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Uncertainty analysis – 5 challenges with today's practice

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Abstract

As pointed out by Venkataraman and Pinto (2010), the importance of estimating project costs arises as the estimates become the benchmarks of which future costs are compared and evaluated. Although estimates become more accurate as decisions are made and uncertainties resolved, they are also chief means for assessing project feasibility, as a comparison of cost estimates with estimates of revenues and other benefits that are crucial in determining whether the project is worthwhile to carry out or not. In this paper we will discuss whether or not the uncertainty analysis is a reliable tool for supporting the cost estimation process. We present 5 challenges in connection with the way uncertainty analyses of cost estimates are done today and present findings that indicate a need to rethink the uncertainty analyses of the projects that have a high degree of uncertainty. This paper is a product of collective reflection, experience and the knowledge of the authors. It is of a qualitative nature as we do not present any quantitative or statistical evidence or methods in our approach. It is understood, due to the diverse contextual backgrounds of the projects involved, that the explanations for differences may be equally diverse. The paper is divided into five parts; The introduction – explaining the importance of the topic; part two provides a short introduction to the applied research methods; part three explain what we mean by cost estimation under uncertainty; part four presents the five identified challenges in cost estimat*ion under uncertainty; part five presents a conclusion and proposes potential areas of further research.

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Keywords: Mega project; Uncertainty analysis; Cost estimation

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1. Uncertainty analysis – tool for finding the right project and a tool for managing the uncertainty

As pointed out by Venkataraman and Pinto (2010), the importance of estimating project costs arises as the estimates become the benchmarks of which future costs are compared and evaluated. In this paper we address the following two research questions: (1) Is the uncertainty analysis a reliable tool for supporting the cost estimation process of projects? (2) Do the result from the uncertainty analysis reflect the end cost of the project, and are the results of the uncertainty analyses trustworthy in the various phases of the project?

2. Research methods and limitations

The paper is inspired by the experiences gained by the authors in working with uncertainty management over the last 15 years. The authors have worked in two large research projects with special focus on uncertainty analysis and uncertainty management; CONCEPT project "Uncertainty analyses" (2003 -2005) and "Practical uncertainty management in the project owner perspective" (the PUS-project, 2005-2010). In both projects, we did extensive literature reviews on uncertainty analysis theory and uncertainty management theory. And in both projects, ideas and concepts were developed and tested in case projects together with industry partners. The authors have been responsible for uncertainty analysis and/or the documentation of more than 100 analyses in total - We have led the 11 concept selection studies for Oslo Municipality, 2 concept studies on major road systems (Ferjefri E39). The authors have worked with health institutions (hospitals), public buildings, power companies, and road and railway constructors in Norway. The basis for this writing process is the discussions and analysis of the authors' joint experiences and interpretations of our findings. The paper is a product of collective reflection on the experiences and knowledge. The methodological approach is qualitative in the sense that we do not use any quantitative or statistical evidence or methods in our approach, It is understood, due to the diverse contextual backgrounds of the projects involved that the explanations for differences may be equally diverse. Therefore, it is aimed at analysing possible explanations and present and discuss them in a manner which could be meaningful on a level superior to that of the single project

3. Uncertainty analysis in Projects – threats and opportunities

In the project management domain, uncertainty is currently understood as lack of information but uncertainty could also be understood as lack of certainty. Rolstadås, et al, (2011) state that uncertainty in projects may take on a number of very different forms, and propose a structure for categorization of uncertainty into controllable and non-controllable factors Hetland, (2003). Rolstadås, et al, (2011) suggest that uncertainty could be negative and positive for a project. Negative implications of uncertainty are labeled as risk factors. Positive implications of uncertainty are labelled as opportunity factors. Both may have consequences if they occur. They refer to risk as the consequence of an unwanted event multiplied by the probability of the event, and opportunity as the opposite of risk, ie. events with positive consequences. Projects have traditionally strived towards predictability and to keep all critical factors under control. However, for large and complex projects, such predictability does not exist in reality (Rolstadås, et al, 2011). Major uncertainties play a large role in important areas. And especially under such conditions, it may not be a good strategy to strive for maximum predictability, but rather to choose a strategy of flexibility in the project, in order to be able to face changes in a better way (Olsson, 2006). In this paper, we adopt the term uncertainty to include both the positive effects (opportunities) and the negative effects (threats) in the execution of projects. We define uncertainty as follows: Project uncertainty is defined as controllable and non-controllable factors that may occur, and variation and foreseeable events that occur during a project execution, and that have a significant impact on the project objective Johansen et al 2012 (1) We define threats as factors, variations and events that may lead to undesired changes to objective, scope, resources, frame conditions that make the project cost more, spend more time or delivers less quality than was agreed up on in the beginning of the project. Opportunities are factors, variations and events that may lead to changes that make the project able to deliver the same quality in less time or to lower price than was agreed upon in the beginning of the project. And all such factors, variations and events that cause changes can make the project to deliver higher functionality or lead to positive NPV after the project is delivered.

What do we mean by uncertainty analysis in this paper - The GAO Cost Estimating and Assessment Guide presents 12 key steps that are essential to producing high quality cost estimates:

1. Define the estimate's purpose
2. Develop an estimating plan
3. Define the Project (or Program) characteristics
4. Determine the estimating structure [e.g., Work Breakdown Structure (WBS)]
5. Identify ground rules and assumptions
6. Obtain data
7. Develop a point estimate and compare to an independent cost estimate
8. Conduct sensitivity analysis
9. Conduct risk and uncertainty analysis
10. Document the estimate
11. Present the estimate for management approval
12. Update the estimate to reflect actual costs and changes

The Cost estimating guide also state that "most cost estimates have common characteristics, regardless of whether the technical scope is traditional (capital funded, construction, equipment purchases, etc.) or nontraditional (expense funded, research and development, operations, etc.). The most common characteristics are levels of definition, requirements (end usage/purpose), and techniques used. These characteristic levels are generally grouped into cost estimate classifications. Typically, as a project evolves, it becomes more definitive. Determination of cost estimate classifications helps ensure that the cost estimate quality is appropriately considered. Classifications may also help determine the appropriate application of contingency, escalation, use of direct/indirect costs (as determined by cost estimate techniques), etc. " Standards of Cost estimation processes for projects (IAACE) describes a cost estimation process where you build up a detailed base estimate with a bottom-up approach. The project should start with determine the estimating structure (WBS) and develop a point estimate and compare it to an independent cost estimate, and in the end follow this up with by an uncertainty analysis of the estimate, often with a top-down approach. The purpose for the uncertainty analysis is to identify the confidence level (e.g., 80 or 85 percent), identify uncertainties and develop an allowance to mitigate cost effects of the uncertainties.

In the early 1970s Lichtenberg S, together with researcher from Stanford University and MIT in U.S.A. Universities in Lough-borough, UK, Gothenburg, Sweden and the Technical University of Norway in Trondheim (NTH) developed a new approach for calculating the cost of big projects called the successive principle of cost estimation (Lichtenberg 2006). Lichtenberg used the term uncertainty, and it was from the beginning a neutral concept and it should have a broader view than risk concept that was dealing only with the down side – for instance, unexpected delays and higher cost. For him, uncertainty just meant that something could go faster or the project could cost less than planned, or it could take longer time or cost more than planned. This concept was adapted by the Norwegian project management researchers from NTH - and from early 90ies uncertainty analysis was used as the concept to find the expected cost or expected time for projects and the variability of cost/time, given by the standard deviation. The step by step approach (the Norwegian evolution from the successive principle) and stochastic estimation were introduced and were spread together with the uncertainty analysis concept among consultants and practitioners in the same time period. Today the step by step approach and the term uncertainty analysis is established as the concept to be used in Norway for uncertainty analyses of project cost estimates to calculate expected cost/time and find the uncertainty factors that could affect the project objectives in a positive (opportunities) or negative (threat) way. And the term uncertainty management is used in identifying the positive and negative events or activities that may or may not happens, quantifying the expected effect, prioritizing, planning response, implementing the response and following them up. The Nordic tradition in uncertainty analysis is typically a group process lead by a facilitator who is expert on uncertainty analysis and a resource group of experts within the areas of the project Klakegg, O.J (1994). Typically ten to twenty experts are involved in the process, and it goes on for 1 to 4 days. It is a top down approach and typically a kind of Monte Carlo simulation tool is used, where the time or cost model can be made out of the input from the resource group that is involved in the process. The model can be complex or simple depending on the purpose. But if a simple model does the job and if the results are reliable enough for the purpose, a simple model is preferred. The uncertainty analyses process can be divided in three phases – The uncertainty analyses process can be divided in three phases – Phase 1, Purpose of analysis – address the six Ws of the risk management process Ward &Chapman, (2004). Phase 2 Uncertainty analyses and phase 3 - Documentation of the result of the process. Torp et al (2008), Klakegg et al (2009), Klakegg, O. J. (1994), Simister, S. J. (2004).

Table 1 The uncertainty analyses – step by step approach

Phases	What	Technique
Purpose of analysis	1. Defining the objective for UA	
	2. Defining what should be calculated	
	3. Defining a cost structure for the base alternative	
	4. Establishing the UA model in a cost estimation tool	Crystal ball or similar tools
Uncertainty analyse	5. Identifying the opportunities and threats	Successive principal
	6. Estimation of the cost for all elements,	Triple estimate
	7. Low Cost- most likely Cost and High cost	
	8. Estimation of the uncertainty all elements impact	Monte Carlo
	9. Finding expected value E(P) and Varian's Var (X) for cost elements, factors and for the total project	probabilitet-curve
	10. Develop uncertainty response to the "Top ten uncertainty's"	Tornado diagram
Documentation	11. Report – documentation of the process and its premises presenting most likely cost for the project (P50 estimate) and continence	Uncertainty matrix
	12. Top ten list – most important opportunities and threats	Uncertainty log
	13. Cuts – list over elements that can be taken out of the scope	

The end result from this process is a picture that describes which cost items or uncertainty factors that are most uncertain and a probability distribution of the cost or time estimate for the project with expected costs and the uncertainty measured as standard deviation.

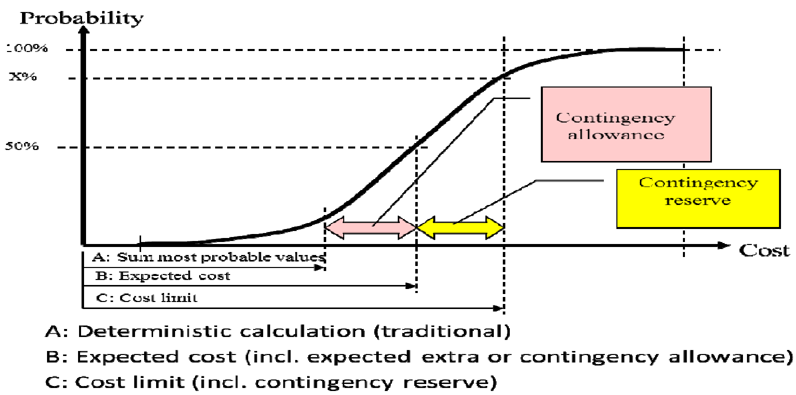

Fig. 1 Probability distribution of the cost estimate for a project

This method for uncertainty analysis was typically used in the early phase of the project and it is closely related to the thinking of Stage gate models Johansen et al 2012(3). A stage-gate model used in Norwegian public project is illustrated in fig. 2

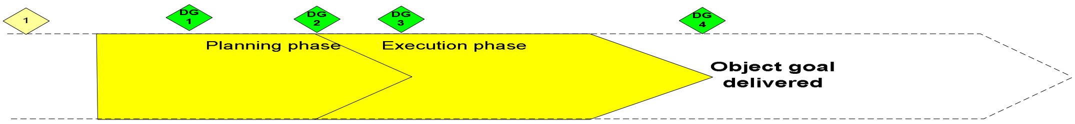

Fig. 2 Stage gate model

"The logic in the stage gate model is based on the principle that one starts with different alternatives (concepts) and develops them up to a stage gate, where the project owner decides which concept that should go over to the next stage. " Johansen et al (2012). (3) This correspond to the thinking that is described in the cost estimation guide and the AACE International Estimation classification. The uncertainty analysis is therefore an important tool in term of picking the right project at decision gate 1 and 2, and in term of establishing the budget that the project should stick to after passed decision gate 3, where budget are authorized and controlled. The American standard suggest that accuracy range at DG 3 should be between – 10 /-20 (low), and +10/+ 30 (high). In Norway it seems like uncertainty analyses provide result that is significantly more precise, the result from the analyses are typically in the range of – 10 to +10 % on a class 3 estimate. In 2006-2007, 56 large public projects were investigated in Norway. The average standard deviation is shown in table 2 for different types of projects. The average in total was calculated as 10,5 %. For single projects it varied from 4 % to 21%. See table 2.

Table 2. Cost uncertainty and standard deviation

Type of project	Cost uncertainty, standard deviation (%)Effect
Roads	11,4 %
Public buildings	9,8 %
Defence procurement	8,5 %
Railway	14 %
ICT	7 %
Other	12 %

Still, the question remains; can we really trust the results from this process, and is this a realistic picture of the uncertainty? And are we able to calculate a realistic expected value, compared to the final costs of the project?

4. Five challenges with - Uncertainty analysis

We have identified five challenges that influence the result from the uncertainty analyses. They are:

1. The expected value / the base case challenge
2. The detail challenge
3. Realistic Standard deviation in all phases of the project challenge
4. The human/team challenge
5. The lost opportunitet Challenge

The expected value / the base case challenge - In Norway, we use uncertainty analyses in the early stage of the project screening to find the expected value of the different concepts that are analyzed. The purposes of the process is more about identifying the "right project" then finding the right expected value. This means that mutual relations between different concepts of uncertainty and expected value are often more important than estimating the true expected value of the different concepts in the early stage of the process. This means that a project that is chosen as the "best project" doesn't necessarily signal the true and correct end cost in the two or three first uncertainty analyses that is conducted in the project. In fig. 3, we illustrate this challenge by showing the result from 7 uncertainty analyses from a building project ending up with 7 different answers to the question what is the expected value of the project, and increasing the value of the project all the way during the project process.

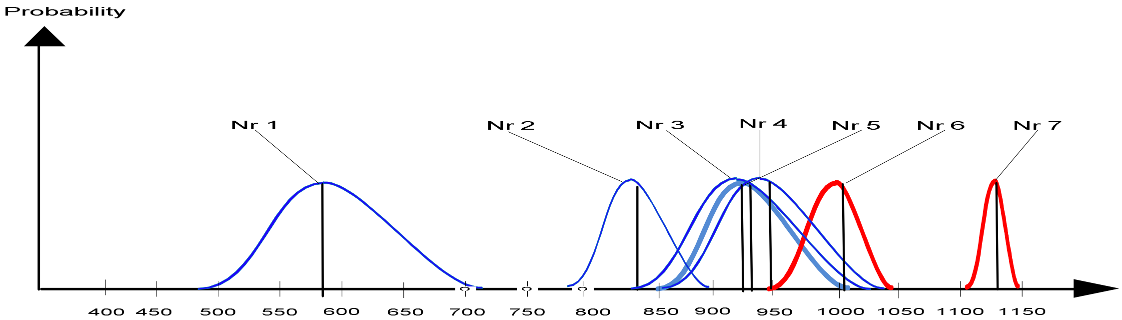

Fig. 3 Seven analysis – 1- 5 planning phase 6- 7 in the execution phase

This building project may illustrate how uncertain projects really are and how poorly some projects perform in term of "guessing" the expected end value of the project. But, it also points out that what we plan for in the early stage of the project will not necessarily be the same at the completion of the project. We will suggest that in many cases what we estimate in the uncertainty analysis is the base case – that means what we believe at the current stage of the process that will be delivered at the end of the project. And, we estimate this as accurate as possible at the current stage. Estimating the cost of project without really knowing what the end result is going to be will mean delivering estimates with high uncertainty. Still, to get project approval, we need estimates with relatively low uncertainty. Based on our experience we suggest that projects in most of the cases give estimates that are as good as you can expect based on the available information. The uncertainty analysis can send out two sets of wrong signals – they give poor signals to the owner in term of expected end cost and they underestimate the uncertainty. The uncertainty analyses number 2 in the fig 3. estimate the costs to about 840 mill NOK with a relative standard deviation of +/- 5,2 % . The real uncertainty when compared to the end result reveals that uncertainty at that given stage in reality was much higher. A more realistic range of uncertainty seems to be to be 840 + 30%. Uncertainty in that range however, would be considered unacceptable. In the building case, we saw that the project delivery in term of m^2 increased by 25% and that the end time was adjusted by two years between analysis 3 and 4 – the two analyses carried out by a 6 months interval and both analyses had low level of uncertainty. But, the reality shows that the first four analyses were based on the wrong assumptions in term of size and capacity compared with what the project ended up building - all four analyses fall short in predicting the project's final cost, although they appeared to be secure of the result. It seems like nobody really questions if the base case was realistic and correct compared to what the project should deliver. In other words, you are very sure about something that you are very unsure of delivering.

The detail problem- The uncertainty analysis method that we discuss in this paper was designed to be a top down approach for the early phase of the project lifecycle. The method was designed for finding the expected value and expected time based on limited information in the early stage of a project life cycle. Ideally the process should focus on the big picture and not all the details. It should focus on the most important items – uncertainty factors or contracts with largest uncertainty and activities that are most important for achieving the project objectives. Based on our experience, we have observed that a lot of the uncertainty analyses that have been conducted have drifted away from the original concept. Today we see two trends:

1. The uncertainty analyses are used at later stages of the process with more details available. This means that project can bring more elements and more details into the uncertainty analyses.
2. The project size is increasing. This means more subprojects and in turn more activities appear in the process.

But unfortunately both trends also mean that the uncertainty may be lost in the calculation and estimation of the details. In 1995 - 2005, 500 mill NOK was considered as a cost that characterizes a big project by Norwegian standards, and the uncertainty analyses had typically 20 – 35 elements that was estimated in the process. Today, the average project size in public sector is often higher than 1 billion NOK and average numbers of elements has increased to + 50 elements. Seen from the project perspective, the details are necessary to give a realistic estimate in the process, and they will be skeptical to the result, if the uncertainty analyses are to aggregate the uncertainties. From an uncertainty analytical perspective, we know that too detailed models will mean that uncertainty will be "calculated away". Today, we see a trend that projects intend to combine the better of the two mind-sets - by allowing detail structures with a lot of elements and discussing factors and overall conditions in the same process. The process for identification of uncertainty is good for the project team, and they feel that results are realistic and reliable. The resulting uncertainty is unfortunately often unrealistically small in the vast majority of cases that we have seen using this approach. If the goal is to avoid calculating away the uncertainty, we must either keep the analysis at a high level – that means less details in the analyses and using uncertainty factors that maintains contextual variables, or create highly sophisticated models where correlation between items and factors are maintained.

Realistic Standard deviation in all phase of the project challenge -Textbooks and company standards operate with uncertainty expressed in standard deviation that typically should be +/- 50 % in the beginning before passing DG 1 , +/- 25 % between DG 1 and DG 2 and typically +/- 10% when the project passing DG 3 and from there it will decline to nought when the project is handle over. The AACE International Estimation classification states that concept screening and feasibility studies estimates typically should have variation from -30% to + 50 % and -20 to + 30 % at budget authorization and control. Studies of more than 100 Uncertainty analyses done in the last 10 years – conducted by the authors of this paper show a different pattern - the standard deviation in % is normally considerably lower than suggest in the AACC standard. US . dep of energy - Cost estimating guide (2011)-

Table 3 Concept screening analyses feasibility studies and planning phase budget authorization and control – check estimate bid/tender

	Type of project	Total nr of projects/analysis	Standard deviation in %
Concept screening analyses	Public buildings	34 project – Schools	From 13,7 % to 21 % average16,1 %
	Road project	16 tunnel /bridge 15 tunnel /bridge	From 12 % to 24 % average 20,56%, From 11-% to 26% average – 19,26 %
Feasibility studies and planning	Public buildings (schools theatre etc) Hospital Road Railroad Road project	6 project 20 + 15+ 15+ 3	From 6 % to 12% average8 %
Check estimate bid/tender	Public buildings (schools theatre etc	10	From 1% to 3% average – 2%

Based on our experience we observe that recommended uncertainty level according to AACC standard is rare in the Norwegian analyses and that the uncertainty analyses often give a considerable more accurate result than the standard suggest. In table 3, we summarized the range we have observed in uncertainty analyses the past 15 years.

Table 4 Theoretical and empiric level of standards deviation in 5 phases

Analyse phase	(Standard deviation) Opportunity		(Standard deviation) Threat	
	Theoretical	**Empiric**	Theoretical	**Empiric**

1 Concept screening	-40%	**-20%**	+ 50%	**+30 %**
2 Study or feasibility	-25%	**-15%**	+30%	**+20%**
3 Budget authorization	-20%	**-10 %**	+25%	**12%**
4 Control or bid/tender	-10%	**-5%**	+15%	**8%**
5 Check estimate or bid/tender	-5%	**0**	+5%	**5%**

This indicates that a high share of the uncertainty analyses from Norwegian projects shows an unrealistic low uncertainty – and we suggest that this has to do with the challenges mentioned earlier.

The human/team challenge-When uncertainty is discussed in projects, we tend to think that we do it more or less objectively and that uncertainty is interpreted more or less in the same way by all the participants in the process. But this is not necessarily the case. Hillson et al. (2005) states that people's chosen state of mind, mental view or disposition with regard to fact or state matter when people interpret uncertainty. The authors label this "risk attitude". People's risk attitude drive project members' behavior – that means that if an uncertain event is observed or presented in an uncertainty analysis process, different participants understand the situation as favorable or as unfavorable or even hostile depending on their individual attitude towards risk. There is also evidence that propose situational factors such as training, role and how accountable the different participants are in relation to the end results Flyvebjerg et al.,(2003) have influence on the project members preferred attitude towards risk. There are also some pitfalls when analysing uncertainty in groups sessions. Hillson et al (2005) talk about group risk attitudes and heuristics, and they list up 5 common heuristic in groups working with identifying risk: Group thinking, the Moses factor, Cultural conformity, Risk shift and Cautious shift. They also point out that this group heuristic often does not occur alone or in isolation, and they are reinforcing causal relationship between them, potentially resulting in the effects of the above mentioned factors becoming even more severe in the uncertainty analysis process. A group offers more insight and experience then a single person can possess – which explains why groups very often are used when uncertainty is discussed Klakegg O, J (1994). Individual heuristic and group thinking may affect how good the group performs in an uncertainty analysis process. This means that the results of the process are depending on the skills and attitudes of the individuals who participate in the process, and the result of the process is therefore clearly not objective. The participants in an uncertainty analysis will often be held accountable for the cost estimates they provide. It is therefore an obvious danger that those who provide estimates actively will add "buffer" to the cost estimate or add unrealistic high uncertainty factors so that the end result of the process will give a "high enough" expected value. Although all participants in the analysis are asked to prepare basic estimates based on a cost break down structure without allowance, and although we tell them that use of triple estimate and uncertainty factors will address the uncertainty in the estimates, we find constantly that buffer is added when cost estimates is discussed. To deal with this challenge, the project management team must have great insight in the price structure on every component of the cost estimate, and very often this is almost an impossible task in large projects. To check if the result of the process is fair, they can use independent expert. Or, they can use benchmarking to control if the estimate is reliable on higher level. Still the challenge remain unsolved - which of the estimates can the project team trust, how big buffer is in the estimates and how much the different stakeholders' expertise, experiences and type of personalities influence the estimation of the uncertainty?

The lost opportunity challenge – the blind spot of uncertainty - From our experience as consultants and our experience in the PUS project, we saw the same pattern, when threats and opportunities were handled in the same process – much less opportunities then threats where identified and discussed in the process. Often 70 or 100 threats were discussed compared to 5 to 10 opportunities. We did a follow up study on five of the case that was a part of the PUS projects in spring 2013. We counted threats and opportunities in planning and execution phases and asked the projects how they did in the end – How many opportunities was exploited and what was the effect for the project, and which threats did materialize and what was the consequence for the project in the end?

Case 1: 17 opportunities were identified and 2 were exploited, 40 threats identified and 22 of them had economic consequences – increased cost + 180 to 200 mill

Case 2: 3 opportunities were identified and 0 was exploited, +50 threats were identified and +30 of them had economic consequences – project delays and increased cost + 40 mill.

Case 3: 6 opportunities were identified and 3 were exploited, reduced cost 10 -15 mill., +50 threats identified and 18 of them had economic consequences – project delays and increased cost + 75 -100 mill.

Case 4: 10 opportunities were identified and 2 were exploited, reduced cost 15 -30 mill., 33 threats identified and 8 of them had economic consequences – increased cost + 30-50 mill.

Case 5: 0 opportunities where identified and 0 was exploited, 28 threats identified and 3- 5 of them had economic consequences –increased cost + 15- 25 mill.

Total number of opportunities exploited –7, total numbers of threats that had economic consequences 100 - 110. The pattern is more or less similar inn all the five cases that we have been looking in to – Why are there so few opportunities in projects? Is it likely that threats are many and opportunities are few in al projects? And, why is so few opportunities exploited in the end?

5. Conclusion Uncertain analyses -problem and limitation

The use of uncertainty analyses for establishing cost estimates is more or less mandatory in Norwegian public companies today. The method is well established and the results have big impacts on establishing the cost estimates and budgets in this type of projects. The trend of using uncertainty analyses as a tool in the execution phase makes it even more of a pity that the method is giving the wrong signals to the project management team. Uncertainty analysis is meant to give the project valuable insight in the most important areas that the project management team should pay attention to. We have argued that today's practice have five challenges that must be dealt with if uncertainty analyses should be a useful strategic decision support tool in project in the future. **The expected value / the base case challenge** –Uncertainty analyses often fall short in predicting the project's final cost and even though they appear to produce accurate estimates – the uncertainty is in most cases underestimated in the base case being analyzed. Additionally, we have seen that in many cases nobody really questions whether the base case estimates represent are realistic picture of the end cost. **The detail challenge** -the calculated uncertainty disappears during the cost estimation process. As details are added to the cost estimates, the results seem to indicate more and more precision, even if in reality nothing has changed**. Realistic Standard deviation in all phase of the project challenge** – the uncertainty analyses fails to give a realistic picture of the uncertainty involved in big projects**. The human/team challenge** –when the participants in an uncertainty analysis learn that the uncertainty associated with cost estimation of the project has an direct impact and learn that they will be held accountable for the cost estimates they provide, then it results in an obvious danger that those who provide estimates actively will add "buffers" to the cost estimate or add unrealistic high uncertainty factors so that end result of the process provides a "high enough" expected value. The consequence will often be a higher expected value with unrealistically low uncertainty. **The lost opportunities** - Exploiting opportunities often requires that project owner and project management team accept changes and have the will and the power to alter the solutions or deliverables described in the plans and in the project management documentation. This is often a difficult task, to motivate to change; the opportunity must be significantly better than solutions that are planned, because implementing an opportunity means that the project must spend money and time to change plans or in worst case; change the whole concept. We see that many projects are conservative to new ideas and change, and that they are not seeking new opportunities. Some opportunities will normally be identified in an uncertainty analysis work shop, but this doesn't mean that the participants actually utilize the opportunities after the workshop is over. What we observe in the uncertainty processes and projects that we have been involved with, is a low willingness to actually do something with the identified opportunities. We believe that uncertainty analyses should be a highly valued tool, and when used properly it could contribute significantly to add value to the projects. But, we also think that todays practice are faced with challenges that must be overcome to avoid project management teams starting to disbelieve in the result from the analyses. If the uncertainty analysis is not giving signals about the end cost and fail to give signals about witch cost item or factors that are important to manage, then there is not much point left in doing the analysis.

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