to take additional risks. Looking at that left column the preferred strategy is always to avoid a risk if you can. If there's a way to avoid it entirely that's the first preference.

The language that I use here gives the illusion of precision that doesn't really exist out there in the world.

So we talk about risk prevention. That generally refers to risk management strategies that are trying to reduce the probability of the risk. Risk mitigation refers to strategies that are trying to reduce the consequence of a risk.

Risk transfer this occurs in things like flood insurance where there is a risk that can be pooled and shared with others.

And then of course the last choice is risk retention.

Just in the interest of time I'll pass on that right column here but it basically corresponds to the same concepts.

Let's move on to risk assessment briefly. This is informally the work of asking and answering these four questions. What can go wrong? How can it happen? How likely is it to happen? And if it happens what are the consequences?

So there are many formal definitions. And here is a risk assessment model that the corps favors at the moment. It has four steps.

The first step is look for the hazard or the opportunity. Remember we have two kinds of risks here. So identify the hazards that can cause harm or the opportunities for gain that are uncertain.

And then there would be a consequence assessment. Decide who or what might be harmed or benefited and in what ways?

Gather the relevant data. And then characterize those consequences and the uncertainty surrounding them. This can be done qualitatively or quantitatively.

A likelihood assessment parallels this. This is basically going back to that original definition of a probability times a consequence.

So you would assess the likelihood of the different adverse and beneficial consequences characterizing them with their uncertainty. Again qualitative or quantitative risk assessments are acceptable.

The fourth step is risk characterization. This is basically where you pool together all the good work that you've done in the previous steps.

So this is where you would estimate the probability of occurrence, or the severity of adverse consequences, or the magnitude of the potential gains those ecosystem restoration benefits for example. And this risk characterization will also be qualitative or quantitative.

The definition if you took time to read it refers to some of those dimensions of risk that we were talking about earlier -- residual and reductions and that sort of thing.

The risk assessor's toolbox is growing. There are a lot of qualitative methods now that are available. This gives you an idea of some of them. Some have very specific uses. Evidence mapping is basically a neat new technique for surveying the literature and trying to identify the arguments in favor of and against the existence of a hazard. So this might be something that you might use for a - the question of wooded vegetation on levees. Is it a hazard or is it not? It could even be something that might be used in some cases for sea level rise or a climate change.

And then of course there are other tools that are far more comprehensive in that they would address all four steps in the risk assessment model.

There are quantitative risk assessment tools as well. And some of you may be familiar with some of these. Just know that the risk assessor's toolbox is growing.

Let's say a few words about risk communication and then we will move into the risk management model. And risk communication informally defined just like our others is the work you have to do to ask and answer these questions.

Why we communicating? Who's our audience? What do those audiences want to know? What do we want them to know? How are we going to communicate? How will we listen to them? And then how will we respond to what we hear? So I hope you would get the notion that risk communication is a two way process here.

Risk communication is especially tricky and it would make a neat topic for another day. But one of the reasons it's especially tricky is there's this scientist consumer disconnect.

You all are the scientist. You're the expert. You know stuff. You think about things. And when you approach risks you tend to approach them from a fact based perspective. You study hazards. You know all about the H&H stuff. And you know all about the water quality stuff. And you are the people who understand the probabilities of things.

On the other hand we have the consumers, the public. They're the people who don't know or think about things. They're the people who feel and believe things. And what they feel and believe is not always objective. Sometimes it's not even true. This group approaches the same risks from a different perspective. They approach it from a value based perspective. So they're more concerned about the consequences and the values that come into play.

So when we talk about, you know, if you mentioned the brownfields and if you say children and cancer in the same sentence maybe the facts are the probability of any child contracting a cancer from playing on - in this field is ten to the minus 27 -- virtually impossible. But what the public hears is children and cancer and they have a very different reaction. It's the consequence that matters not the probability.

And so this disconnect leads to the need for different kinds of risk communication strategies.

This little graphic you're looking at arrays four strategies. So, on the vertical we have the outrage, the fear, the anger, the perspective of feelings and the emotion that the public has. On the horizontal axis we have the actual hazard, the true danger. And that's the perspective that the corps takes.

And you can see sometimes they misalign. When people are really upset but there's a very low danger then your job is outrage management reducing the outrage so people don't take unnecessary precautions. On the other hand we might have a high danger and low outrage. Then we have a precaution advocacy risk communication strategy.

That's when you have to hit people upside the head and tell them anybody in a one or two story building who does not leave the floodplain faces certain death as happened with the recent hurricane in Galveston.

So this gives us a little overview of three tasks of the risk analysis. Maybe I'll pause for a second to see if there any questions before we move in to the corps risk management process.

(Courtney Chamber) Remember to take your phone off of mute before speaking.

(Charles Yoe): Okay I'm counting to five slow. If you come up with a question feel free to type it in but I'll move ahead then.

On how is the corps then? So we just had this overview of risk analysis. How is the corps going to approach this? What is going to be the corps' risk management process?

If (Dave Moser) were here he could give you the background to a whitepaper that was written some time ago and defined risk management in this manner for the corps.

Risk management is the process of problem finding and initiating action to identify, to evaluate, to select, to implement, to monitor, and to modify actions taken to alter levels of risk as compared to taking no action.

So those of you from the planning side of the house might notice there's a with- and without-condition context for this definition here.

I'm working with (Dave) and a number of others. And we have looked at a number of risk management models. And the one I'm going to show you now is the one that the corps favors. We are working on an EC for risk management and it would be implementing this model. And this model by the way is based rather closely on the organization for international standards ISO 31,000. So we're in good company in using this model although it has been modified for the purposes of the corps.

The first step is to establish a decision context. Figure out the problem and what now you're trying to do with it. When you do that at the same time this consultation communication and collaboration process begins.

So steps are shown horizontally and in the vertical you'll see two ongoing processes.

So after you do - establish the decision context the very first step is to identify the risks. What are the risks germane to solving this problem and making this decision? Once you've identified those risks then you would go ahead and

analyze them. This analysis could be qualitative or quantitative. And these two steps together comprise the risk assessment aspect of the risk management model.

So a little bit earlier I showed you risk assessment as four steps and that's basically what we're talking about here. Those four steps would be implemented over these two risk management steps.

After you've analyzed the risk you would evaluate the risk. This is basically where the risk managers are going to stand back look at the risk and say can we live with that or not?

Now I'm going to unpack each of these steps for you. So we'll revisit each one, one more time.

In the fifth step in this risk management process for the corps is to make a risk management decision. But because there is uncertainty there's always a pile of things that we don't know the process is not done. No decision is final. Every decision is conditional. And it's conditioned on the information that we had at the time we made that decision.

So the second ongoing process is to monitor the effectiveness of the decisions that we're making. And then to evaluate them find out are we getting the risk reductions that we desired? Are we realizing the ecosystem restoration benefits we were looking for? And if the answer is no then you would modify the risk management solution. And that could kick you back into this risk management model at any one of the steps.

So all the crazy arrows are basically saying this is an iterative process. And it's iterative largely because of the uncertainty that exists. Over time the

uncertainty may be reduced and convince us that we don't have the right decision or it could work in just the opposite direction as uncertainty is resolved it may convince us that we have exactly the right decision.

So we'll go ahead and unpack each one of these briefly. The decision context whether it's something that starts this risk management activity and it could be an authorization from Congress, or it could be a lock gate that falls into the lock chamber, or it could be any other kind of activity that typically kicks off a corps decision process.

So you've got to define the decision problem, identify the goals and objectives of decision making. What does success look like?

This is the problem and what will success look like not what is the measure that you will use or what is a specific solution but just tell us what success looks like. In this step you would also identify specific decision criteria so that we can begin to gather data that's appropriate for decision making from the very beginning.

If there is going to be public involvement it would begin here. And not all decisions obviously are decision problems in the corps involve the public. Sometimes it's just the people across the hall from you, you know, when we're trying to decide how to allocate budgets and those sorts of things. So stakeholder and public involvement that exists would begin here.

The specific outputs from this first step are basically five pieces of paper. One is a written problem statement. The written statement of the risk management activities objectives meaning what success looks like and how we will recognize it.

Remember the risk managers have to identify the information they need. So there is a written list of questions that need to be answered. And don't take this too literally because for flood risk management those questions are well known. We don't have to write them down. But in unique instances it would be important to communicate that information. So a written list serves as well here.

The last two outputs would be a list of the decision criteria and a list of the key uncertainties that you recognize from the very beginning when you begin to make that initial pile of things you know and the things you don't know. So this is what happens in the first step.

Second step is the risk identification task. If there's going to be a risk assessment this is where it gets done. So you want to look at all those risk dimensions that we spoke about earlier. This is where you would ask and answer the two basic questions what can go wrong and how can it happen? So the idea again right now is to identify what the risks are at this step. You don't have to do any analysis of them but let's just try to comprehensively become aware of them.

The methods that you'll use to do this are really going to depend on the nature of the activity or the process or assets that are identified in your decision context. Stakeholder and public involvement would continue here.

The outputs are fairly simple. You would have a narrative description of the risk. And this is where you decide we need to do a risk assessment. We've got to do some more work. In some instances identifying the risk in the process of doing that you might realize we're comfortable with this.

We know how to handle situations like this. There's no need for risk assessment. So you won't always need to go to a full blown risk assessment process.

Step three in the risk management model is analyze the risk. If you are doing a risk assessment this is where it gets completed. Each of those risks that you identified needs to be characterized as part of your risk assessment. Remember risk characterization was the fourth risk assessment step we identified a little bit earlier. So risk characterization would include a risk estimate that would be a qualitative or quantitative estimate of the risks quantifying the consequences. There would be a risk description to accompany it. Risk assessment is not just about the numbers. We need to understand the numbers, what they mean and what's missing from those numbers.

A risk assessment is where you would evaluate and compare risk management options. So RMO there stands for Risk Management Options. And that's just a term that could be a synonym for plans in the planning process. But since we're talking about a risk management model for more than planning it's a broader idea. Risk management options could apply to any stovepipe.

You would also account for the uncertainty that could affect decision making. So that's another piece of this analyzed the risk step. The outputs you would have written answers to the risk managers' questions. There would be risk characterizations. You would describe the alternative risk - risk mitigation strategies and their relative effectiveness. And every once in a while there would be a formal risk assessment. Now a formal risk assessment would be a separate document that would accompany the decision documentation. The corps fortunately hasn't had to do formal risk assessments too often. So I make a subtle distinction here.

We do risk assessment all the time but it's very often embedded in a broader context of planning or construction and that sort of thing. And so unlike other agencies that are required to do formal risk assessments that hasn't happened too much in the corps just yet.

Step four I'll get to, I think I need another drink of water.

Step four, the risk management model is to evaluate risks. The risks have been assessed and this is where decision makers have to look at them and say is this acceptable? This is done with stakeholder and public input. And the job then is if you look at the risk and say it's unacceptable you have to reduce it either to an acceptable level, that would be the skinny point of that inverted triangle on the right would be an acceptable level, or to a tolerable level. And tolerable is tough because when something's unacceptable that means we've got to do something. But you can't always get to an acceptable level of risk.

So if you could imagine me standing in front of you with my hands palm down on the top of that triangle you're looking at and I begin to push that risk down. Every time I push it down an inch or so it's costing more and more money so tolerable risk is often defined by a tradeoff between risk and the cost of risk reduction.

So, you know, once we get into, you know, this flood risk management project's going to cost \$500 million they're going to be people out there who are saying whoa stop. Even though this levy, this conceptual levy we're talking about is not going to solve the flood problems it will reduce them to a tolerable level.

It's a little bit different when you're talking an ecosystem restoration because tolerable is risk taking now not risk avoidance. So your job at times is to look at those ecosystem restoration benefits and to try to decide when do we have a sufficient probability of realizing these benefits or when do I have enough or when have I reduced the uncertainty about the magnitude of ecosystem benefits enough to justify taking a risk?

All of those decisions take place in this step the evaluation of risk. So the outputs would include an effective summary or display of the uncertainties involved in this decision making. You need the contributions of the risk management options to the risk management objectives that you identify. And it's in this step that you either accept a risk as it is or identify a Tolerable Level of Risk. So TLR is a concept that may come up again.

I just see there's a question here so let me pause for that. And it says if you have a chance would you please address the decision path to determining an acceptable level of risk for a flood structure or system structures? That is in a risk management world are we compliant with congressional authorization or what would Congress authorize as an acceptable project?

That's easy to answer (Peter). I have no idea. I'm sorry that's not the answer you were looking for. But let me back up just a little bit. In other federal agencies this idea of a tolerable level of risk is sometimes set an established by law, by authorization. So if for example just to make up an example here if Congress said, you know, a tolerable level of risk for flood risk management is the 500 year flood.

I know we're not supposed to talk like that in the public but I hope I can speak like that here among friends. But if Congress said there's a 500 year level of protection then it becomes easy. And then it's a matter of policy and it's

determined for us. But as you know that's not the case. And so the reason I say I don't know is because business under risk management wouldn't be too terribly different than it is right now except that we might be freed from that NED criterion. So tolerable level of risk is determined by a variety of tradeoffs, multi-criteria decision analysis, or by hook or by crook and so I am sorry that that's not a satisfying answer. But an alternative could be that the corps corporately might decide to establish tolerable levels of risk.

You know, in my early days with the corps we used to say that the corps wouldn't build a channel that was less than 100 year level of protection. And then of course that changed later on.

So, you know, there is some precedent for that but I don't know how that would actually play out.

Man: Thank you.

Charles Yoe: The fifth step in the risk management model is the risk management decision. This is where we would decide to take a tolerable risk or to reduce a risk to an acceptable level depending on whether we were wearing our risk taker or our risk reducer hat. So we would reduce unacceptable risks to tolerable level. Or try to increase desirable outcomes to a tolerable level and then take that risk.

A risk management plan should identify the mitigation measures, responsibilities in the various parties, the schedules associated with implementing the measure. Importantly risk management plan would identify an expected outcome and measurements associated with that mitigation strategy.

It would be critically important, if we are going to do risk management well, to identify desired outcomes of a risk management strategy before it is implemented. Because that is what we are going to be measuring. To see if we are getting our desired risk reductions. Or to see if we are getting our desired gains from opportunities.

So you would select the best risk management option here. That is one of the outputs. You would identify a measurable desired outcome to monitor. That would be a specific output to step by. When appropriate when you have large uncertainties you might have an adaptive management plan that would be designed to help you address the uncertainty.

Then there would be an implementation plan. And the plan would be implemented. This would all be considered part of the risk management decision step.

What has been going on throughout these steps is this process of communication, consultation and collaboration. So it means keeping all the stakeholders informed about the process and the findings of the risk assessment. They need to understand the nature of the risks and its associated benefits.

How did you get to the risk management decision? What were the values that you considered? What were the tradeoffs? They also need to know what their role is going to be in implementing their solutions. So this is a continual process among the participants. And it is done to minimize misunderstandings and surprises.

So sometimes this is all inside baseball. This is all corps people talking to other corps people because these are corps issues. But when we get into

ecosystem administration and planning studies then the world gets a lot bigger and this might include public involvement in risk communication strategies.

So the basic output of this process is to prepare and execute a public involvement plan. And that might include provisions for risk communication if you are dealing with some significant risks of interest to the public.

The last process is to monitor, evaluate and modify your risk management options. An implication of this uncertainty that we talked about is that risk management is evolutionary decision making. Every time you make a decision it is based on the information that was available at the time of your decision. So there were things that you didn't know.

That being the case we have to make sure our decision is having the desired outcome. So monitoring means that you are actually gathering information that measures progress towards those desired outcomes - those risk management objectives. What are you going to measure? That information that you gather is periodically evaluated to see if you are making progress. And if the outcomes are satisfactory then you are okay. If they are not satisfactory then we need to change the risk management strategy. So a mechanism for change would be part of the best practice here.

And one example of that would be adaptive management. Something familiar to those of you working in ecosystem restoration. The outputs would be a plan for monitoring evaluation and modification. And then implementing and following through in that plan.

We have a couple of takeaway points but before I get to there let me say that - if this model that I just described does come out in EC and the corps is directed horizontally and vertically to implement it. Basically what that means

is that we would have to figure out what does risk informed planning look like? How would planning incorporate this model? What would risk informed construction look like? Risk informed O&M. Risk informed regulatory. Risk informed ecosystem, you know.

All the different centers of expertise would all have to figure out how do we implement this model in what we do. Because the vision is it would be implemented vertically and horizontally throughout the organization.

So our couple of takeaway points would be that risk analysis comprises three tasks - assessment, management and communication. Risk management is decision making under uncertainty. And it depends on the best available science. But also values the importance to stakeholders. Risk communication - that is going to vary with the circumstances of the risk. So that gets us in with a few minutes before the - well for me the three o'clock hour. For you the two o'clock hour.

So if there are any questions I would be happy to entertain them.

(Courtney Chamber): Alright thank you very much Charles. Please remember to take your phone off of mute if you would like to ask your question vocally. Or feel free to use the chat feature but please send your question to everyone if you don't mind so we can all read it. Thanks.

Alright do you see these? Here are the chat features. You can read them first and then address them.

Charles Yoe: First I have - could you please spend a few minutes describing how risk is being used during the rescoping (unintelligible)?

Good question.

I don't know how many of you have heard about 3 x 3, this was General (Walsh)'s memo of February that basically changed the way that planning is going to be done. Three by three...

Man: Will the slides be archived?

(Courtney Chamber): Yes. They will.

Man: Okay because I won't be able to tie in. You are only limited to 60 participants.

(Courtney Chamber): Okay I am sorry about that. We are very full today. It is recorded and it will be posted on the gateway under the learning tab under archived webmeetings.

Man: Okay thank you.

(Courtney Chamber): Yes okay. Sorry about that.

Charles Yoe: That's okay. So this 3 x 3 is now called Smart Planning. And I start off saying there is a perfect storm brewing and that is a big part of it because Smart Planning is basically planning under uncertainty.

What it is trying to say is - to make planning decisions or risk management decisions if you will - what is the minimal amount of information that we need to make decisions. In other words - how much uncertainty are we willing to accept and to live with.

And we are finding out that that is a contentious issue. Because for years and years, corps planners have been beat on to be conservative, don't make mistakes, get the details, get all of that stuff nailed down. And so we would like to do our, you know, our models and get the data. And the big settlement contracts and the big environmental data contracts. And now all of the sudden we have a reversal and we are being told - make those planning decisions as quickly as you can. And save the details for design.

So, when we do these rescoping - if you are working with feasibility study - there are planning charrettes. And the purpose of these planning charrettes is to basically introduce to the PDT how you would implement some of these ideas we have just been talking about in risk management in the planning process. And then trying to use those ideas to save time and money.

So that is being done through the development of something we are calling the decision management plan and a risk register. A risk register is basically a log that identifies the risk of making a decision without all the data. It identifies what the consequence of a mistake could be from doing so. And then it documents the PDT's decision on how to proceed and how to manage that risk.

So the rescoping charrettes are very much making this process that we have been describing mainstream for planning. I would love to say more because I love that topic and I am very active in it. But let me go down through a couple of other questions here.

And one of them is - why do you characterize flood risk communication as primarily inside baseball. And let me say if I said that then I was mistaken. I wouldn't say flood risk communication is inside baseball. I guess what I was saying was that for some risk management activities - some of those are inside baseball, you know.

If you are working within the district and you've got an O&M budget and you are trying to figure out how to spend this O&M money within a project site. Well there is a good likelihood that that's just one of those examples that is not going to involve a lot from the public. You are not going to have to have public meetings or involve any stakeholders.

That might be going across - going out and asking the site engineer and talking to a couple of people in O&M. So some risk management activities - the collaboration and the communication - would be all inside baseball, all internal to the corps. But for others it is going to be much broader than that.

The distinction - a little bit more on the distinction between tolerable and acceptable levels of risk. Let's imagine that we have got a flood risk management study because that is the first thing that popped in my head. We have identified the risks. We have identified expected annual damages. We have got good H&H. We can tell, you know, who gets flooded when and how often and all that sort of stuff.

So we now have the risk described. And the very first thing that we have to do is decide - is that acceptable or not? Now an acceptable risk would be a risk that has a very, very low probability of occurrence. Or an acceptable risk is one that would have a very, very small consequence. Or an acceptable risk could be one that has benefits associated with it.

So driving is an example of a risky activity that has tremendous benefits associated with it. So by looking at the risk and considering its probability, its consequence or the benefits. And seeing how people or groups of people are willing to respond to that risk - you would identify the risk as acceptable or not.

If we are doing a flood risk management study it is likely because the flood risk is not acceptable. So the first step is judging something to be unacceptable might not be that difficult. Acceptable, you know, to get from unacceptable to acceptable - we might not be able to get there.

Can we reduce the risk of flooding to something so small that people would say - yes that is fine with me? Or can we reduce the consequences that much? Maybe. But I kind of doubt it because most of our projects have significant residual risks as that post Katrina picture showed.

We can build a great project but if it fails or it gets overtop, you are in a world of hurt. So the next step then is to get - presuming we have an unacceptable risk and we can't get to acceptable. This is where that term tolerable emerges. Tolerable is the concept that we have invented I guess to identify something that is between - it is less severe than an unacceptable risk. But it is not yet acceptable yet.

So a risk that is being reduced that we can't get to an acceptable level is tolerable. So a tolerable level of risk is non-negligible. Meaning people are still concerned about it. We would like to see it reduced even further. But the reason we tolerate it as I mentioned before could be a trade off of cost. It could cost too much money to reduce the risk further. Or sometimes the technology is just not available.

When we use the best available technology we might only be able to reduce the risk to a certain point. And so a tolerable risk is in that range between unacceptable and acceptable. And it is one of those terms of art that would have to be determined by subjective trade off.

Next question from (Mark) - I feel like a radio DJ or something.

(Courtney Chamber): We are still here though. You are doing great. Thank you.

Charles Yoe: How far along is the draft Risk EC. When do you expect if final and ready for implementation. Is it being written in coordination with the RMC? There is a draft EC, there has been a draft EC for two years. And if (Dave) was here I would punt this question to him now. Because you all understand the workings in ways of corps policy far better than I. I think it has been waiting for that magic moment to appear. I think with smart planning and with the creation of the RMC that magic moment might be getting closer and closer.

But apparently it takes time to get folks higher up comfortable with the idea of a risk management process. So I don't know (Mark). I thought we had something that was ready to go out. And when we were doing a road show about two maybe three years ago we went to all the MSCs and there was a draft EC then. So coming sometime soon in an EC near you.

The coordination so far the version that exists wasn't specifically coordinated with the RMC simply because it takes a much broader view of risk management than the RMC mission does. But I am sure that is something that would happen before it appears.

(Alvin) wants to know if there is a template for the risk register. And I would say yes there is. There is a spreadsheet right now, you know, an Excel spreadsheet that we are using - and I don't know if I can go back real quickly. Let me see if I can go back.

(Courtney Chamber): You can use those same arrows, yes. Or drop down.

Charles Yoe: If you use my email address I could send you a copy of that spreadsheet. Just understand that it is a work in progress. Smart planning. We are building that airplane as we fly it. So the risk register would be changing.

Here we go - someone else has said the risk register template is available at that link. So thank you very much for that.

Let's see - we have from (Craig). The difference between the risks of project failure as opposed to making a bad planning decision. That is a good question as well. It is hard for many of us and certainly hard for me to wrap my head around some of these things sometimes. So this is confusing and I would say I think that makes you pretty normal.

So right now for example with this smart planning and the risk register - what we are saying is that there are three risks - three broad categories of risks that could result from planning and making decisions under uncertainty in planning. And one of these categories of risk is what we are calling project risk. And I apologize. I think the language is just awful we just haven't figured it out yet.

But a project risk would be a risk that exists in the project area. So if it's a flood risk management study - flooding is a project risk. If it is ecosystem restoration - the possibility that we might make some improvements and not realize the benefits, that would be a project risk. So these would be the outcomes of a project. Or they would be situation that currently exist in the study area. So that is one kind of risk.

The second kind of risk is as (Craig) mentions here. If we make a bad planning decision. We could make an error. We could make a wrong decision. We could build the wrong project. That's a second category of risks.

And remember what we have just been talking about this integrated risk management was talking about identifying risks as one of the key steps. And that's exactly what a risk register tries to do and identifies risks associated with different planning decisions.

So there are risks in a project area. There are risks of bad planning decisions. And then there is a third category of risk that relates to the implementation of a project itself that, you know, we might build the wrong project, we might not design it properly. And that would give rise to a project failure.

So right now, the best I can tell you (Craig) is we are still kind of struggling with language. And we do recognize that there are these different grades and qualities of risks in these three categories. And we are trying to raise planner's consciousness about them to consider them all. But it is a practical manner as far as planning goes.

Pretty much all we are looking at is making a bad planning decision. Not because that is the right thing to do but because this is early on. It is new and this is just too much for people to handle to think about these categories of risk. So I am hoping that as we get better at this as people become more familiar with these ideas, we will get smarter about how to answer the question that you have asked.

(Courtney Chamber): Charles I see one more question, at least on my screen, from (Mark). Is that all you see left?

Charles Yoe: I see - so does ETL 11-10. I thought that was talking about where the risk register might be? Maybe (Mark) can clarify that?

(Mark): Yes, that is what that is (Charlie).

Charles Yoe: Okay. That's how I took it.

(Courtney Chamber): Okay. Well we did get to a lot of questions. I think we had better go ahead and start winding up at this time. But if you do have other questions Charles would it be okay if they email you at that email address?

Charles Yoe: Yes that is why it is up there. If you have any questions please feel free.

(Courtney Chamber): Okay, alright. [Co1@verizon.net](mailto:Co1@verizon.net). Alright. One more thing - I am going to send a link to where this presentation will be posted as well. Oh wait we did have a few more questions, I am sorry.

Do you need to - do you want to take a few quick minutes Charles to address that one that asks to discuss the difference between the project failure - you did do that right?

Charles Yoe: Let's see. (Tom Hackett). Hi (Tom). He says - it seems to me that some elements of risk analysis are not consistent with the three by three by three constraints. What do I think?

I would like to hear more about what you mean by three by three by three constraints (Tom). Just to make sure I am answering consistent with what you are thinking. Do you want to expand on that a little?

(Tom): Hi (Charlie). Yes. I was just thinking that some of the risk analysis may take more time. May take more paper, more work.

Charles Yoe: Oh, okay. What you are saying is if we are going to be doing this risk analysis stuff that might be costing us a little bit more than three million or a little bit more than three years.

(Tom): Yes.

Charles Yoe: I think - I guess when it occurs to me I guess what I would say is I am not sure I think so. I think what we are talking about is being clear about what we do know and what we don't know. Being clear about when we have enough information to make a decision. And so this would actually - I think if we are being real focused in the way we approach and the way we identify these risks. And if we get vertical team buy-in. Then we can begin to make decisions with less information.

Let me try to give an example I guess. I'll take (scaget) was one of our planning charrettes. And they got displacement around for a long time. They have got a number of alternatives right now. And what they needed to do was to move the process along. You know, you don't want to do all the detailed analysis, detailed cost estimates, all the combined measurements, H&H work. You need to get voter certificate profiles from different plans and all that sort of stuff for six or seven plans, if we can avoid doing that.

So with this risk and uncertainty - the risk analysis stuff. We were actually doing things like, you know, using topo and just drawing straight lines for levy alignments to say - okay this is going to cost more than that because the line is longer, you know. There was uncertainty there but people felt real comfortable in making judgments about relative cost.

This plan is going to cost a lot more than that plan because a levy that is six inches long and my topo sheet is going to be more expensive than a levy that

is two inches long on my topo sheet. So once we figure out how to do it well - how to communicate it. I think it would actually make it easier to - that it could save money and it could save time.

That was a really miserable rambling answer, sorry.

(Courtney Chamber): Okay well at this time we will go ahead and wrap up. Charles thank you very, very much for sharing your knowledge about risk management with us today. And thank you all participants for joining.

END