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Appendix 2
Risk Schedule

Report Phase 2
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Introduction

Effective Risk management determines the success or failure of a project. The way risk is allocated, managed and mitigated significantly influences the progress, quality and cost of a project. The management of risk is therefore a key focus in any project and it is vital to identify and address risk thoroughly and efficiently throughout the whole project – from early planning through to implementation, commissioning and operation.

A risk management process is a continuous process throughout the duration of the project. This process will normally be punctuated by five or six discrete studies, reviews or workshops at key stages of the project. During each review, the focus of the procuring authority should evolve according to the stage of the project as illustrated in the table below:

Project Stage	Focus of the Risk Management study
Feasibility and Business case - confirm that the project is achievable and likely to deliver what is required. Options have been analysed and feasibility reports prepared	Business justification – Focus is on understanding the key risks to the business or project. Risks areas can be categorised as strategic, political/reputational, legislative, implementation and operational service risks (including business, technical, financial and commercial/contractual risks within these categories as appropriate)
Develop delivery strategy – Project is clearly defined and there is a project plan through to completion	Delivery strategy: Focus is less on the business case and more on issues surrounding delivering the project. Risks will be scoped in terms of likelihood of occurrence and potential impacts. The risk register would set out how risks are intended to be allocated contractually and how they are to be managed
Procurement	Investment decision: The risk register and risk allocation plan will be flexed refined in light of market feedback and experience from other projects.

Project Stage	Focus of the Risk Management study
Design, construct and commission	Costs and programme control: Emphasis is on managing the risks and limiting the draw down on contingency funds and time to deliver the project on time and within budgetary constraints
Operational readiness	Operational review and benefits realization: Focused on updating the risk register, removing risks that have by now been properly dealt with and addressing issues that might be appearing during the operational phase, in particular those risks which could compromise the realization of the full benefits of the project.

Approach

For the purpose of identifying relevant risks and elements of uncertainty related to development of HSR a pre – business case stage Risk Workshop was facilitated in Oslo on 22/23 November 2010. In addition to the Project Leader and project members from NRA, the following advisors attended the Risk Workshop: Atkins, Asplan Viak, Misa, Pöyry Infra, WSP and Railconsult. The objective of the workshop was threefold:

- Identification and discussion of relevant risks to inform the process of assessing contractual and commercial strategies as well as organizational aspects of this study.
- Identification and discussion of relevant risks and uncertainties to serve as basis for an uncertainty analysis in connection with the appraisal of the project undertaken by the technical consultants.
- Initiating work in connection with risk management and uncertainty that needs to underpin the further development of the project should a HSR project be realized

In preparation for the workshop the participants were asked to consider in advance "What are the principal incidents and issues that could introduce significant risk or uncertainty to the realisation of project benefits, costs or timescales?" Participants were asked to consider 15 different subject areas of potential risks. This risk schedule was prepared during the discussion and circulated to the participants afterwards for comments and additions. At this stage of the project the main focus has been to identify the nature of the risks in order to be able to take the risk into account in the further planning, not to allocate, evaluate or quantify the impact of the various risks.

It is important to note that the risk schedule as presented in this appendix represents the opinions and assessments of the parties involved in the project at a very early stage in its development. The risk schedule will both be subject to amendments, additions and changes as the project progresses and a formal risk management process is developed and adopted.

Input from this risk schedule has been taken into account in preparing the report on Contractual and Commercial Strategies and Operational aspects.

Risk area	Description of risk	Comment/ explanation
1. Planning Policy and processes		
	Public reactions to construction of new route may lead to delays or less optimal routing/design	Could increase cost and/or timescale
	Risks arising from the planning / approval	Actions against the application documents: • Technical expertise (hydrology, geology, geotechnical reports, environmental assessments, noise and vibration report, survey, etc.) are not available on time • Changes of design on an approved section • Necessary changes of design in one section which effects permissions sought in another section • Designation of new protected areas (such as water conservation areas, nature reserves)
		Actions to process the necessary land purchase (line area, land for temporary use): • Shortcomings in planning applications to obtain the right to build • Changes to design due to specific proposals of the construction companies (innovative solutions) • Changes to the design, as the draft plan is deemed unworkable • Interface problems with the planners/ designers for different activities or pieces of infrastructure • Interfaces with third parties /lines owner, authorities • Inadequate capture and management of all the requirements to be met/ conditions surrounding any permissions
	Failure to comply with planning process requirements	Result is that applications are rejected or refused
	Risk of having to deal with three levels of public institution to get planning permission and that decisions made are inconsistent	Three levels: state, regional and municipal. Under the Norwegian Planning and Building Act the Ministry makes the final decision.
	Risk of delays in obtaining planning permission	
	Lack of clarity of legal responsibilities relating to application	Could lead to challenges over whether the right person is making decisions and therefore delays
	Risk of lack of co-ordination with Environmental Government Body	Could result in contradictory decisions
	Local planning processes	
	Local planning of Specific individual components	
	Integration of railway as part of master plan for specific areas of Norway e.g. link with housing plans	Reports on developments in the railway will feed into master plan
	Risk of international or related elements not being delivered	e.g. HSR in Sweden and links to airports

Risk area	Description of risk	Comment/ explanation
	properly	
	Risk surrounding clarity and quality of deliverables required for the planning process. Possible departure from 'standard' process	Current processes may not be adequate and new process may have to break new ground
	Risk of having to make too many compromises to get through planning process	Planning process leads to sub-optimal solutions e.g. too many stations
	Change of legislation	i.e. changes to the rules the project needs to comply with
	Planning fails to take into account the impact on existing lines and implications for spending on such lines.	e.g. why keep old lines or what is the extent of remedial works that needs to be carried out to existing lines
2. Finance and funding		
	Political (or public) reaction to the amount of public funding required may slow project or lead to lower cost alternative	Could increase timescale and lead to sub-optimal solution
	Norwegian policy on project financing and structuring may change during course of project	Could increase timescale and lead to non-optimal solution
	Exchange rates, interest rates or construction sector price inflation may change significantly	Increase in project costs
	If privately financed, ability to raise finance from the private sector	
	If privately financed, ability to get competitively priced bids	
	Inconsistency of costs incurred during the planning processes and those budgeted	
	Risk of inconsistency between budgets and all activities **expected** to be undertaken to deliver the project	e.g. project costs increases as better planning and design information becomes available, even before contracts are let
	Risk of inconsistency between budgets and all activities **actually** undertaken to deliver the project	
	Risk of conditions attached to funding or finance being irreconcilable owing to different objectives of funders/ financiers	• Result could be funding/ finance shortfalls. • Equally applicable to public sector, local and regional support and private sector including Institutional finance
	If privately financed, unrealistic financing terms owing to lack of experience of the market in Norway	Delivery comprised mainly due to scale
	Affordability issues	Can be exacerbated by scope or cost creep
	Political risk due to long delivery period for project, therefore vulnerable to changes in policy etc	
	Change of legislation altering financial terms or arrangements	
3. Market		
	Rate and distribution (cities or rural...) of population growth, including immigration levels, is uncertain	
	Rate and distribution of economic growth is uncertain	

Risk area	Description of risk	Comment/ explanation
	Employment levels and patterns are uncertain	
	Relationship between rail demand and population, employment and economic growth may change due to carbon concerns or changes in working habits	
	Patterns of leisure travel change (Norway as a destination increases or decreases OR levels of domestic leisure travel involving Norwegian citizens increases or decreases)	More flexibility in terms of origins / destinations served.
	Passenger perceptions of HSR and its performance (journey time, frequency, reliability, safety) are unknown or change over time.	Forecasts changing of duration of the programme?
	Business travellers' needs may change in future as communications technology develops.	More video-conferencing, remote working, etc. may reduce demand for travel or may increase the features demanded on HSR.
	Passenger priorities over mode choice and environmental performance of different modes are unclear	
	Policy on rail and HSR fares may change in future	
	Future prices for competing modes (air, coach, car, ferry) may change	Could arise because of pricing policy, underlying cost changes or changes such as road pricing
	Changes in cost of oil may change prices of competing modes	
	Performance (journey times, frequency, reliability, carbon emissions, passenger comfort) of competing modes may change	
	Other transport modes may compete aggressively on service and/or pricing	e.g. Air vs. HSR significantly affected by security checks
	Development of Swedish HSR network faster / slower than expected (influencing journey times to Stockholm / Gothenburg / Malmo)	
	Risk of policy decisions favouring competing schemes and undermining demand	
	Risk of political decisions undermining 'pure' demand decisions	i.e. being forced to add stops and undermining HSR
	Failure to assess correctly willingness to pay	Due to new modes of transport, over estimating the attractiveness of HSR
	Risk of plans for land use that would deliver demand not subsequently being implemented	e.g. an industrial park/ office block not being developed
	Accuracy and consistency of base data	e.g. having to assess current demand, volumes using information from other modes, influencers of modal shifts
	Occurrences in market which compromise benefit/product	e.g. slower trains, not being able to follow original routes
	Propensity for HSR in rest of Europe to affect attitude to using Norway HSR	Image and popularity of HSR in people's minds
	Perception of safety of HSR and other modes	
	Inadequate understanding of interconnecting journeys currently being made	Demand projections may not be consistent with the way the market is using internal flights i.e. if flights are largely being made to make international

Risk area	Description of risk	Comment/ explanation
		connections, unless HSR delivers users to Oslo airport HSR is of little/ no value to such customers
4. External stakeholders		
	Public reaction to construction of new route may lead to delays or changes towards less optimal routing/design	Could increase cost and/or timescale
	Political drivers may change - e.g. more or less in favour of aviation or HSR.	Could change appetite for public investment in HSR.
	Businesses may believe that HSR has positive (faster, easier journeys) or negative impacts (not benefitting from HSR services, business having to relocate because it is on the route of the railway, fear of noise or vibration)	
	Risk of challenge by competing mode providers/operators (air/road/express buses/existing rail operators) on HSR	This could be challenge to HSR plans or a failure to support the effective delivery of HSR e.g. by frustrating construction or, for example, by not providing services to the new stations. Airlines and airports could respond by cutting fares/ charges
	Challenge by utility companies etc who may have costs and disruption imposed on them	
	Lack of contractors and suppliers required to support the supply chain	
	Competing airports around Oslo (two private airports) may challenge HSR or be pro HSR and even be a source of funding	
	Oslo City Council, Regional and Local councils will need to support, enable and possibly help fund the construction of suitable infrastructure	
5. Environment incl energy issues		
	Environmental/carbon emissions impact of HSR is not clear - depends on HSR technology, power generation and mode shift	How to take account of the impact of the build of HSR?
	Environmental policy may change (or may be unclear)	
	Energy shortage/supply problems	Might the energy distribution problem in Norway become worse (power lines supporting central Norway/Trøndelag especially)
	Technical requirements of Norwegian terrain may increase carbon footprint above expectations	
	Construction impacts on environment and land take requirements are currently unclear.	Depends on part on route alignment/corridor.
	Perceptions of environmental impact are unclear.	Public acceptability difficult to assess.
	Carbon savings are dependent on modal shift and may therefore differ from forecast	Carbon savings may not materialise as forecast

Risk area	Description of risk	Comment/ explanation
	Poor planning to deal with sites of scientific interest or environmentally sensitive sites leading to delays	
	Risks of new environmental issues	
	Costs of addressing noise and vibration issues	
	Failure to deal successfully with any environmental or energy issues	
	Extent of solutions to meet environmental issues	
	Successive new lines are raising the environmental bar	
	Is national electricity infrastructure adequate for HSR during construction	
	Energy policy risks	e.g. if policy changes or relative energy prices change part way through the build or operating phases
	Deliverability of assumptions on the consumption requirements of rolling stock?	NB Inefficiency of driving HSR through tunnels BUT scope to realise technical innovations to deliver efficiencies
	Delays/ diversions/ cost increases because protected species found	
6. Safety and security		
	Safety	
	Safety standards and/or legislation may change in future.	Additional costs and/or delay. Change in standards that may require protection
	Accidents during construction leading to changes in working practices or delays	
	Extra costs of construction arising from need to provide protection against animals / landslides etc	Relevant to build and operating phases
	Safety requirements may drive or constrain technical solutions	e.g. obligation to have double track in tunnels, specific requirements re evacuation
	Risk of high demands from safety authorities driving up costs or delaying approvals	It is difficult to challenge a safety requirement and bad for public relations
	Risk of safety decisions being made without reference to cost	i.e. the cost of the remedy is much higher than the value attributed to the life it may save
	Security	
	Failure to cost properly protections required against terrorist attack & vandalism.	
	Risk to ridership of perceptions that these issues are not addressed or that HSR is an unsafe form of transport	
	Safety decisions made on the wrong criteria i.e. with no reference to cost or the implications of delays	
	Risk of cost creep as Norway HSR takes on board the growing	

Risk area	Description of risk	Comment/ explanation
	requirements adopted by other HSR operators	
	Demand forecast on the modal shift being wrong because security provisions at airports are speeded up or because similar security provisions are imposed on HSR	
7. Geology and Physical (archaeology)		
	Geological risk	• Unexpected archaeological finds, weapons, not located cables and pipes, abandoned mines of unknown, chimneys • Unidentified composition sensitive layers in the subsurface • Exchange of necessary ground for contaminated sites
	Reflecting experience of "Romeriksporten" tunnel near Oslo - Difficult or unknown geology could result in unpredictable problems and challenges	Lake disappeared leading to bad press.
	Prevalence of mountainous terrain, granite, dealing with fjords and remote working conditions	
	Stability hazards (in tunnels and cuttings)	
	Climate change generating more thawing resulting in more water which could lead to more flooding and subsidence problems	
	Unforeseen geotechnical conditions results in extra costs or delays or even route realignment. Clay is notoriously difficult to construct through/ over	
	Impact of scale of geological issues to be addressed during the construction phase	i.e. problems in one area could knock on across the whole project
	Discovery of valuable archaeological objects/areas resulting in delay or need to divert	
	Risk of expensive/ time consuming solutions to cross/ work around fjords	
	Risk of increased construction and energy costs owing to extent of tunnelling and proximity of tunnels to each other	
	Risk premium attached to construction concerns arising from geological and physical environment may be excessively high leading to wrong decisions	i.e. concerns of the unknown could result in Cost Benefit Analysis being negative
	Risk of discovering old mines / seams given extent of mining activity	
	Mapping risks	Maps may be out of date
	How to get the HSR service into City centres and joined up with local transport	What happens to the Cost Benefit Analysis if this is not possible?
8. Climate		
	Frozen ground conditions. This brings safety issues during the	

Risk area	Description of risk	Comment/ explanation
	construction phase and the risk of differential settlement once the infrastructure is constructed	
	Extremely cold weather could impact productivity (people and equipment)	
	Because high speed switches (points) have long contacts between rails there is a real risk they freeze together and don't work	Even more of an issue where lines are relatively lightly used
	Risk of disruption to operations due to ice growth due to temperature gradient between closed and open sections	
	Risk that rolling stock becomes unreliable due to inadequate "winterisation" for the extremes of Norway	
	Risk that manufacturers/ constructors do not properly translate/ take account of Norwegian specifications	
	Risk of over specifying "just in case"	
	Risk of overhead power lines not being able to deal with the weight of snow. Having to close the gaps between pylons could add cost and delay the build	Would be very expensive to do retrospectively
9. Specification/scope		
	Inadequate specification so what is delivered is not what is required	
	Scope and specification not supporting business case e.g. journey times not delivered	
	Inadequate phasing leading to not realising the benefits	Issue is that Corridors are unlikely to deliver significant benefits until work on the whole corridor is completed
	Risk of specification being too prescriptive or input led thereby constraining efficiency or innovation	
	Risk of over specifying	i.e. setting standards too high with the result that project incurs costs but cannot realise benefits for the extra cost
	Demand/timetable leading to over specification	e.g. might need to build double track solely based on timetable
	Risk of project benefits not taking into account the effects on existing lines	e.g why retain old lines or what is the reduction in remedial works needed to be carried out as a result of the introduction of the new lines
	Lack of clarity of scope	This could result in a specification that does not deliver an appropriate solution
10. Technology to be used for HSR		
	Evolving technical standards makes it difficult to establish technological solutions	Lack of clarity over what needs to be delivered for HSR
	Technology may evolve in unforeseen ways (e.g. HSR performance significantly improves, Maglev may become viable)	HSR system may not be optimised or compatible with international networks, planning work may need to be revisited
	Choice of technology that is not "proven" can lead to failures	

Risk area	Description of risk	Comment/ explanation
	Technology not adapted to specific conditions	
	Technology may not be suitable for Norwegian conditions	e.g. length of tunnels required, gradients
	Evolving technical standards for rolling stock make it difficult to establish technological standards	HSR system may not be optimised or compatible with international networks
	What steps to take to accommodate use of new technology both in the beginning and during the life of the assets	
	Risk that technology of HSR is incompatible with existing Norwegian rail network	Could compromise design of HSR (e.g. UK's classic-compatible trains have less capacity)
	Risk of not getting the choice of technology right	
	Mixed traffic (freight, regional passenger traffic, high speed traffic) causes a higher number of hazards / accidents	The mitigation measures may be much more complicated than a complete new separate high speed line
	Maturing supply market may lead to wrong decision about scope or technology based on wrong prices	
	Risk of extended process and uncertainty around approvals of new technology may result in not using new technology	
	Failure to fully realise opportunities for bringing new technology materials and methods to bear on HSR	
11. Systems integration risk		
	Systems introduced not adapted to specific conditions in Norway	
	Failure to integrate new network and systems (timetables, services, ticketing, passenger information) with existing systems	
	System differences when crossing international boundaries frustrating international services	
12. Interface		
	Lack of certainty over Swedish rail/HSR policy and technical development	Interface with Swedish rail routes may introduce a new set of requirements if Norwegian HSR is to be compatible
	Risk of interface failings between construction activities	This could result in: • Delayed completion of those activities with dependencies on other construction activities • Delayed construction by third parties • Availability of resources (material, construction firms) • Errors in logistics because resources not available on time (mass transport, delivery) • Shortage of materials by the large construction project • Bankruptcy of construction companies
	Different gauges between HSR and existing infrastructure	

Risk area	Description of risk	Comment/ explanation
	Interfaces between phases of the project or 'segments' of the build	This could be important where all the links in a chain need to be completed before HSR can work effectively on a Corridor
	Technical standards different between different countries	Could give problem using specs from overseas and linking to international networks
	Interface with what should be done in Oslo	
	Interface between service providers and infrastructure provider	
	Linking to Oslo airport to be an effective carrier of air passengers seeking to travel abroad	
	HSR Project interface with existing network – data provision and sharing	
	Timetabling not co-ordinated properly with existing services	
	Imperfect interfaces with the Intercity project resulting in delays, competing for assets etc	
	Imperfect interfaces between HSR and existing network on technology communications and power supply	
	HSR project is predicated on imperfect knowledge of the asset base in the existing network	
	Capacity in Oslo (both rail and at stations for moving passengers to/from the stations)	
	Ticketing systems and pricing do not interface properly between the HSR and existing networks	
	Interface of customer relationships - do HSR and existing network maintain separate relationships or should they be shared?	
	Access to and over the existing network during construction	
13. Supplier/Supply		
	Scale of international HSR development cannot be matched by supply chain	Costs increase
	Unexpected changes in costs of raw materials	Costs increase
	Shortage of suitable suppliers	
	Inadequate supply network frustrating the delivery of supplies	
	Choice of sub-suppliers based on favouring locals rather than proven solutions	
	Supply chain decisions undermine the Safety Case	To define the safety requirements, especially the functional technical requirements, it is necessary to have a clear definition of the system (number of trains, number of vehicles, length of track, frequency of train movement, number of passengers etc)

Risk area	Description of risk	Comment/ explanation
	Supply solutions are not appropriate	
	Capacity of supplier chain, such as tunnel boring machines	
	Adequacy of power supply, in particular during the construction phase	
	Sourcing foreign materials	
	Lack of infrastructure to transport materials to where construction is taking place	
	Similar projects elsewhere vying for the same resources	
	Lack of skilled resources globally	
	Management of long lead items and deciding who procures	
	Commodity price/ exchange rate changes: Steel, aluminium, other precious metals	
	Political risk on resources e.g. immigration laws preventing use of foreign contractors	
	Number of HSR projects being undertaken worldwide may influence unit costs and capacity etc	
	Competition from other local construction projects e.g. roads, for scarce resources and skills	
14. Construction/delivery		
	Uncertainty of cost of constructing HSR in Norwegian terrain	A major potential issue surrounding earthworks
	Construction costs dependent on labour, materials costs, international markets etc.	
	Client may refuse or delay acceptance of the works	• Usability is questioned • The track or the buildings do not meet the functional requirements
	Product does not meet specification/standards	
	Costing of uncertain items e.g. tunnelling does not adequately reflect the variability of such cost leading to cost overruns	
	Challenge of managing and coordinating all of the works	Project risk management issue
	Delayed delivery of rolling stock	
	Disruption to construction works due to failings of existing infrastructure, road and rail etc	
	Local conditions preventing work e.g. reindeer mating season, migrations other restrictions	
	Risk of selecting suppliers who cannot/ don't deliver on time/ to budget/ to spec	

Risk area	Description of risk	Comment/ explanation
15. Operations and maintenance		
	Reliability of HSR in Norway, particularly during winter, may be worse than expected	Risk increases with long stretches of single line. Interacts with passenger reactions/demand levels
	Wage cost inflation differs from forecast	Costs increase
	Maintenance intervals - cold / salt environments / incident management / number of spare train sets	
	Passenger accidents and accidents involving third parties	
	Business case/legislation may depend on access agreement	e.g. other operators seeking or being granted access might undermine the business case
	Punctuality and reliability not as planned, eroding perception and undermining the demand	
	Financial robustness of the operations in response to fluctuations in demand	
	Maintenance costs exceeding estimates	
	Level of maintenance risks may increase based on whether dedicated service on dedicated line or not	
	Insufficient time allowed in the timetable affecting maintenance of infrastructure	
	Underestimating the costs of rolling stock maintenance owing to the environment	
	Climatic impact (e.g. de-icing) may affect how maintenance needs to be undertaken and how frequently	
	Underestimating the resources (depots, equipment etc) required to maintain the trains	
	Risk of not determining the correct fleet size	
	Fleet integration risks	
	Single track decision undermines maintenance flexibility and adds to cost/ disruption	
16. Systematic Risk		
	Systematic risk reflects risks that all businesses are exposed which cannot be managed/ mitigated by those businesses	
	Inappropriate consideration of systematic risk could undermine business case and affordability decisions	
	Risk of using inappropriate risk factors in the long term business case because systematic risk increases over time	Use real growth / differential inflation. Consider reducing discount rates at various points in the evaluation
	Is there a risk that the requirements of the construction phase could	

Risk area	Description of risk	Comment/ explanation
	lead to higher prices for certain resources across Norway?	

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