VDI Wissensforum

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES
INSTITUT FÜR UMWELT- UND BIOTECHNIK

IZP

COWEC 2013

What are the game changing components that will optimize the maintenance process?

Saskia Greiner, Susanne Appel, Henning Albers
Hochschule Bremen, Institute of Environmental and Biotechnology

Torsten Renz
IZP Dresden

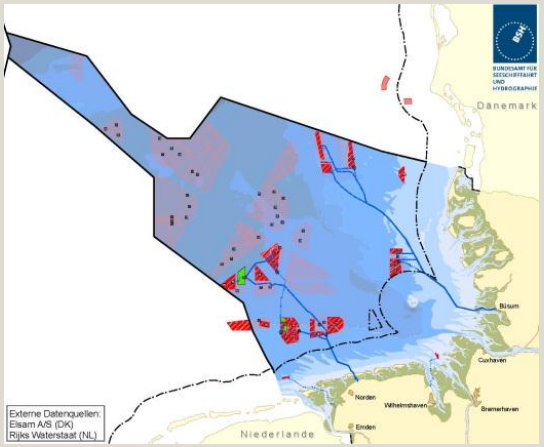
CONTENT

1. STARTING SITUATION

Offshore wind energy today

- Companies focuses on financing, grid connection, assembly and set up of offshore wind turbines (OWT)

- First operation experiences shows:
  - Portion of operating costs base is represented by ~ 75% in terms of 20 years runtime
  - Electricity production costs ~ 10 €ct/kWh
    [Windenergiereport,2011]



1. STARTING SITUATION

Improvement of economy is needed, by reduction of

- **Investment costs**
  - Optimized set up concepts & logistics
  - Light OWT and support structures
  - ...

questions today

- **Operation costs**
  - Optimal choice of maintenance strategy
  - Optimized organizational and procedure structure
  - Functional technology

questions in future

1. STARTING SITUATION

Reduction of operation costs

- Good strategic maintenance planning
  - Can be reached with clear process descriptions and definitions with evaluated risks
  - Difficult because of high number of interfaces, players and interactions

⇨ Method of resolution:

Analysis and Evaluation of Process Risks

2. PROCESS RISKS IN OFFSHORE WIND FARMS

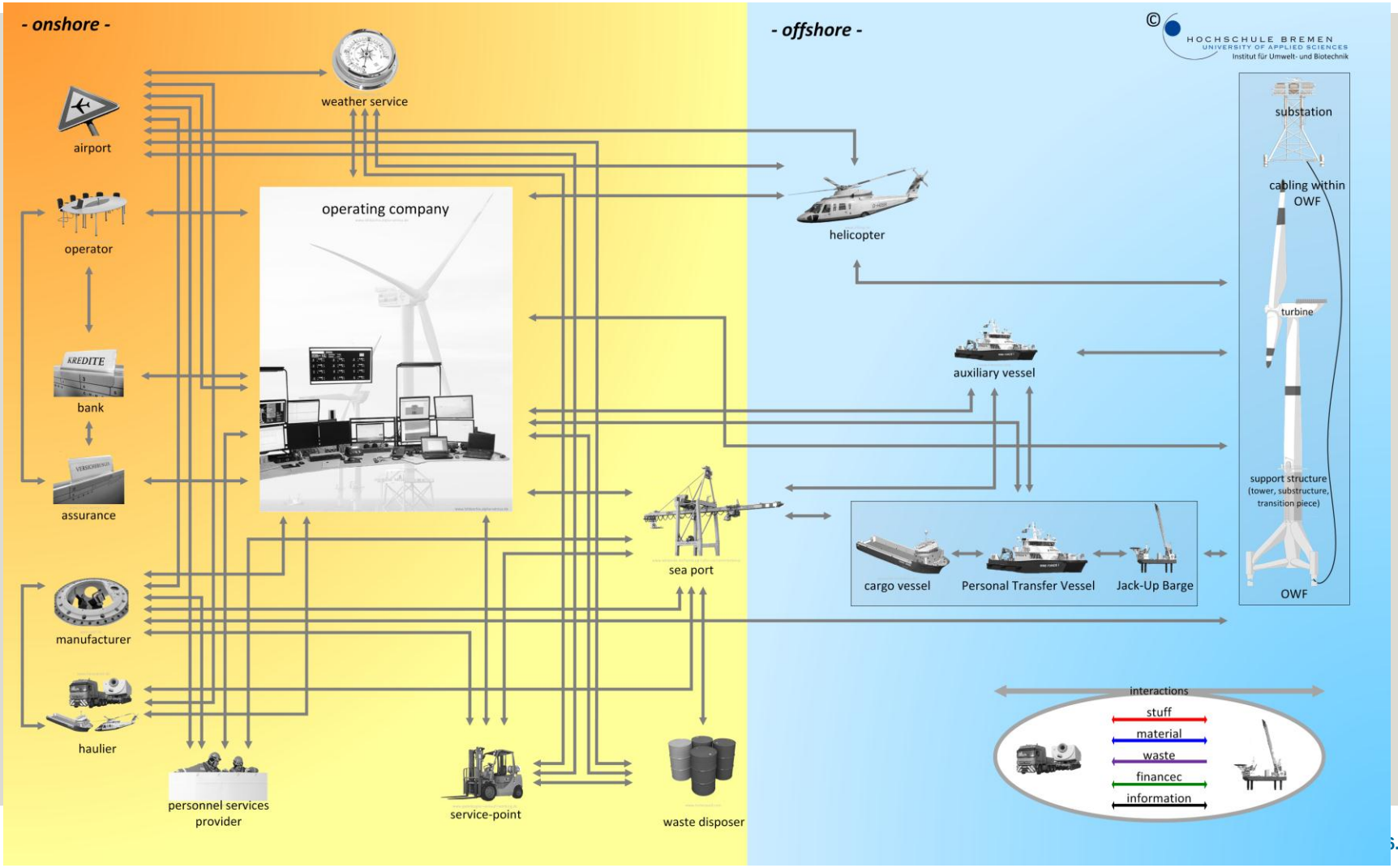
Process risks in OWF

- Human, e.g. failures because of their activities / actions
- Hardware, e.g. IT is under construction or crane is damaged
- Material, e.g. damaged transport boxes or no information
- Method, e.g. way of doing work
- Environment, e.g. stormy weather or non-compliance with a rule

⇨ ***Delays and aborts of process steps***

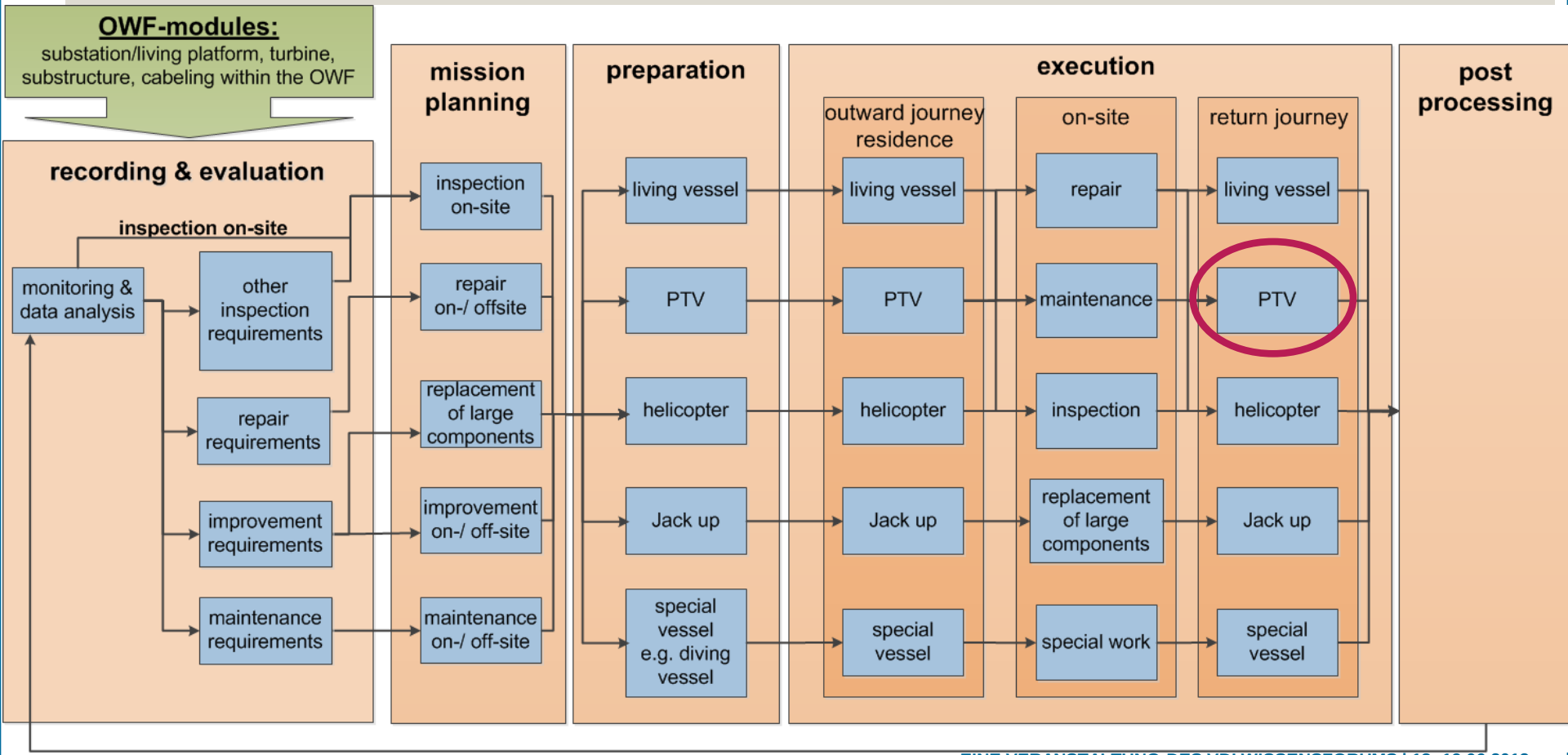
⇨ ***Significant financial implications, e.g. loss of income or logistic costs***

3. OFFSHORE WIND FARM SYSTEMS` PERFORMANCE



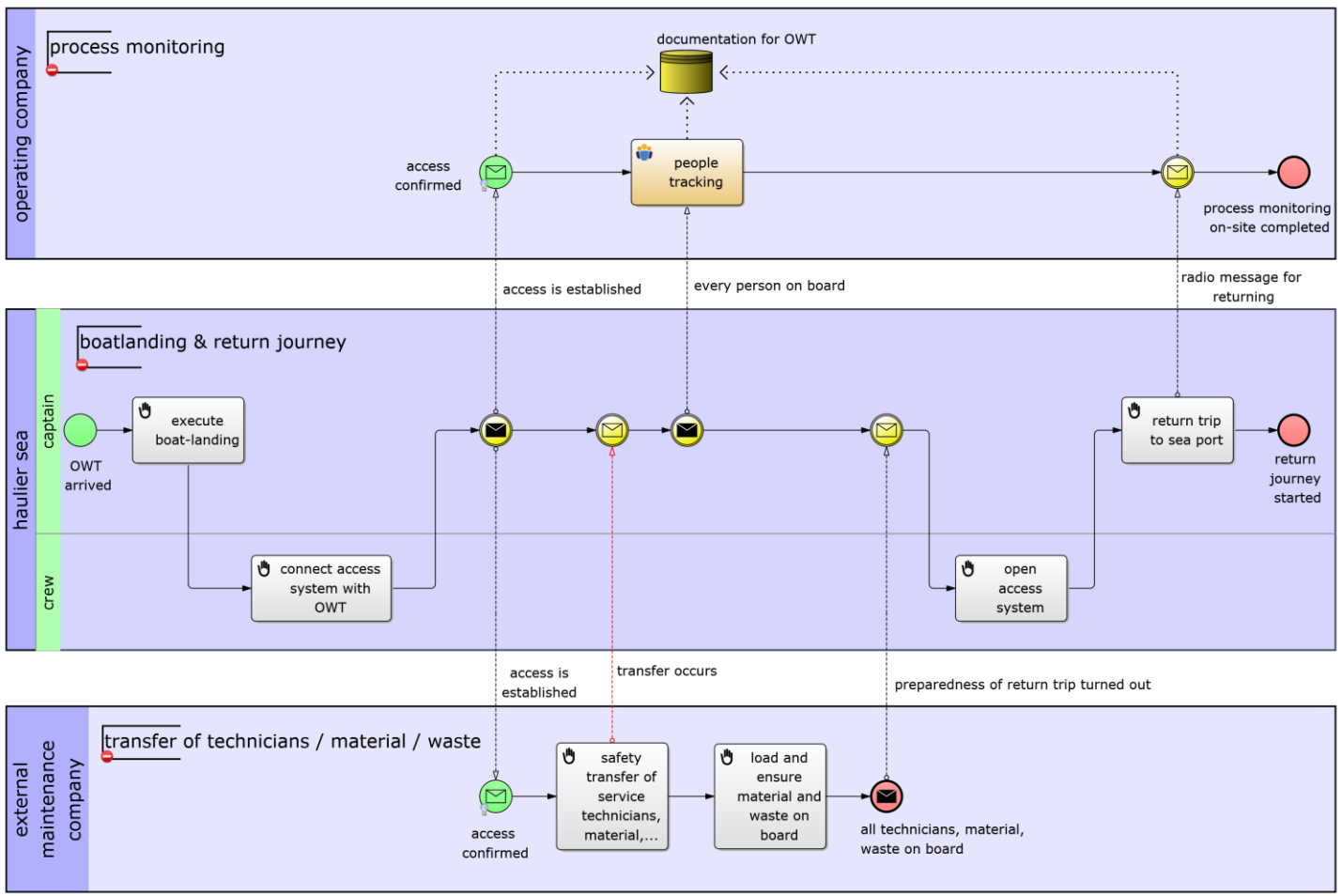
3. OFFSHORE WIND FARM SYSTEMS` PERFORMANCE

- Process Landscape of OWF Maintenance -



3. OFFSHORE WIND FARM SYSTEMS` PERFORMANCE

Process model: Return trip by PTV

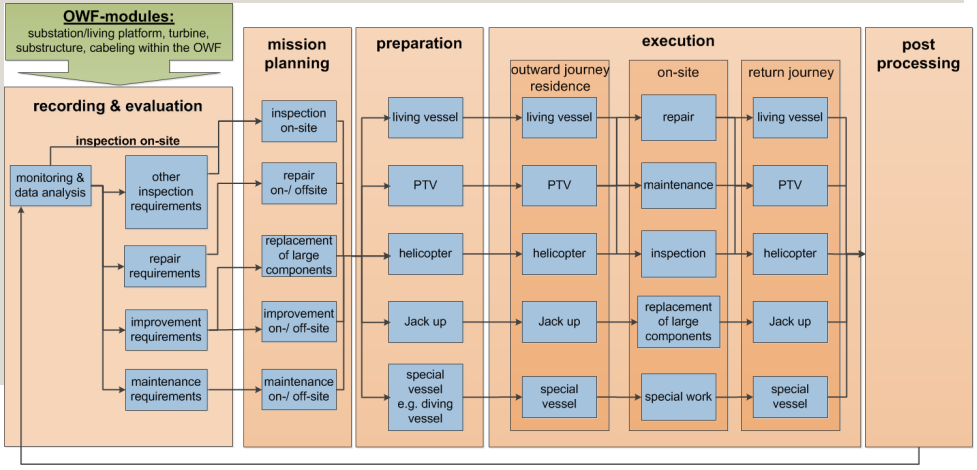


3. OFFSHORE WIND FARM SYSTEMS` PERFORMANCE

- Process models are the basis for risk analysis and process optimization

- But: Only some sub-processes have a high risk or have to be optimized.

⇨ ***Find the risk- & optimization-relevant sub-processes!***



4. ANALYSIS OF PROCESS RISKS

Risk-relevant processes: Extract of selection criteria

Key process

prime importance for process leading & availability of OWT

Financial impact

significant impact on assets or income and expenses

Complexity

complicated net of players, their activities and interactions

Dependency of ressources

process depends on less number of staff, …

4. ANALYSIS OF PROCESS RISKS

Extract of risk-relevant processes

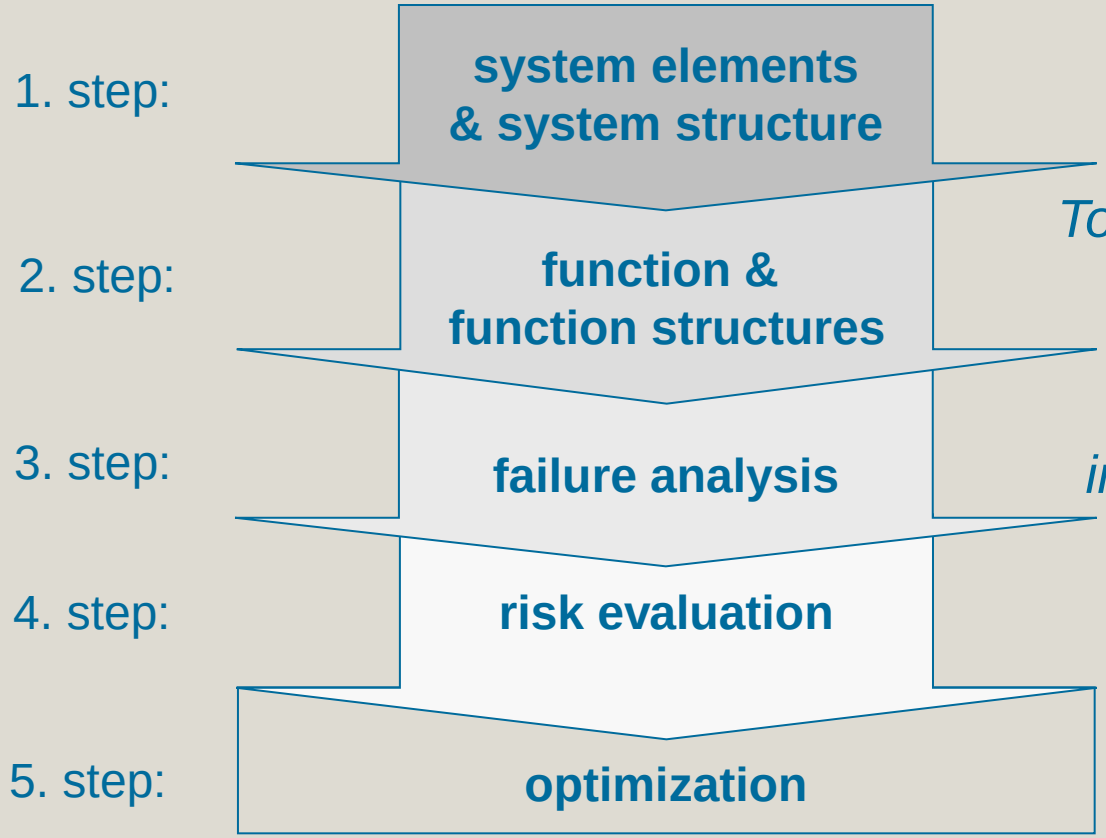
- Recording & Evaluation:
  - decisions about maintenance activities at OWT with a great impact on expenses and incomes

- Mission Planning
  - best combining of planned work assignments under current requirements, e.g. weather conditions, logistics, …

- Preparation
  - don´t forget materials, tools, spare parts, …
  - redundant material

4. ANALYSIS OF PROCESS RISKS

The method: FMEA



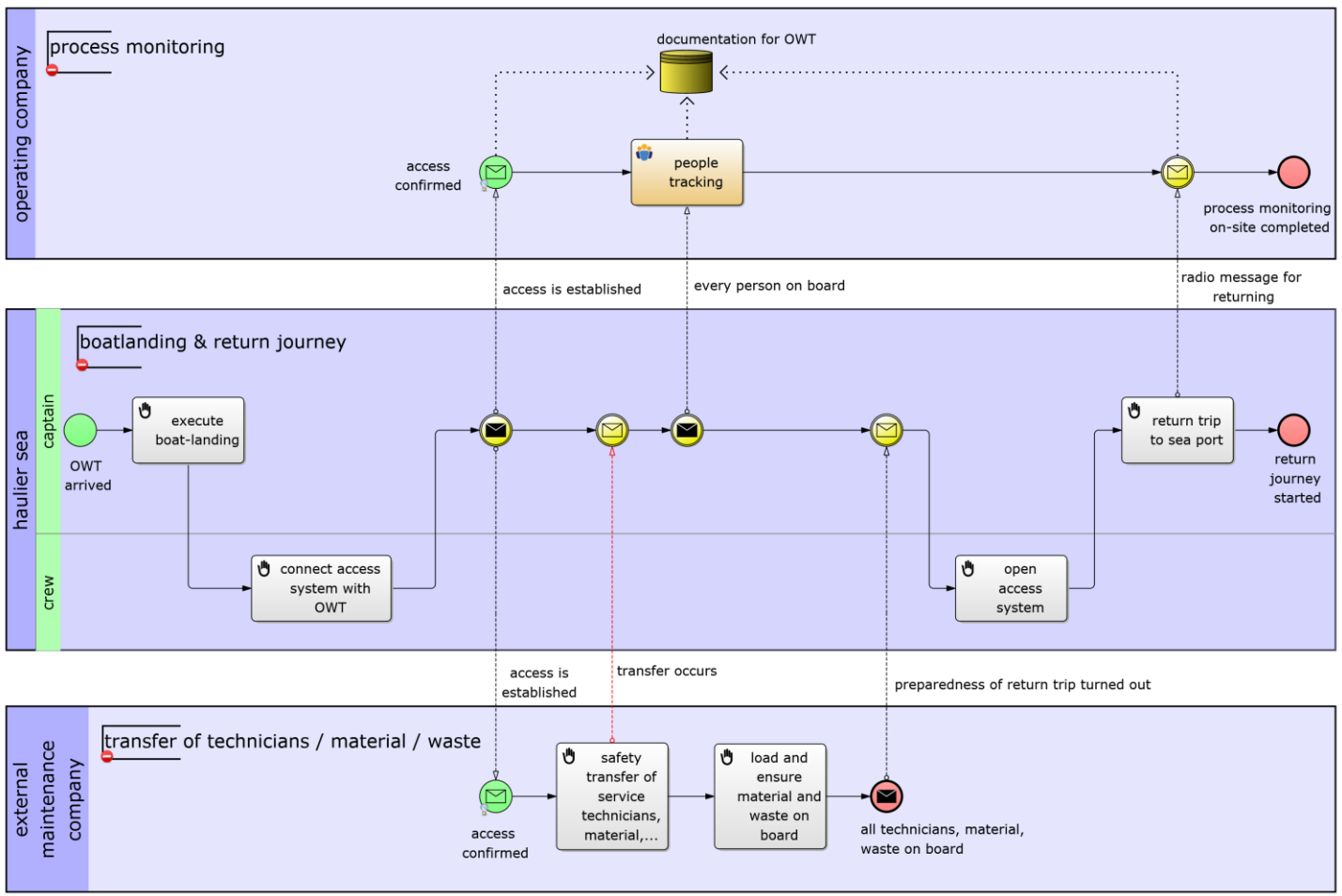
Tool for obtaining knowledge in the company

inter-divisional initiated improvement of product or process

[IZP, 2012]

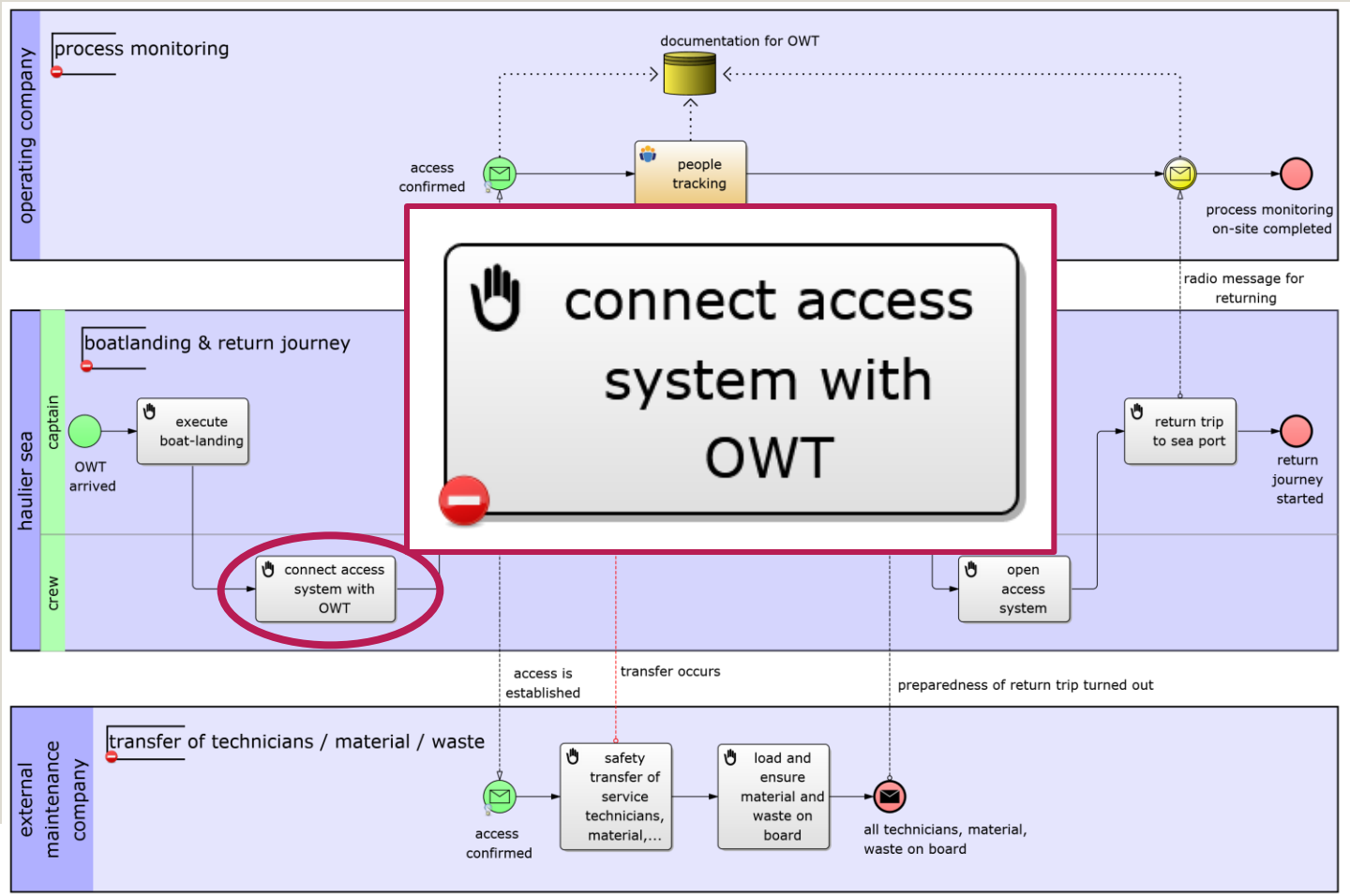
4. ANALYSIS OF PROCESS RISKS

FMEA-Example: Return trip by PTV



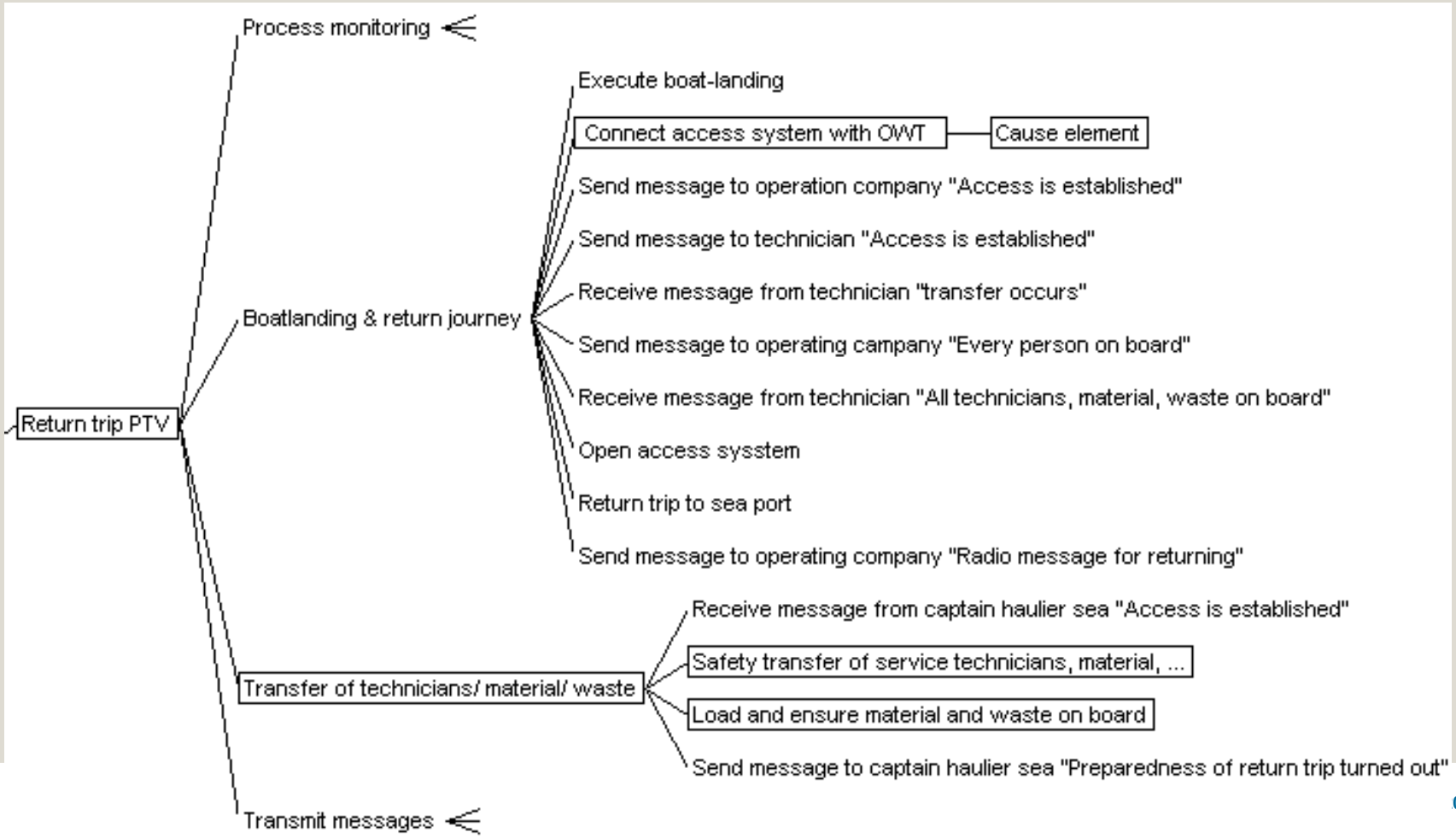
4. ANALYSIS OF PROCESS RISKS

FMEA-Example: Return trip by PTV



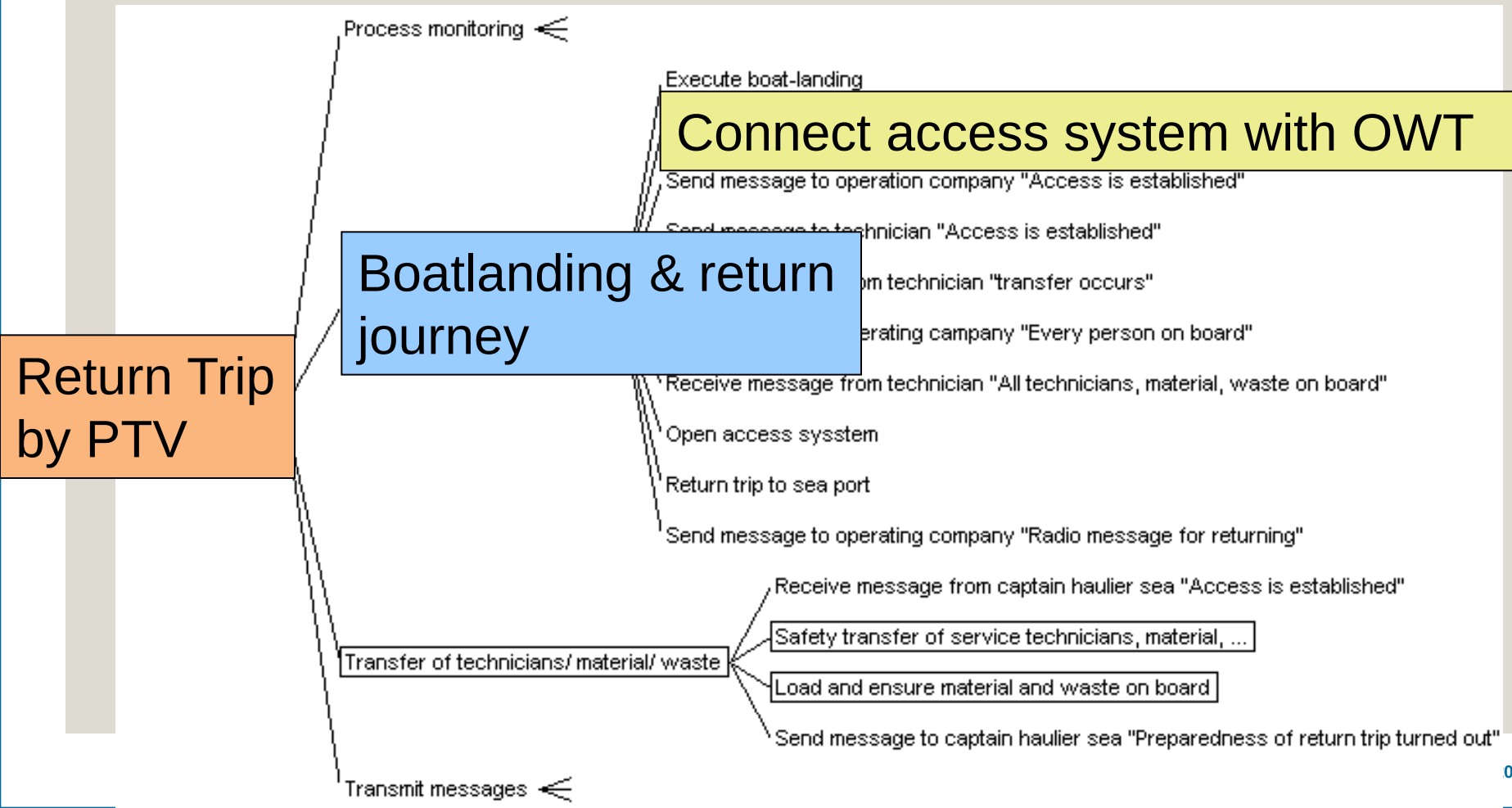
4. IDENTIFICATION & EVALUATION OF PROCESS RISKS

Process structure: Return trip by PTV



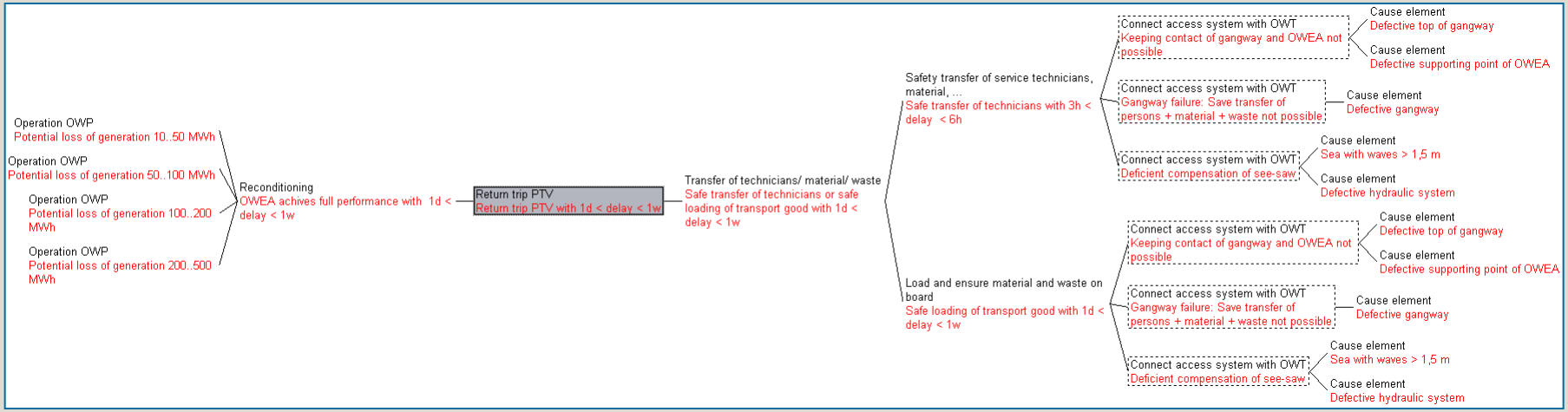
4. IDENTIFICATION & EVALUATION OF PROCESS RISKS

Process structure: Return trip by PTV



4. ANALYSIS OF PROCESS RISKS

Failure analysis



effect ← **failure** ← **cause**

4. ANALYSIS OF PROCESS RISKS

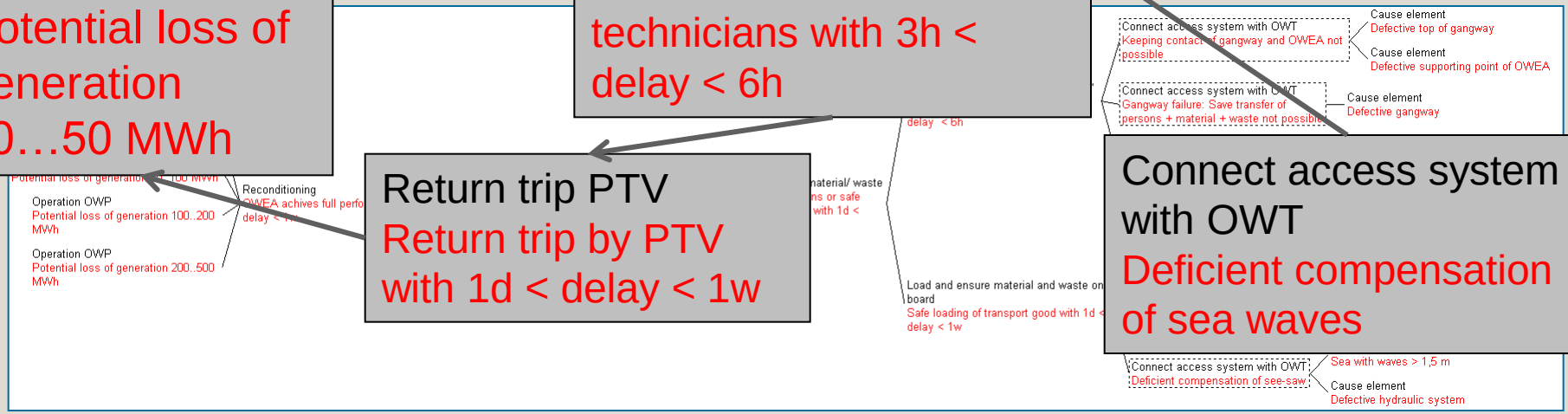
Failure analysis

Operation OWP
Potential loss of generation
10…50 MWh

Safety transfer of service technicians,…
Safe transfer of technicians with 3h < delay < 6h

Return trip PTV
Return trip by PTV
with 1d < delay < 1w

Connect access system with OWT
Deficient compensation of sea waves



effect ← **failure** ← **cause**

4. ANALYSIS OF PROCESS RISKS

Risk evaluation

Effects	S	C	Failure Mode	Causes	Preventive Action	O	Detection Action	D	RPN	R/D
APiS Informationstechnologien GmbH				F M E A Prozess				Number: 1.5.3.2.4.3.2.2.2 Page:		
Type/Model/Fabrication/Load: Instandsetzung				Item Code: Revision State:	Responsible: Company:			Created: 25.03.2013		
FMEA/System Element: Connect access system with OWT				Item Code: Revision State:	Responsible: Company:			Created: 08.05.2013 Modified: 27.05.2013		
Effects	S	C	Failure Mode	Causes	Preventive Action	O	Detection Action	D	RPN	R/D
Process Element: 1.5.3.2.4.3.2.2.2 ◈ Connect access system with OWT										
Function: 1.5.3.2.4.3.2.2.2.a Compensation of see-saw {1}										
>> 1.a.2 Potential loss of generation 10..50 MWh {1}	2		1.5.3.2.4.3.2.2.2.a.1 Deficient compensation of see-saw {1}	1.5.3.2.4.3.2.2.2.1.a.1 Sea with waves > 1,5 m {1}	Initial State: 13.05.2013 Missions are planned for wave-height forecasts below 1.5 m only {1}	4	none {1}	10	200	
>> 1.a.3 Potential loss of generation 50..100 MWh {1}	3									
>> 1.a.4 Potential loss of generation 100..200 MWh {1}	4			1.5.3.2.4.3.2.2.2.1.a.2 Defective hydraulic system {1}	Initial State: 13.05.2013 Monthly service, preventive exchange after two years {1}	3	Check before mission {1}	2	30	
>> 1.a.5 Potential loss of generation 200..500 MWh {1}	5									
Function: 1.5.3.2.4.3.2.2.2.b Save transfer of persons + material + waste {1}										

general information

specific risk information

4. ANALYSIS OF PROCESS RISKS

Risk evaluation

Effects	S	C	Failure Mode	Causes	Preventive Action	O	Detection Action	D	RPN	R/D
APiS Informationstechnologien GmbH				FMEA Prozess					Number: 1.5.3.2.4.3.2.2.2 Page:	
Type/Model/Fabrication/Load: Instandsetzung				Item Code: Revision State:			Responsible: Company:		Created: 25.03.2013	
{1}										
Function: 1.5.3.2.4.3.2.2.2.b Save transfer of persons + material + waste {1}										

Effects	S	C	Failure Mode	Causes	Preventive Action	O	Detection Action	D	RPN
Process Element: 1.5.3.2.4.3.2.2.2 Connect access system with OWT									
Function: 1.5.3.2.4.3.2.2.2.a Compensation of see-saw {1}									
>> 1.a.2 Potential loss of generation 10..50 MWh {1}	2		1.5.3.2.4.3.2.2.2.a.1 Deficient compensation of see-saw {1}	1.5.3.2.4.3.2.2.2.1.a.1 Sea with waves > 1,5 m {1}	Initial State: 13.05.2013				
					Missions are planned for wave-height forecasts below 1.5 m only {1}	4	none {1}	10	200
>> 1.a.3 Potential loss of generation 50..100 MWh {1}	3								
>> 1.a.4 Potential loss of generation 100..200 MWh {1}	4			1.5.3.2.4.3.2.2.2.1.a.2 Defective hydraulic system {1}	Initial State: 13.05.2013				
					Monthly service, preventive exchange after two years {1}	3	Check before mission {1}	2	30

5. OPTIMIZATION POTENTIALS

- Combining of different work assignments and parties concerned for more effectiveness and efficiency
  - e.g. yearly maintenance with period tests
- Redundant hardware offshore
  - e.g. accumulators or tools
- Adequate assistance for technicians
  - e.g. operating procedures, checklists, …
  - e.g. training courses

5. OPTIMIZATION POTENTIALS

- Support in operational management
  - e.g. shared software application for all parties concerned
  - e.g. adapted people- and vessel-tracking systems

- Knowledge transfer from power plants and oil & gas
  - e.g. combination of preventive maintenance and periodic inspection

6. *SystOp Offshore Wind*

- Cooperation:

  Hochschule Bremen, IZP Dresden, Universität Hamburg, BTC AG

- Run time:

  01.05.2011 – 30.04.2014

- Goal:

  Recording, Analysis and Optimization of Offshore Wind Farm Systems` Performance in Maintenance

- Funded by:

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

VDI Wissensforum

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES
INSTITUT FÜR UMWELT- UND BIOTECHNIK

BTC IZP

UH Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

6. *SystOp Offshore Wind*

Bugsier Reederei- und Bergungsgesellschaft mbH & Co. KG
DEWI-OCC Offshore and Certification Centre GmbH
DOTI GmbH & Co KG
EWE Energie AG
EWE Offshore Service & Solution GmbH
Frisia-Offshore GmbH
Hochtief Solutions AG
htm Helicopter Travel Munich GmbH
Nehlsen GmbH
Nordwest Assekuranzmakler GmbH & Co. KG
PHH Personaldienstleistung GmbH
REETEC GmbH Regenerative Energie- und Elektrotechnik
RKM Personaldienstleistungen GmbH
Signalis Germany
Windparkservice GmbH
WindMW
WKU AG
wpd windmanager GmbH & Co. KG

VDI Wissensforum

HOCHSCHULE BREMEN
UNIVERSITY OF APPLIED SCIENCES
INSTITUT FÜR UMWELT- UND BIOTECHNIK

IZP

Thank you very much.

Hochschule Bremen
Institute for Environmental and Biotechnology
Neustadtswall 30
28199 Bremen

Saskia Greiner
saskia.greiner@hs-bremen.de

Prof. Dr.-Ing. Henning Albers
henning.albers@hs-bremen.de

Susanne Appel
susanne.appel@hs-bremen.de

IZP Dresden

Stauffenbergallee 4
01099 Dresden

Torsten Renz
t.renz@izp.de

www.systop-wind.de

[Windenergiereport,2011]

Windenergie Report Deutschland 2011, Fraunhofer Institut für Windenergie und Energiesystemtechnik (IWES), Kassel, www.iwes.fraunhofer.de

[IZP, 2012]

Ingenieurgesellschaft für Zuverlässigkeit und Prozessmodellierung, Dresden