Universitetet
i Stavanger

KANDIDAT

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PRØVE

RIS505 1 Fundamentale temaer innen risikostyring og risikovitenskap

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RIS505

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¹ Problem 1

1. Er påstandene nedenfor sanne eller usanne i henhold til pensum?
a) Risiko kan referere til både negative (uønskede) og positive (ønskelige) utfall
b) Sannsynligheter kan ikke angis når usikkerheten er høy
c) En aktivitet kan betraktes som sikker hvis sannsynligheten for uønskede konsekvenser knyttet til aktiviteten er tilstrekkelig liten
d) En risikovurdering omfatter risikoanalyse og risikoevaluering
e) Hvis usikkerhetene knyttet til risikovurderingen anses som svært små, er det ikke nødvendig med ledelsens gjennomgang og vurdering

Vennligst svar med 'sant' eller 'usant'. Kommentarer kan gis for ytterligere forklaring eller for å støtte svaret ditt (for å oppnå full score, er det tilstrekkelig å svare 'sant' eller 'usant')

Skriv ditt svar her

A) True, even though risk is mostly referred to as a term with negative consequences, taking risk could also lead to positive outcomes such as winning the lottery.

B) False, subjective probability is not subject to uncertainties as there is no true, underlying value to compare to and can therefore be specified. Probabilities can be specified when uncertainties are large along with a judgment of strength of knowledge.

C) False, the strength of knowledge is not specified. For an activity to be considered safe there also has to be a judgment on the strength of knowledge supporting this decision

D) True, a risk assessment covers these to steps in addition to planning and use of risk assessment. The steps are in this order: planning, risk analysis, risk evaluation and use of risk assessment.

E) False, there is still a need for Managerial review and judgment (MRJ) as it is critical towards the results of the risk assessment, acknowledges the limitations of this assessment and takes other assessments into account along with values. This is not related to whether the uncertainties are large or not as it also reviews the strength of knowledge associated.

Ord: 193

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

5 4 6 9 5 5 9

2 Problem 2

Ifølge læreboken kan risiko defineres som (A,C,U), der A betegner hendelser som inntreffer, C utfall/konsekvenser av hendelsene og U usikkerheten knyttet til A og C. Vis hvordan sårbarhet kan sees som en komponent av risiko, ved hjelp av ovennevnte notasjon. Hva betyr sårbarhet? Hva er sammenhengen mellom sårbarhet og resiliens?

Skriv ditt svar her

Risk can be defined as the consequences of an activity and associated uncertainty. Vulnerability can be defined as the consequences of an activity and associated uncertainty given an event (risk source).

Risk = event risk (A, U) + vulnerability (C, U|A)

Risk concept = (A,C, U)

The above notion shows how event risk and vulnerability together makes up risk. Vulnerability is therefore a component of risk, showing how a system would be affected by an event. An example could be how a factory would be affected by the consequences of a fire.

Resilience can be viewed as an aspect of vulnerability. Resilience can be defined as the ability to quickly return to a normal state given an event (risk source). One could imagine a U-curve, where the area inside the U-curve is the vulnerability of a system. The right slope of the curve illustrates the system`s resilience. One can use the human body as an example in this case. If the consequences of impact from a virus are significant the curve will be deeper, but if the body is resilient the curve will be steep and quickly return to a normal state. If the consequences of the virus are severe such as a hearth attack, but the body is resilient, it is quickly able to return to a normal state, and thus the vulnerability is decreased. In relation to the U-curve, the vulnerability are would therefor be smaller as a result of a high degree of resilience. High resilience and low vulnerability is not necessarily granted as resilience is only one aspect of vulnerability. If the consequences are severe enough, it will impact the system (in this case the human body).

Ord: 281

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

2 8 9 3 2 9 1

3 Problem 3

John planlegger en backpackertur til Asia. Han er klar over at matforgiftning er vanlig på slike turer, og angir en sannsynlighet på 0.3 for at denne hendelsen skal inntreffe. Hvilken type sannsynlighet er dette? Gi en tolkning av sannsynligheten. Er sannsynligheten usikker? Hvorfor/hvorfor ikke?

Skriv ditt svar her

$P(X|K) = 0,3$

P = probability

X = the event food poisoning

K = knowledge supporting the probability

The type of probability assigned is knowledge-based probability as it is John`s subjective belief and his degree of uncertainty that the event will occur. The probability of getting food poisoning is therefore based on his subjective knowledge.

An interpretation of the probability $P = (X|K) = 0,3$ could be that it is the same degree of belief of the event occurring as randomly drawing a red ball out of an urn with 100 balls where 30 are red.

This probability is not uncertain because knowledge-based probabilities are not uncertain because there is no, true underlying value to compare to. The knowledge supporting the assigned probability could be more or less strong.

The value of frequentist probabilities on the other hand, can be uncertain because it expresses variation between a true, underlying value and the fraction of times an event occurs repeated indefinitely under the same conditions. However, the frequentist probability is not used in this case because John assigns a value to the probability and it is therefore based on his knowledge.

Ord: 190

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

4 0 4 0 2 1 4

⁴ **Problem 4**

Ledelsen i et produksjonsselskap vurderer å implementere et tiltak for å forbedre sikkerheten på anlegget. De har beregnet at forventede kostnader for tiltaket er 10 millioner dollar. Forventet antall liv som reddes, er 0.5.

a) Finn kostnadseffektivitetsforholdet for dette tiltaket. Hva kalles denne verdien? Hvordan kan selskapet bruke denne verdien til å støtte beslutningstakingen om hvorvidt tiltaket skal implementeres eller ikke?

b) Denne typen analyse er basert på forventede verdier. Hvordan blir forventningsverdi tolket i henhold til pensum? Hva er begrensningene knyttet til bruken av forventningsverdier for å uttrykke risiko?

Skriv ditt svar her

A) Cost effectives ratio: E[X] expected cost/ E[B]expected benefits = ICAF

The value of the cost benefit ratio can be expressed as the implied cost of averting a fatality (ICAF). In other words, it is the expense of reducing the number of fatalities by one.

The cost benefit ratio for this case is 10mill/0,5 = 20 mill

The ICAF is therefore 20 million dollars

In order to decide whether the measure should be implemented or not, the company has to set a value of statistical life (VSL), which can be interpreted as the maximum a company is willing to pay to reduce the number of statistical deaths by 1. This value is usually standard and set in advance by the company. Assume VSL is set to 15 mill.

If VSL > ICAF the measure should be implemented because the value of the statistical life is greater than the implied cost of averting a fatality.

If VSL < ICAF the measure cannot be justified, however that does not mean that decision-makers should solely base decisions on this value alone, the measure could be justified through other means, should as favoring protection over development.

Expected values can be defined as the center of gravity of the probability distribution, and does therefore give little weight to extreme outcomes, which could damage the organization greatly, if not giving attention to possible events with low probability but significant consequences. An issue with using expected number to express risk is that they do not reflect the potential for extreme outcomes. As expected values refer to the center of the probability of distribution, there is no refection on the possible, extreme outcomes. A second issue with expected values is that strength of knowledge is not reflected. Strength of knowledge is an important component in order to weigh different risk measures and know if the supporting knowledge is weak or even wrong. Therefore the use of expected values can be a poor representation of risk.

Ord: 327

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

6 6 7 3 9 6 3

⁵ Problem 5

Vurder casen i forrige oppgave (oppgave 4). La oss anta at selskapet også ønsker å inkludere andre aspekter i analysen, inkludert omdømmefaktorer, miljøaspekter og sosiale og etiske sider. Hva slags analyse ville du anbefale at de bruker? Hva er fordelene og utfordringene knyttet til bruk av denne typen analyse?

Skriv ditt svar her

I could recommend the company to use a multiattribute analysis, which is a analysis comparing different options with regard to attributes such as reputation, environmental aspects,social and ethical concerns. For example could impact on reputation be given a value between low and high, and impact on environment could be given a value between 100. See the table below as an example.

The benefit of this analysis is that the analysts are not forced to convert all attributes to one value, like in cost-benefit and cost-effectiveness analysis. This allows for decision-makers to give weight to the attributes they understand as most relevant or necessary. A challenge with this approach is that it requires effort and is time-consuming compared to other options.

A multiattribute analysis does not necessarily point out the best options, as decision-makers have to weigh which attributes they value the most. It is therefore no specific result of the analysis such as in the cost-effectiveness and cost-benefit where you are left with one specific number as a result.

It is important to point out that the analysis itself does not prescribe decision on what to do, but can provide a foundation of knowledge for taking a risk informed decision rather than a risk based. Through the MRJ process the decision-makers give weight to other assessments and values as well.

	Option A	Option B	
Reputation	Low	Medium	
Environment	55	78	
Social factors	Excellent	Okay	
Ethical factors	0,2	0,5	

Ord: 238

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

0 7 3 6 9 8 8

6   Problem 6

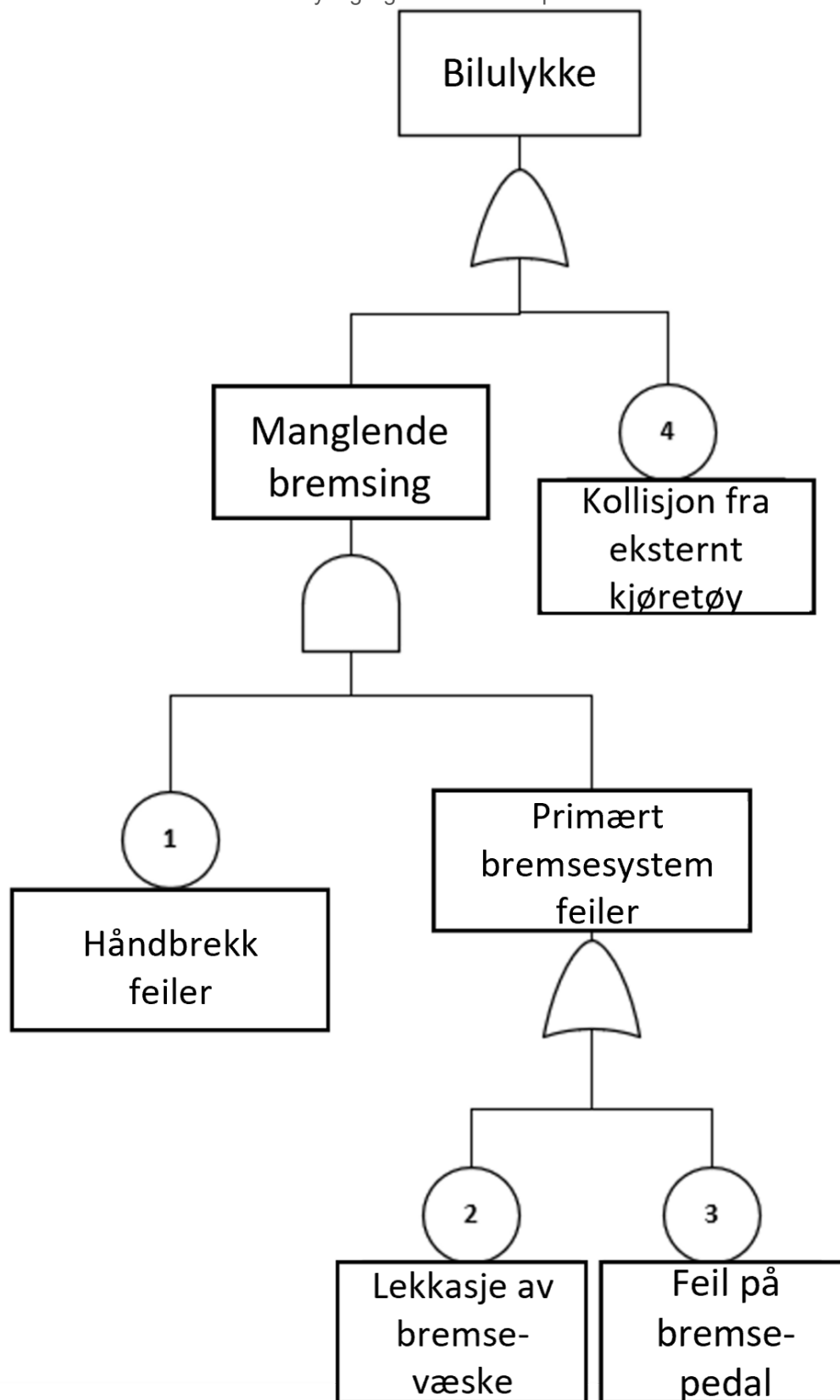Nedenfor er et feiltre for topphendelsen "Bilulykke".

a) Tegn det tilsvarende pålitelighetsblokkdiagrammet.

Anta at basishendelsene (1, 2, 3 og 4) inntreffer med en sannsynlighet på 0.1 hver, og at hendelsene er uavhengige.

b) Finn systemets upålitelighet ved bruk av tilnærmingsmetoden.

c) Finn systemets upålitelighet ved nøyaktige beregninger.

Bilulykke

Manglende bremsing

4

Kollisjon fra eksternt kjøretøy

1

Håndbrekk feiler

Primært bremsesystem feiler

2

Lekkasje av bremse-væske

3

Feil på bremse-pedal

Skriv ditt svar her

See appendix.

Ord: 2

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

2 9 0 3 0 0 7

Question Code Oppgavekode	Date Dato	Subject code Emnekode	Candidate ID KandidatID	Question nr Oppgavenr	Page number Sidetall
2 9 0 3 0 0 7	01.12.23	RIS505	4220	6	6
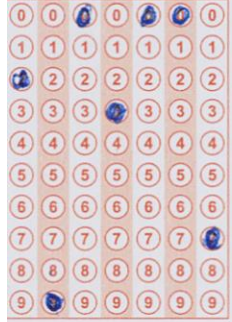
Reliability block diagram
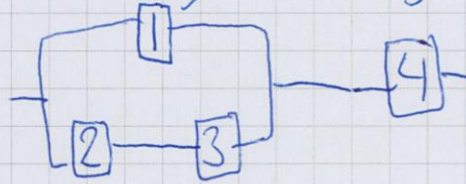
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$$P_2 = 0.9 \quad q_2 = 0.1$$
$$P_3 = 0.9 \quad q_3 = 0.1$$
$$P_4 = 0.9 \quad q_4 = 0.1$$

Approx.

Minimal cut sets $(1,2)(1,3)(4)$

$$(0.1 \times 0.1) + (0.1 \times 0.1) + (0.1)$$
$$= 0.01 + 0.01 + 0.1$$
$$= 0.12$$

Exact calculation

$$q_{S_1} = 1 - (0.9) \times (0.9)$$
$$= 1 - 0.81$$
$$= 0.19$$

$$q_{S_2} = 0.19 \times 0.1$$
$$= 0.019$$

$$q_{S_3} = 1 - (1 - 0.019)(0.9)$$
$$1 - 0.8829$$
$$= 0.1171$$
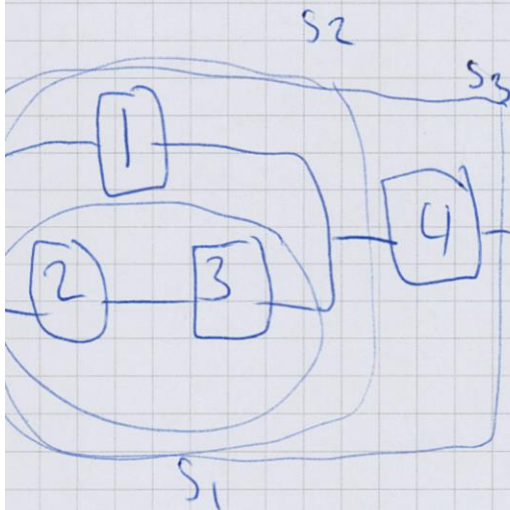
Unreliability of system from approx $= 0.12$

Unreliability of system from exact cal. $= 0.1171$

7   Problem 7

Forklar forskjellen mellom profesjonelle beskrivelser av risiko og personers risikopersepsjon. Bør personers risikopersepsjoner tas hensyn til i risikostyrings- og beslutningsprosessen? Hvorfor/hvorfor ikke?

Skriv ditt svar her

Professional descriptions (C`,P, Sok, K) of risk are based on risk assessments and therefore more system II based. System II can be understood as a slower, more exhausting and time-consuming methods and system I on the other hand is more intuitive and less time-consuming. This can be compared to a learner who is driving for the first time, using system II process and an experienced driver who drives without really thinking about how you drive, using system I processes. Risk perception can be viewed as more of a system I approach and is defined as the subjective feeling of risk. Risk perception is influenced by affect (emotions) and trust. It also includes a judge of acceptability of the risk, such as judging whether it is safe to attend an event with regard to a possible terrorist attack. Professional risk description does on the other hand not include a judgment of acceptability, and is a characterization of risk. It is up to the decision-makers to judge whether the risk is acceptable or not.

Factors affecting risk perception include but are not limited to fear, knowledge, experience, distance to the risk source and whether you expose yourself to the risk source voluntarily.

The main difference between the two is therefore that professional risk descriptions is developed objectively by experts and risk perception is the subjective feeling of risk. However, they can be viewed as two concepts which complements each other as they consider different aspects of risk.

People`s risk perceptions should be taken into account in the risk management process because they can point out factors that tend to be missed by experts or not given enough weight by experts.

Lay people tend to give more weight to events with the possibility of extreme outcomes but with low probabilities. An example could be a terrorist attack, which could be judged to have a low probability in a risk analysis, but fear and the potential for extreme consequences could amplify the feeling of risk and thus increase the feeling of risk.

People`s risk perception could be beneficial in the risk management process because it can point out black swans. Black swans can be defined as surprising event relative to one`s knowledge and divided into three types: unknown unknowns, unknown knowns and known but not believed to occur.

Unknown unknown are events no one saw coming. Unknown knowns are known buy someone, but not the analysts e.g. terrorists knowing about an planned attack. Known but not believed to occur could be events covered in a risk analysis but not prioritized because the probability was judged to be low.

Lay people tend to give weight and therefore bring attention to events who are known but not believed to occur. Even though the probability of the event occurring could be judged as low, the possibility of extreme consequences could justify implementing measures. In this sense, risk perception can be valuable to the risk management process. To solve the issue regarding black swans the company has to build resilience, to be able to return to a normal state after a event.

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

2 7 4 0 7 2 0

8 Problem 8

Et multinasjonalt energiselskap planlegger et kontroversielt oljeboringsprosjekt i et miljøsårbart område. En risikovurdering utføres for å identifisere potensielle hendelser som kan inntreffe i forbindelse med prosjektet, inkludert potensielle oljesøl, skade på økosystemet og innvirkningen på lokale samfunn. En risikomatrise brukes til å beskrive risikoen der hver av hendelsene tildeles en sannsynlighetsverdi og en (forventet) konsekvensverdi. Hva er begrensningene knyttet til bruken av denne typen risikomatriser for å uttrykke risiko? Selskapet bestemmer seg for å bruke risikomatrisen for å kommunisere risikoen knyttet til prosjektet til offentligheten og relevante aktører. Er dette god risikokommunikasjon fra et risikofaglig perspektiv? Hvorfor/hvorfor ikke?

Skriv ditt svar her

A risk matrix is a table, typically with two dimension: consequence and probability. The events are judged from low to high or assigned a number. There are two main limitations with the use of a risk matrix. Firstly, it does not reflect on the strength of knowledge (SoK). This means that for example the two events "oil spill" and "fire during drilling" from the casecould both be in the same position in the matrix but the supporting knowledge could differ. The SoK of "oil spill" could be judged as high, and the SoK of "fire during drilling" could be judged as low without this element being reflected in the matrix. This could further lead to poor decsion-making because it is not reflected whether the knowledge used to produce the risk matrix is strong, or even wrong. A solution to this issue could be to expand the risk matrix to include a judgment of SoK.

A second issue with risk matrices is that they do not properly reflect upon the potential for extreme outcomes. This is because the matrix is based on expected values, which is the center of the probability distribution. There could be extreme outcomes or outliers which is not sufficiently reflected because the matrix is based on expected values and therefore does not sufficiently reflect on the uncertainties.

All of the consequences of an event is also transformed together into one value, which does not represent the different consequence categories such as health, environmental and costs.

An advantage with using risk matrices to communicate risk to the public and stakeholders is that it is a visual tool and therefore easy to understand for people who are not directly involved with the project. However, from a risk science perspective, using a risk matrix to communicate risk associated with the project is poor practice as it does not reflect upon uncertainties or strength of knowledge. Risk communication can be understood as the exchange of risk data between groups with the aim to improve the understanding of risk and support decision-making. It is equally important to communicate what we know as what we do not now, and trust is an important aspect of this. Because the company`s risk matrix is based on expected numbers and does not reflect uncertainty or SoK, it is poor risk communication from a risk science perspective.

Ord: 390

Knytte håndtegninger til denne oppgaven?
Bruk følgende kode:

6 4 5 3 6 3 1

9 Problem 9

Hva er de tre hovedstrategiene for risikostyring? Hvilken vil du anbefale i tilfellet med oljeboringsprosjektet i Problem 8? Hvorfor? Definer forsiktighetsprinsippet og føre-var-prinsippet. Hvilket av disse er mest relevant for saken i problem 8? Hvorfor?

Skriv ditt svar her

Risk management can be defined as all measures to address risk. There are three main strategies for managing risks, all suited for handling different risk problems. The first one is being risk informed which is best suited for simple risk issues. Here the results from risk assessments are used as a foundation along with other assessments and judgments of values. Including these other elements leads to taking risk-informed decisions rather than risk-based decisions and acknowledges the limitations of risk assessments such as possible lack of knowledge. Being risk-informed is also a part of the managerial review process, where the decision-makers summarizes, interpreters and deliberates upon risk assessments, other assessment and values in order to make a risk-informed decision.

The second strategy is giving weight to the precautionary and cautionary principle. Precautionary principle can be defined as if an activity is subject to scientific uncertainty, measures should be implemented, or the activity should not be carried out. The main difference between the cautionary and precautionary principle is that the precautionary principle should be implemented when facing scientific uncertainties and the cautionary principle should be implemented when we are faced with "regular" uncertainties. Scientific uncertainties can be understood as uncertainties regarding the cause and effect. In relation to the case, scientific uncertainties can include not knowing the full extent of the effects of the oil drilling on the environment. This strategy is best suited to manage activities affected by uncertain risk problems. This strategy also favors protection above development as it states that an activity should not be carried out if measures to reduce the risk are not implemented successfully.

The third strategy is discursive strategies which includes building trust and transparency, and focuses on participation and inclusion of stakeholders and the public. This strategy is most suited for handling ambiguity as it allows for involvement and participation when handling risk problems.

In most cases, a combination of the three strategies is the best option. Especially the precautionary principle is suited for managing risk in problem 8 because there are scientific uncertainties regarding the environment. These consequences on the environment could be irreversible and it could therefore be necessary to evaluate which measures should be implemented to reduce the risk. If the risk of the project cannot be reduced through precautionary measures, the principle states that the activity should not be carried out. It therefore favors protection. Discursive strategies could also be beneficial to include as it would lead to involvement from the local community how would be affected by the consequences of the oil drilling project. This would also lead to an opportunity for them to express their concerns and include their risk perception in the overall decision-making process, especially giving weight to black swans or events with extreme outcomes.

Ord: 459

10   Problem 10

I pensum skilles det mellom to typer risikoanalyse (vitenskap): generisk risikoanalyse (type B) og anvendt risikoanalyse (type A). Forklar hva forskjellen mellom disse to typene er. Hvordan kan type B bidra til type A? Hvordan kan type A bidra til type B? Gi eksempler for hver type.

Skriv ditt svar her

Risk knowledge can be understood as the most warranted and justified beliefs within the risk field. Risk science is the process of getting this knowledge, and is not static as the field is under continuously development. An important aspect to note is that risk science it self cannot tell decision-makers what to do but provide a foundation for decision-making with guidelines and principles.

Generic risk science is approaches, methods, principles etc regarding risk fundamentals, perception, communication, assessment and management. It is generic, which means that is not specific for one company or industry. An example could be a development of a new risk glossary or generic guidelines on characterization of risk.

Applied risk science is approaches, principles and methods etc. which are specific for one case, company or industry. An example could be a risk analysis of a fire on an oil rig.

The main difference between the two is that generic is within the risk field as a whole, and not specific for one industry, and applied is specific for one particular industry or case.

Generic risk science can contribute with guidelines on how to for example communicate risk or how to characterize risk which can be used in an applied risk analysis on an oil rig.

Applied risk science can provide generic risk science with real life cases and experiences on which approaches and principles work in the field/practice.

Ord: 231