

Project Type: Large-scale regional hospital construction project

Risk Estimate - Monte Carlo Simulation Model																																		
Standard deviation												10%			Total Risk (simulated)		#NAME?		€		16 960 250,00													
Estimate related project Cost Estimate if the risk occurs (EUR)												EFFECT simulation (Normal distribution or Pert distribution if 3 point est)			Likelihood simulation (Bernoulli distribution)		Risk simulated		Likelihood (O) x Most Likely (Z)		Decision-making/need for action		Date for decision/action		Responsible for decision/action		Need for reporting/communication		Additional comments					
ASSUMPTION												MOST LIKELY			BEST CASE			WORST CASE			Standard deviation (10%)		#NAME?		#NAME?		#NAME?		3500000					
1	Planning	Project design/review	RDE	Budget risks	Possible underestimation of the budget and, therefore, possible extension of the Collaboration Phase(2-3) to implement the market research, figure out alternative solution and possible optimisation.	4	5	35%	8	20	12	0	Addition of an Extra cost for additional 2 months needed for developing all these activities: Best case: NO delay Most likely: 1 months additional time required 1,5M€ to be compensated (no final	Cost overruns and disruption/delay to the time schedule	EUR 10.000.000	Budget risks	10 000 000,00				1000000	#NAME?	#NAME?	#NAME?	3500000									
2	Planning	Time Schedule and logistics	RDE	Delays because of tight schedule	Risk of underestimation of mobilisation period; need of temporary site facilities (Immediate risk) and risk of delays on the overall project.	4	5	35%	12	20	8	0	Addition of an Extra cost for temporary site facilities to be rent until definitive ones arrive Best case: use of RBAI JV office for the first month during mobilisation phase and Erikson Office Most likely: 1 months of additional rent, incl.install/dismantl 100'000€ + 3W delay (400'000*18gg)=7'200'000€ Worst: 1 month of additional cost	Delays to the completion date of the project.	EUR 7.500.000	Delays because of tight schedule	7 500 000,00				750000	#NAME?	#NAME?	#NAME?	2625000									
3	Planning	Events/accidents/health and safety in general	RDE	Rework and project changes because of complexity in MEP work	Due to the huge number of interfaces with client deliverables and their complexity, risk of lack of experience and professionalism in civil subcontractors taht could generate delay and remaking some works.	4	5	35%	9	20	9	0	Invest in Professional staff to implement this coordination both on technical and planning side (included within staff cost, planners and technician with experience in Hospitals); if reworks shall be re-made: BEST: 1 extra month (working hours) x 100pp + 10% material = 740'000€ at the initial stage (compensated); ML: 1 extra month (working hours) x 100pp + 10% material =740'000€ at the intermediate stage not compensated + 0,5month delay = 4'000'000 WC: 1 extra month (working hours) x 100pp + 10% material =740'000€ at the final stage not compensated + 1month delay = 8'000'000	Disruption and delays.	EUR 4.000.000	Rework and project changes because of complexity in MEP work	4 000 000,00				400000	#NAME?	#NAME?	#NAME?	1400000									
4	Commissioning	Time Schedule and logistics	Hillerd	Insufficient establishment of temporary measures	No coordinated planning phase with the stakeholders. Risk of an extended phase with loss of earnings for NHN Hospital and possible damages to medical equipment.	4	4	35%	12	16	12	4	Organization of Coordination Meeting with Client representative for monitoring the process (staff included, no additional cost), cost for client for replacing Equipment damaged. ALERT	The medical supply is not ensured. Danger of image loss - and subsequently loss of earnings	open	Insufficient establishment of temporary measures	1 000 000,00				100000	#NAME?	#NAME?	#NAME?	350000						Risk could be reduced by a timely and comprehensive planning			
5	Commissioning	Project design/review	Hillerd	No coherent migration concept	No coherent migration concept leads to a loss of functional medical care, risk that medical supply is not ensured. Danger of damaging the image of the new hospital - and subsequently loss of earnings	4	4	35%	8	16	12	4	Support the client in the migrational process (staff included, no additional cost). ALERT	No coherent migration concept leads to a loss of functional medical care	open	No coherent migration concept	1 000 000,00				100000	#NAME?	#NAME?	#NAME?	350000						Risk could be reduced by a timely and comprehensive planning			
6	Planning	Project design/review	RDE	Time risk	Possible shift on structural works due to increasing of time required for these activities affecting the completion of the structure but the phase 3.	3	5	20%	8	15	12	0	Addition of an Extra cost for additional 2 months needed for developing all these activities: Best case: 2 months of running costs extra -> 3M€ Most likely: 2 months of running costs extra = 118000000€ Worst: 3 months of running costs extra = 118000000€	Cost overruns and disruption/delay to the time schedule	11800000	Time risk	11 800 000,00				1180000	#NAME?	#NAME?	#NAME?	2360000									
7	Planning	Purchasing, materials and supplies	RDE	Marked prices are higher than expected	Possible increase of market price due to high activity in Denmark (starting of Ferhmann project) and lack of capable subcontractors during Phase 1; need of foreign subcontractors who have to assess their work situation for starting activities in DK and possible delay in signing subcontracts (2 months lost on structural works).	3	5	20%	8	15	8	0	Addition of an Extra cost for accelerating these activities for remedying delay: Best case: double shift work for 1 months (300pp x 330€/gg=100'000€ * 22gg=2,2M€) Most likely: Increase of 10% material for steel and concrete (2M€) + 2 months double shift for remedying delay (300pp x 330€/gg=100'000€ * 44gg) =4,4M€ + 26days delay (10,4M€) = 14,8M€	Higher market prices from all types of vendors	EUR 15.000.000	Marked prices are higher than expected	15 000 000,00				1500000	#NAME?	#NAME?	#NAME?	3000000									
8	Planning	Contractual ambiguities or encumbrances	VAMED	Interfaces	Possible mismatch between interface list provided by client and Vamed checklist and long-term decision making; Risk of possible inadequate delineation of services and delay in project execution.	3	5	20%	12	15	6	6	Addition of an Extra cost for additional 3 months needed for developing all these activities: Best case: 1 month delay 1,5M€ Most likely: 2 months additional time required 3M€ Worst: 3 additional month 1,5M€ -> 4,5M€	Long-term decision-making; additional costs; too late recognized requirements from the project; delay in project execution	EUR 3.000.000	Interfaces	3 000 000,00				300000	#NAME?	#NAME?	#NAME?	600000		01.07.2019		Risk assumption: one percent of project volume					
9	Execution	Project design/review	RdE	Cashflow risk	Due to lack of advance payment, Main Contract presents a payment schedule and client doesn't accept; therefore Main contractor needs to invest at the early stage of the project and ask for a loan;	5	3	50%	5	15	5		To proceed with Contract obligations, issue Bonds pay the first costs for the start up of activities, Main Contractor will ask for a loan: ML: 3,5% yewarly cost for 4,2M loan = 514'000€	Need to finance the start up of the project	EUR 514.500	Cashflow risk	514 500,00				51450	#NAME?	#NAME?	#NAME?	257250									
10	Planning	Project design/review	RDE	Concurrent engineering with overlap of design and construction can cause rework and/or delay	Possible underestimation, during design phase, of interfaces between MEP and Concrete works. During construction, this could generate need of additional and unforeseen concrete coring after casting.	3	4	20%	9	12	9		We consider an amount for unforeseen concrete coring during construction phase (no delays, only operational cost) + an additional work for concrete refurbishment and support ML: 250'000€ for extra coring + 200'000€ hourly hours needed for works + 550'000 for concrete refurbishment.	Concurrent engineering with overlap of design and construction can cause rework and/or delay	EUR 1.000.000	Concurrent engineering with overlap of design and construction can cause rework and/or delay	1 000 000,00				100000	#NAME?	#NAME?	#NAME?	200000									
11	Execution	Unforeseen negative factors	VAMED/RDE	Resistance of the population	Construction Activities can generate complaints with Neighbours in terms of noise and dust.	4	3	35%	8	12	4	0	Our cost includes the activity of a stakeholder manager who will deal with neighbours to mitigate possible complaints; estimated cost for possible fine or legal issue: ML: 500'000	Project delay	EUR 150.000 per day	Resistance of the population	500 000,00				50000	#NAME?	#NAME?	#NAME?	175000		01.01.2020			Due to interruption of the construction process				
12	Execution	Project design/review	RdE	Archeological Evidences	Possible additional evidences found out during constuction within site boundaries. Risk of stop of activities in the area until Authority provides a new green line.	3	4	20%	6	12	2		Running cost for an additional month (1,5M€), implementation of a new traffic plan and possible need of re-routing and compartmentalization of the arae (0,5M€), no penalties -> 2M€	Running cost	EUR 2.000.000	Archeological Evidences	2 000 000,00				200000	#NAME?	#NAME?	#NAME?	400000									
13	Execution	Contractual ambiguities or encumbrances	VAMED	No definitive Scope of Works (Conditional phases)	As per tender specs, Phase 2 and 3 are unconditional and can be subject to withdrawal; Risk of legal disputes with partner and subcontractors .	2	5	10%	8	10	10	0	Legal Protection against partner and subcontractors (legal advisors, costs related to contracts management, etc.); Estimated cost 3'000'000€	Many interfaces to external project participants.	EUR 3.000.000	No definitive Scope of Works (Conditional phases)	3 000 000,00				300000	#NAME?	#NAME?	#NAME?	300000		01.12.2019		Risk assumption: two percent of conditional part; more interfaces and risks in the execution					
14	Execution	Unforeseen negative factors	VAMED	Change of legal framework during project implementation	Changes in the legal framework that came into effect during the construction phase and not taken into account during the planning phase.	2	5	10%	8	10	0	0	Evaluation of the standards, directives and draft laws that are being amended. Kick-off workshop with planning team	No use permit	EUR 3.000.000	Change of legal framework during project implementation	3 000 000,00				300000	#NAME?	#NAME?	#NAME?	300000		01.01.2020		Risk assumption: one percent of project volume					

Risk no.	Phase	Group	Risk owner	Risk	Description	Likelihood (score)	Economy (score)	Likelihood (%)	Time	Economy	Quality	Costs - Operational management	Mitigation measures	Effect if risk occurs?	Estimate related project Cost Estimate if the risk occurs	Column1	Estimate related project Cost Estimate if the risk occurs (EUR)				Effect simulation (Normal distribution or Pert distribution if 3 point est)	Likelihood simulation (Bernoulli distribution)	Risk simulated	Likelihood (0) x Most Likely (2)	Decision-making/need for action	Date for decision/action	Responsible for decision/action	Need for reporting/ communication	Additional comments
																	MOST LIKELY	BEST CASE	WORST CASE	Standard deviation (10%)									
15	Execution	Events/accidents/health and safety in general	RDE	Risks associated with health and safety	The magnitude of the project with many workers working at the same time on large scale construction poses increased risk in relation to health and safety. It must be expected that unions and the Danish Working Environment Authority will inspect the site frequently.	3	3	20%	9	9	6	0	Implement a rigorous safety program on site based on making the work places always safe and aggressive awareness. No additional Cost (HSE staff, inspectors and measures already included in budget cost) Possible potential Fine for implementation of HSE measures: estimated cost: 500'000,-	Fines by Authorities.	EUR 500.000	Risks associated with health and safety	500 000,00			50000	#NAME?	#NAME?	#NAME?	100000					
16	Execution	Project design/review	RdE	Quantity variations	After performing tests on anchors, additional perforation will be needed. Possible risk of increase of cost and time.	3	3	20%	6	9	3	0	In case test results highlight the problem, we consider an extra cost of 500'000,- for extra perforation.	More costs and more time for activity	EUR 500.000	Quantity variations	500 000,00			50000	#NAME?	#NAME?	#NAME?	100000					our indirect cost are almost 43M€ (29RdE+14,5VAMED) so approx 1M/month
17	Planning	Communication	VAMED	Communication	Presentation via communication to the client requires considerable additional effort Digital Sharing Platform will generate a difficult flow and communication between parties due to mutual lack of experience. Risk of possible misunderstanding and delay for decision making.	4	2	35%	10	8	8	4	Additional cost for dedicated staff joining the project for 6 months at the start up persons for organizing and preparing the documents accordingly (digitally). ML: 3pp * 10'000*6months -> 180'000	Many discussions and long decision-making paths; optimizations may not even be shown	EUR 30.000 per month	Communication	180 000,00			18000	#NAME?	#NAME?	#NAME?	63000	01.07.2019			Additional staff due to more and inefficient meetings	
18	Execution	Unforeseen negative factors	VAMED	Negative environmental effects	Bad weather, fire, etc.	2	4	10%	8	8	0	0	Protection of storage on site already included within our costs; possible additional cost on MEP machinery already installed during phase 2/3 -> 2% risk on Budget for MEP (1,5M€)	Damage to the building to be refurbished.	EUR 1 500.000	Negative environmental effects	1 500 000,00			150000	#NAME?	#NAME?	#NAME?	150000	01.01.2020			Risk assumption: half percent of project volume	
19	Execution	Other suppliers and specialist Sub-contractors	VAMED	Loss of subcontractor	Due to the magnitude and time-frame for the hospital project, it is likely that some of the sub-contractors will face bankruptcy, which can cause delays and unforeseen cost.	2	3	10%	10	6	6	0	Additional Legal/Administrative local services to support replacement of subcontractors and remedy measures; possible overlap of activities estimated 500'000,-	Delay in project implementation, possibly cost increase	EUR 500.000	Loss of subcontractors	500 000,00			50000	#NAME?	#NAME?	#NAME?	50000	01.01.2020			Risk assumption: one and a half percent of project volume	
20	Execution	Soil conditions	RDE	Soil conditions: Geotechnical reports may be inaccurate	If geotechnical investigations/ tests are inaccurate to actual conditions, it may cause unforeseen cost and delays	2	3	10%	8	6	4	0	Adapt to actual soil conditions as fast as possible reducing or even eliminating delays, then manage cost consequence to keep them at a minimum. Estimated cost for additional activities: 750'000,- (longer piles, different anchors).	Mostly cost increase.	EUR 750.000	Soil conditions: Geotechnical reports may be inaccurate	750 000,00			75000	#NAME?	#NAME?	#NAME?	75000					
21	Planning	Communication	VAMED	Upstream services are not appropriate	Extra effort for coordination and testing	3	2	20%	6	6	12	12	Additional staff of appropriate quality is to be provided	Extra effort for coordination and testing	EUR 30.000 per month	Upstream services are not appropriate	180 000,00			18000	#NAME?	#NAME?	#NAME?	36000	01.07.2019			Additional staff required for checks and coordination	
22	Execution	Project design/review	RdE	Quantity variations	Additional dewatering will be needed (15 days)	2	3	10%	6	6	3	0	Additional pumping system will be required	More costs and more time for activity	EUR 600.000	Quantity variations	600 000,00			60000	#NAME?	#NAME?	#NAME?	60000					half month + additional cost for pumping (estimated)
23	Migration	Project design/review	Hillerød	BIM	Transfer of BIM to FIM (material test/execution test with regard to quality for FM)	3	2	20%	3	6	15	15	Analysis of the published BIM model of design for technical operation (Facility Management/FIM); introduction of VAMED FM know-how	No optimal sequence of operations; higher operating costs; survival cycle; wrong material quality in terms of hygiene, durability, appearance, DGNB certification. Delay on the critical path of the project and some disruption to the operation.	EUR 80.000 per month	BIM	320 000,00			32000	#NAME?	#NAME?	#NAME?	64000		VAMED/Client			Additional BIM specialist for detailed model review
24	Planning	External	RDE	Authority permits may be delayed	There is a risk of delay of building permit and other authority approvals.	2	2	10%	10	4	4	0	Employ acceleration measures to the extent possible. Use time of delay to better plan and organize the works.	Delay on the critical path of the project and some disruption to the operation.	EUR 300.000	Authority permits may be delayed	300 000,00			30000	#NAME?	#NAME?	#NAME?	30000					
25	Execution	Other suppliers and specialist Sub-contractors	VAMED	Quality of execution by subcontractors	Lack of professional qualifications, poorly trained staff, communication problems	4	1	35%	8	4	14	8	Use of known subcontractors; for unknown applicants increased attention to experience and references; through use of BIM; consistent supervision in the construction process	Quality is not suitable, deviations from the schedule, poor coordination with the remaining project participants	EUR 15.000 per month	Quality of execution by subcontractors	60 000,00			6000	#NAME?	#NAME?	#NAME?	21000	01.01.2020			For each additional BIM coordinator to keep the BIM standard at a high level	
26	Execution	Soil conditions	RDE	Soil conditions: Environmental investigations may be inaccurate	If environmental investigations / tests are inaccurate to actual conditions, it may cause unforeseen cost and delays	2	2	10%	6	4	4	0	Adapt to actual soil conditions as fast as possible reducing or even eliminating delays, then manage cost consequence to keep them at a minimum.	Mostly delays and also cost increase.	EUR 300.000	Soil conditions: Environmental investigations may be inaccurate	300 000,00			30000	#NAME?	#NAME?	#NAME?	30000					
27	Planning	Project design/review	VAMED	BIM	Quality of the published BIM model; information is missing	1	4	5%	5	4	5	0	Checklist for procurement process; in-depth examination of the planning documents; kick-off workshop with planning participants asap; training of the employees.	Sluggish project flow, idling, additional expenses	EUR 500.000 per month	BIM	2 000 000,00			200000	#NAME?	#NAME?	#NAME?	100000	01.07.2019	VAMED/Client		- Collaboration phase with all employees is delayed - Construction has to be stopped - Decision	
28	Planning	Project design/review	VAMED	BIM	The number of clashes requiring the planner to perform rework exceeds 1 clash/10,000m3	1	4	5%	5	4	5	5	In-depth review of the planning document together with the customer/scheduler	Sluggish project flow, idling, additional expenses	EUR 500.000 per month	BIM	2 000 000,00			200000	#NAME?	#NAME?	#NAME?	100000	01.07.2019	VAMED/Client			
29	Planning	Communication	VAMED	Offering interests of the stakeholders	Missing information about previous cooperation of client / ARCH / planner / etc.	2	2	10%	4	4	3	2	Experience from already completed projects with similar scope of services. Risk assessment	Attempts are made to pass known risks onto the contractor	EUR 30.000 per month	Offering interests of the stakeholders	180 000,00			18000	#NAME?	#NAME?	#NAME?	18000	01.07.2019			Additional staff for mediation, coordination and adaptation of materials	
30	Execution	Construction	VAMED	Execution not up to standards	Legal framework/standards of execution in the bidders' countries of origin differ from Danish standards and norms	1	4	5%	1	4	5	5	Use of qualified employees; involvement of local employees familiar with the situation.	No official user permit; no DGNB certification (gold) obtainable	EUR 1.000.000	Execution not up to standards	1 000 000,00			100000	#NAME?	#NAME?	#NAME?	50000	01.01.2020			All costs for planning and execution related to DGNB are sunk costs. As the certification cannot be granted	
31	All	Project design/review	VAMED/RDE	Delays in decision-making on possible re-scheduling	The organizational setup and decision-making process may be bureaucratic and lengthy because of many stakeholders, high number of decision-makers, language barriers, and complexity, due to highly specialized clinical expertise.	3	1	20%	9	3	9	0	Evaluation of whether decision processes are plausibly represented in the schedule; assistance in the preparation of bases for decisions (through the use of BIM 360, monitoring of decision-making processes) Early aggressive coordination.	Disruption, delays and cost overruns	Best case: EUR 100 per day if (maximum 20 rooms) Most likely: EUR 20,000 per day (maximum one component) Worst case: EUR 150,000 per day (2 or more components)	Delays in decision-making on possible re-scheduling	80 000,00	5 000	3 000 000		#NAME?	#NAME?	#NAME?	16000	01.01.2020			Due to interruption of the construction process	
32	All	Unforeseen negative factors	VAMED	Risk of insufficient human resources (Contractor/vendors)	Illness, termination, etc.	3	1	20%	9	3	3	0	Sufficient human resources available in the company.	Possible delay in construction progress, loss of quality.	EUR 40.000	Risk of insufficient human resources (Contractor/vendors)	40 000,00			4000	#NAME?	#NAME?	#NAME?	8000	01.01.2020			New contract and start up phase for new employee (amount 4x EUR 10,000)	
33	Execution	Purchasing, materials and supplies	VAMED	Delay in the procurement process	Good economy, small market, limited circle of bidders, pricing agreements	3	1	20%	6	3	6	3	Market investigation and international implementation partner of VAMED	Offers do not match the budget.	EUR 10.000 per month	Delay in the procurement process	40 000,00			4000	#NAME?	#NAME?	#NAME?	8000	01.09.2019			During Collaboration phase more intense market screening	
34	All	Communication	VAMED	Communication	There is risk of cultural and language barriers for effective communication and collaboration. Experience from other Danish sites with many nationalities show that this can effect both time and cost.	3	1	20%	3	3	3	0	Language training, integration of local project staff	Misunderstandings and conflicts due to different language, culture, usage, etc.	EUR 10.000 per month	Communication	60 000,00			6000	#NAME?	#NAME?	#NAME?	12000	01.07.2019			Additional costs for translator or language class	

Risk no.	Phase	Groups	Risk owner	Risk	Description	Likelihood (score)					Mitigation measures	Effect if risk occurs?	Estimate related project Cost Estimate if the risk occurs	Column1	Estimate related project Cost Estimate if the risk occurs (EUR)				Effect simulation (Normal distribution or Pert distribution if 3 point est)	Likelihood simulation (Bernoulli distribution)		Risk simulated	Likelihood (0) x Most Likely (2)	Decision-making/need for action	Date for decision/action	Responsible for decision/action	Need for reporting/ communication	Additional comments
						Likelihood (score)	Economy (score)	Likelihood (%)	Time	Economy					Quality	MOST LIKELY	BEST CASE	WORST CASE		Standard deviation (10%)	#NAME?							
35	Execution	Project design/review	RdE	Delay in Handing over the site	Enabling works, developed by third party, will take more time and site will be handed over later (15 DAYs)	1	3	5%	2	3		Implement teams and accelerate activities	More costs	EUR 500.000	Delay in Handing over the site	500 000,00			50000	#NAME?	#NAME?	#NAME?	25000					
36	All	Unforeseen negative factors	VAMED	Risk of insufficient human ressources (Client)	Failure of key individuals on the part of the client	2	1	10%	8	2	8	Documentation must be of a high standard.	Agreements need to be reopened	EUR 40.000	Risk of insufficient human ressources (Client)	40 000,00			4000	#NAME?	#NAME?	#NAME?	4000		01.01.2020		Additional coordination	
37	Execution	Project design/review	RdE	Currency Risk	Negative rate fluctuation	1	2	5%	1	2	1	Finalise contracts as soon as possible when exchange are at least the current one	Possible increase of cost	EUR 400.000		400 000,00			40000	#NAME?	#NAME?	#NAME?	20000					I CONSIDER THAT PHASE1 WILL BE MAINLY "LOCAL" DKK PAID; PHASE 2&3 POTENTIALLY COULD BE PARTIALLY EURO PAID -> I ASSUMED THAT NOT ALL WILL BE IN EURO BUT THE 75% (FITTINGS AND MEP) APPROX 1,0268 DKK (137,6M€). IN THE LAST 10 YEARS MIN 1€=7,42, MAX 1€=7,4€ ~> LOW RISK OF 1€=7,4€ -> LOW
38	Planning	Time Schedule and logistics	VAMED	Faulty estimation of dates and project flows	Specifications coming from project stakeholders are not recognizable at the start of the project	1	1	5%	4	1	1	International project experience through VAMED; detailed market observation.	Project delay,	EUR 15.000 per month	Faulty estimation of dates and project flows	60 000,00			6000	#NAME?	#NAME?	#NAME?	3000		01.07.2019		Additional scheduler	
39	Execution	Project design/review	RdE	Temporary Watertight	Impossibility of 100% watertighting structure and delete in starting fit-out and MEP activities	5	0	50%	10	0	10	Additional watertight system where steel structure will be installed (to provide a waterproofing during working progress)	More costs to watertight temporarily to maintain the schedule	0	Temporary Watertight	-			0	#NAME?	#NAME?	#NAME?	0					provisional waterproofing on upper floor (tot sqm of floor ...) NO RISK, IT'S A COST!!