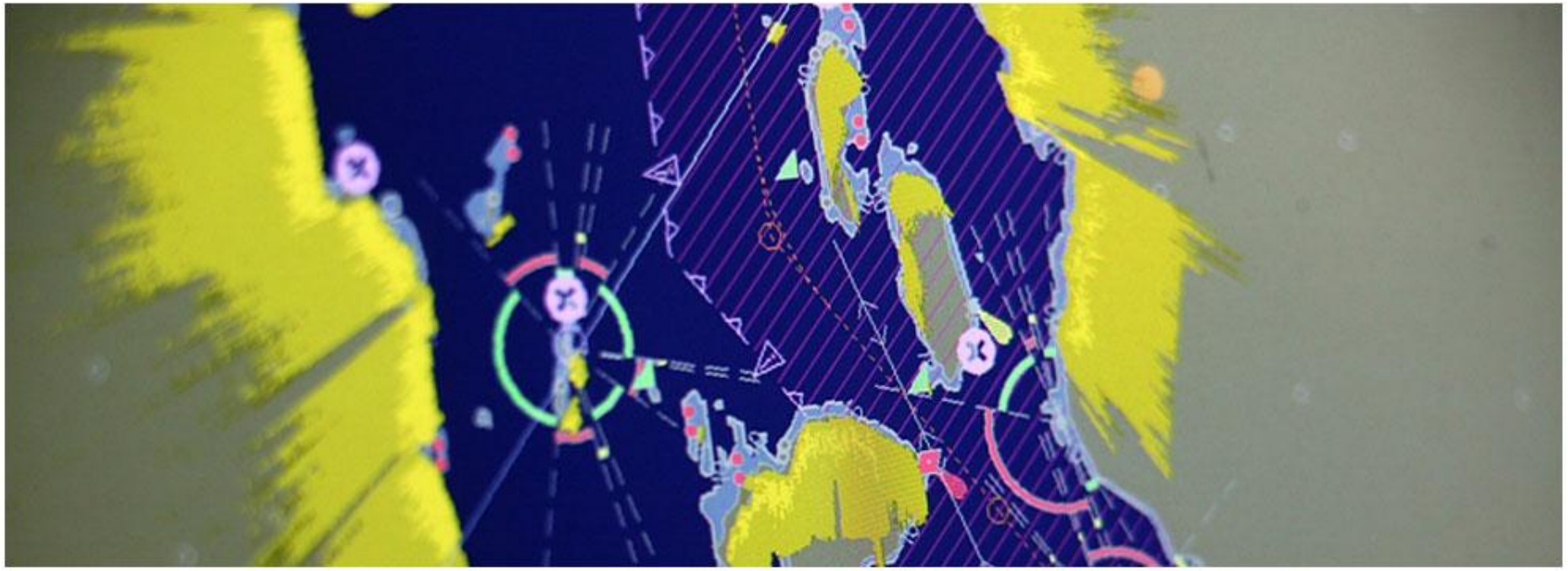


Early Validation through the A3 method

Kristian Frøvold

HØGSKOLEN i Buskerud

STEVENS Institute of Technology

KONGSBERG

Introduction

KONGSBERG

- 2008-2011 Systems Engineering - Master
  - HIBU
  - Stevens Institute of Technology
  - Kongsberg Maritime (KM)

- Thanks for close cooperation to Martin Kruse
  - KM: Sølve Raaen, Katarina Hagner, Wenche Enga
  - Advisor: Gerrit Müller

- Have worked in Kongsberg Maritime since 2008 in the Product & Development department

- The study is performed in KM's currently largest development project, the New OS project

- The new operator stations were presented for the first time at the Nor-Shipping exhibition, May 2011

Introduction – Need and Solution

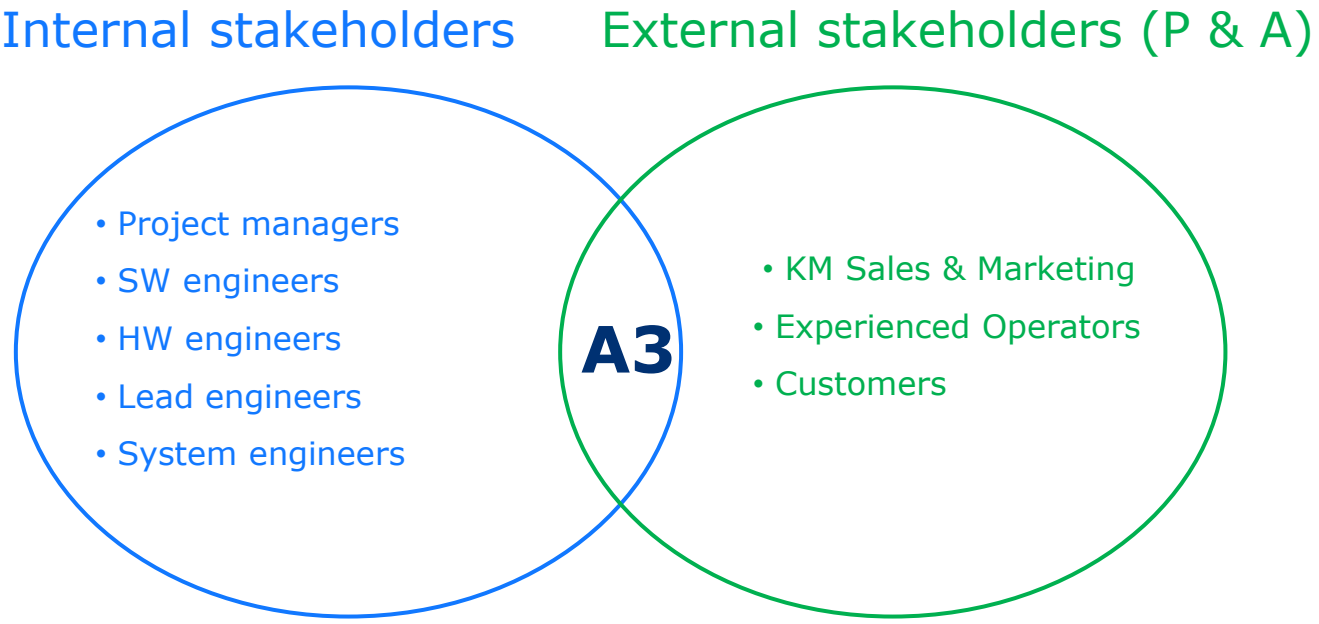
KONGSBERG

- The need was to shorten the distance between development groups and external stakeholders, like customers, operators, and sales & marketing
- We had discovered that too less communication could lead to validation problems (bad requirements)
- Our study's goal: To create a tool for early validation and communication (at this stage in the development process)
- Through Early Validation A3 reports, by simple means we increased communication and contributed to early validation
- The high-level system focus beacme very important

Stakeholders

KONGSBERG

- The most important factor for the early validation
- Lots of the information is contained in peoples heads
- Multi-diciplinary teams



Stakeholders

KONGSBERG

A3 - History

KONGSBERG

- Paper size of 297 x 420 mm
- Emerged from Toyotas lean development
- Spread to other domains, such as Health-Care
- Architecture Overview
- Goal for Early Validaiton A3

Ensure that the system/function or service being developed accomplish the needs of the operator and customers

A3 – Key features

KONGSBERG

- Multiple related views
- Different levels of abstraction
- Concise and Digestible
- Mixture of text and models
- High-level system focus
- Based on story-telling (operation)

KONGSBERG

Example

New Operator Stations

KONGSBERG

Vessel Mode

- New OS
  - Multi-function OS
- New architecture
- Opens for new functions
- A complex function
  - Modes
  - Interfaces DP, Nav, Aut
  - Flexibility

KONGSBERG

Example

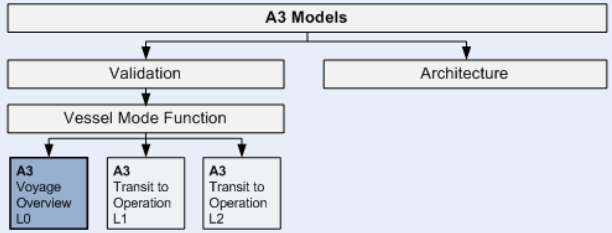
KONGSBERG

- We depicted a proposed solution for the system function at an early stage
- The Vessel Mode functions goal is to increase safety and efficiency on voyages/operations
- In this case we collected information from and created the A3 reports with stakeholders mentioned earlier
- “To collect real information you have to go there”

Viking Energy – Deepsea Atlantic

KONGSBERG

6 m (9 m) waves - ±40 knots (20 m/s wind)



Function Goal
Safe and efficient voyage from CCB Ågotnes to Veslefrikk, Deepsea Atlantic and Gullfaks

Model Goal
Model the real events of a container loading operation with a OSV (Viking Energy)

Considerations

There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interaction

Abbreviations

FOW – First Officer on Watch
TTR – Time To Repair
S&M – KM Sales & Marketing

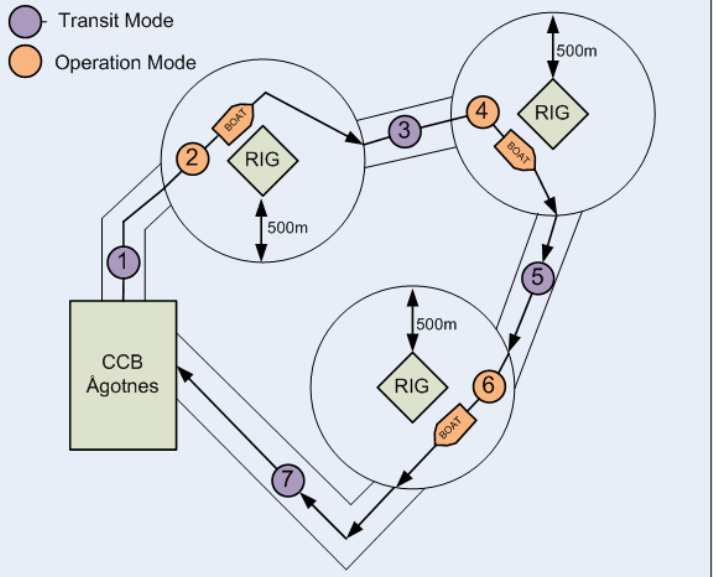
A3 Operation Load Containers V11

Author: Martin K / Kristian F
Version Comment: This A3 is updated after after interviews with operators, sales and marketing
Last Update: 04.03.2011

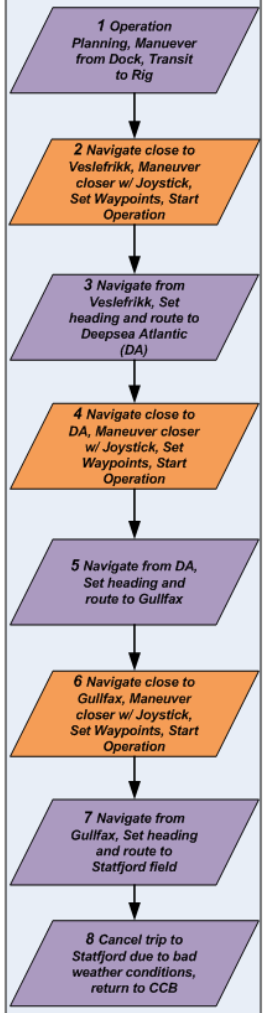
Scope: Transit - Operation
Status: Approved V 1.0

Operation flow

Operation: Load/Transport Containers



Flow Diagram



Need Statement

A system/function for guidance and operational support for safety and efficency is needed, as there is a trend towards higher safety and increased efficiency.

Vessel Mode Function

What shall the Vessel Mode function do/contain of?

- Create Electronic Checklists
- Manage Electronic Checklists
- RCA/State Readings/Status
- Bridge Setup
- Change screen layouts
- Auto start sequences
- Role Change

Concerns/Feedback

Observed

- Seems like there is no time to save in this voyage
- The operators have lots of time to fill points in checklist, also FOW does this during operation
- Checklist only filled once during 3 days voyage, multiple operations. Filled underways towards the Rig, but not completed before "mode change"
- Basically they use very few screens activly for navigation (1, and some ECDIS) and operation (2)

- Does not see any need for an Approach Mode

Key Drivers (KM)

1 Improved Safety
- 1.1 Ease of operation/guidance
- 1.2 Availability
  - 1.2.1 System uptime / TTR
  - 1.2.2 Screens and Interaction elements reacable

2 Improved Efficiency
- 2.1 Time savings during Voyage
- 2.2 Fuel savings
- 2.3 More efficient handling of lists

Market

A Vessel Mode function is a function that can be implemented in any ship and operation type (S&M)

Viking Energy operators suggests Diving Operations, Bouy Loaders. OSV w/ only aft bridge

It have to be considered that every market have very different needs

Validation Result (PSV)

For PSV Operations in the Northern sea Vessel Mode function seems at this point as unneccesary and complicating.

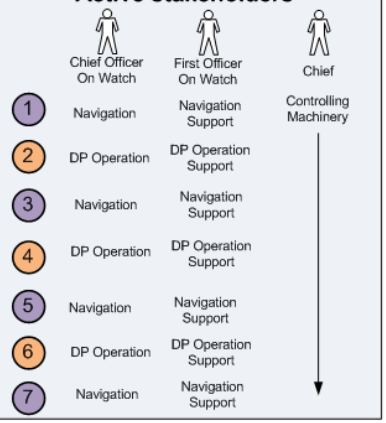
Vessel Mode are probably more suitable for other markets

A mapping of where Vessel Mode suits the most and a design focus towards this application would be perferable

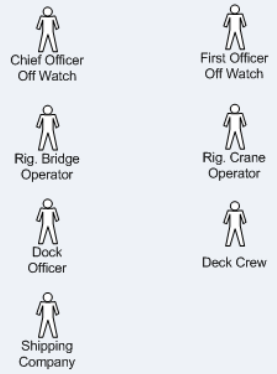
Sources

Operators From Viking Energy and KM external stakeholders.

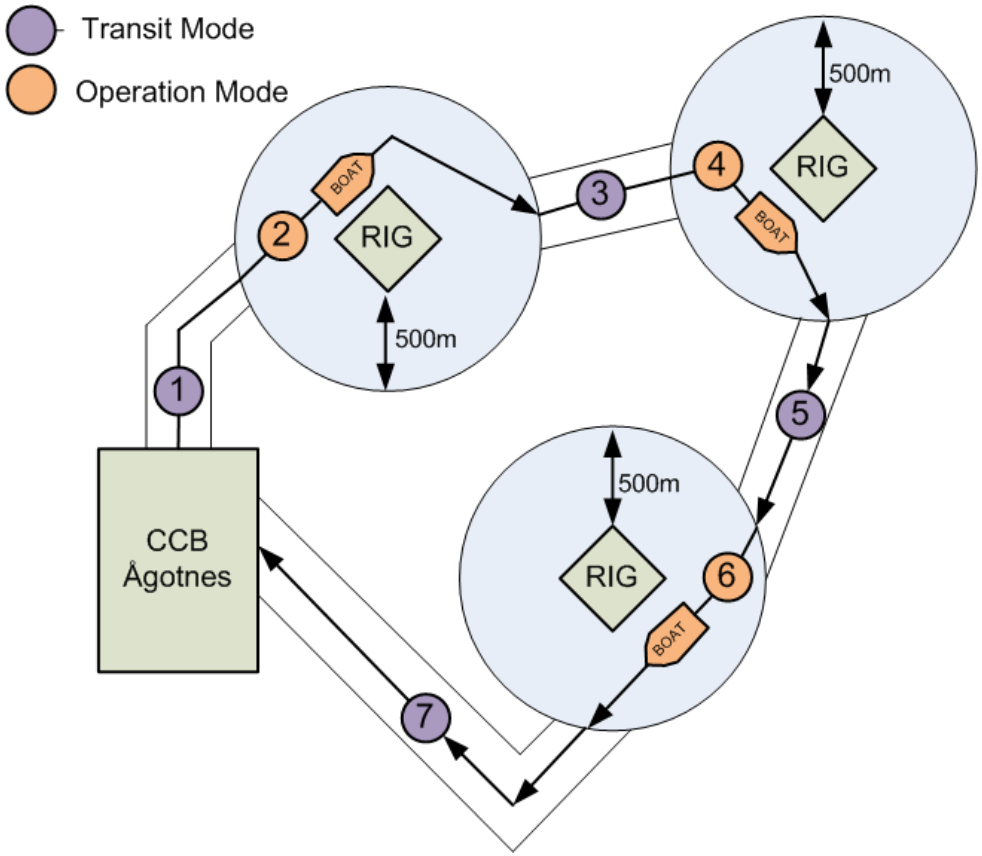
Active stakeholders

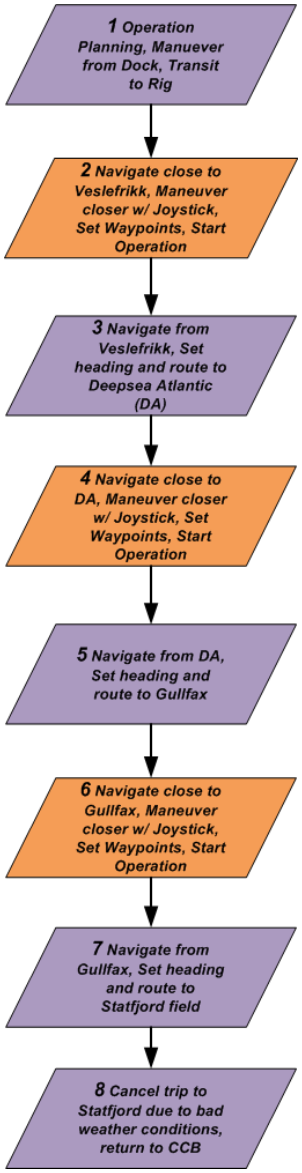


Passive Stakeholders



Pieces of an A3





- Interrelated views
- Color codes, vizualisations, quantifications ..

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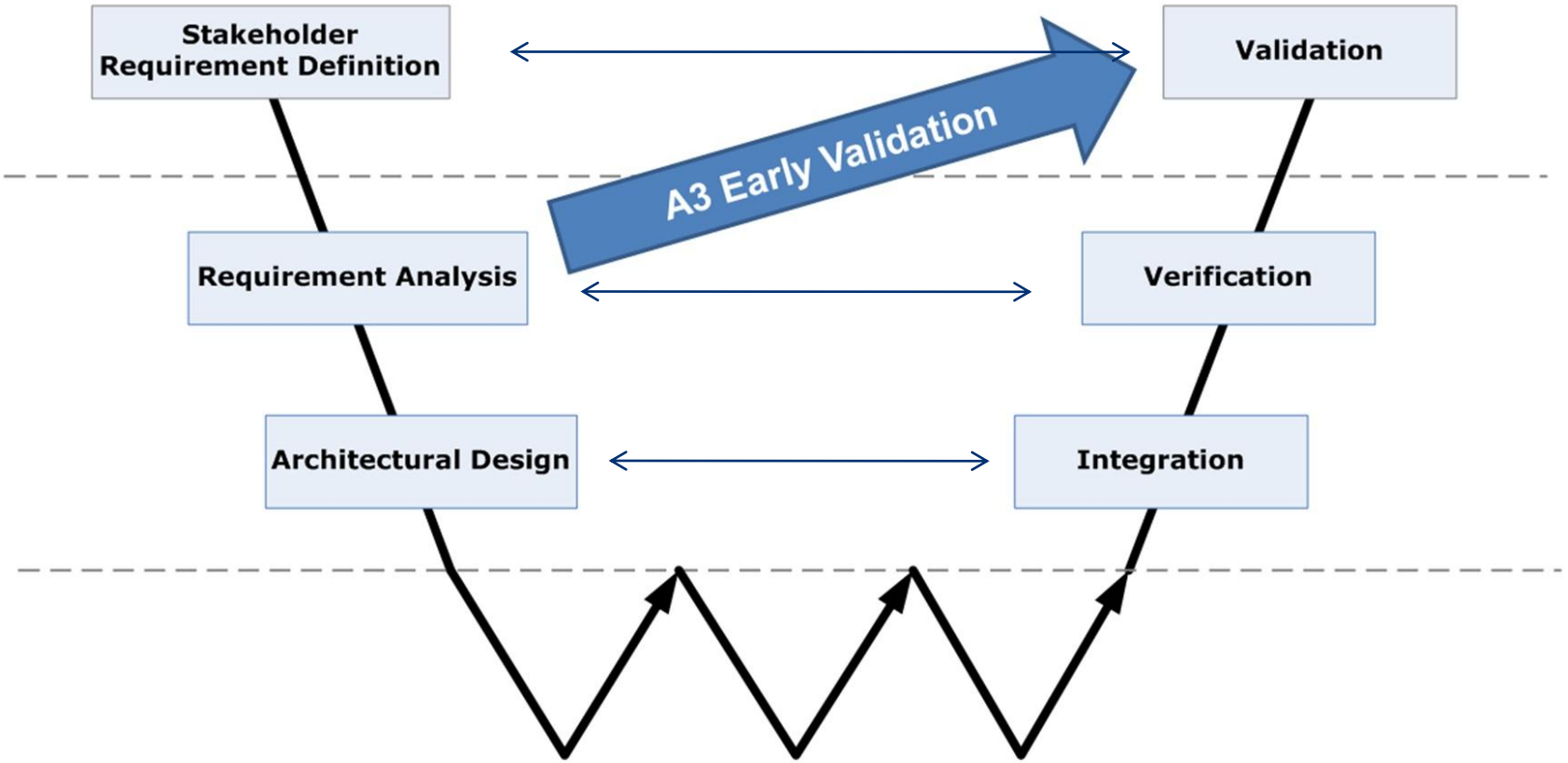
The Method and Process

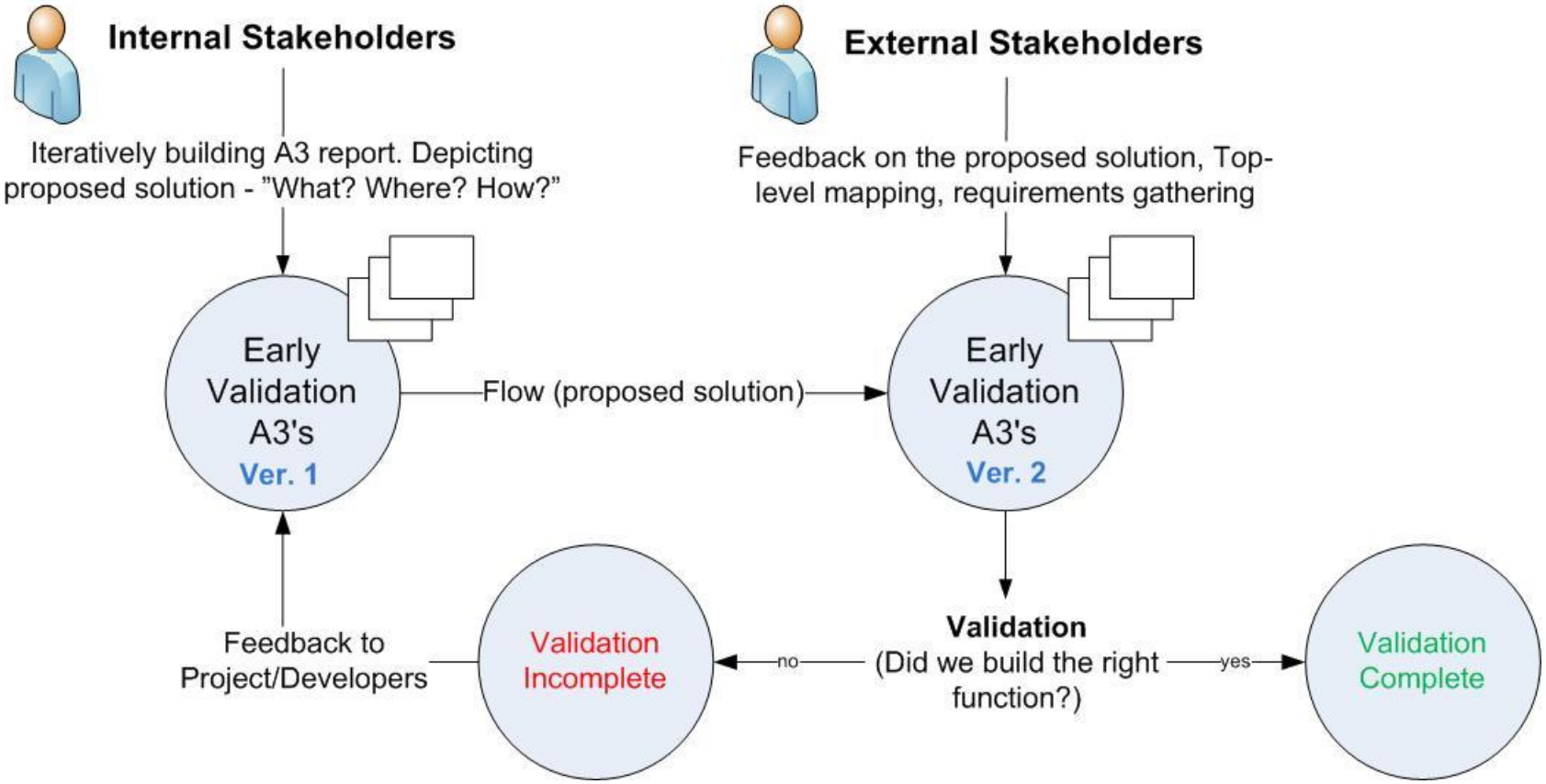
A3 method for Early Validation

KONGSBERG



The Process

KONGSBERG



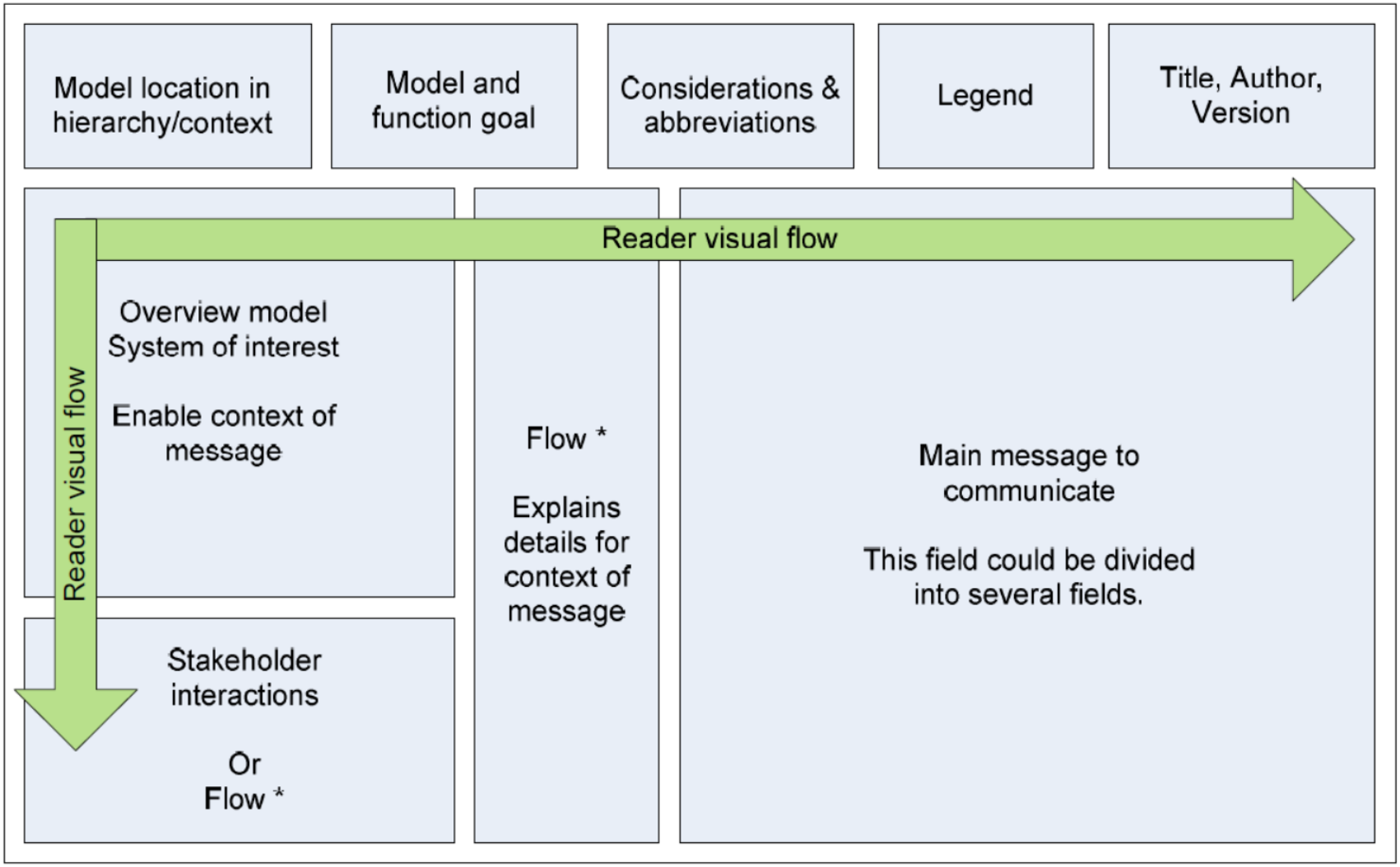
The Process

KONGSBERG

- Meetings mainly done with one stakeholder at a time, presenting the latest A3 reports
- Many iterations
- Start with a top-level report illustrating the proposed solution for the system/function
- Handing out printed A3 reports and letting stakeholders draw on them and comment as we discussed and led the stakeholder through

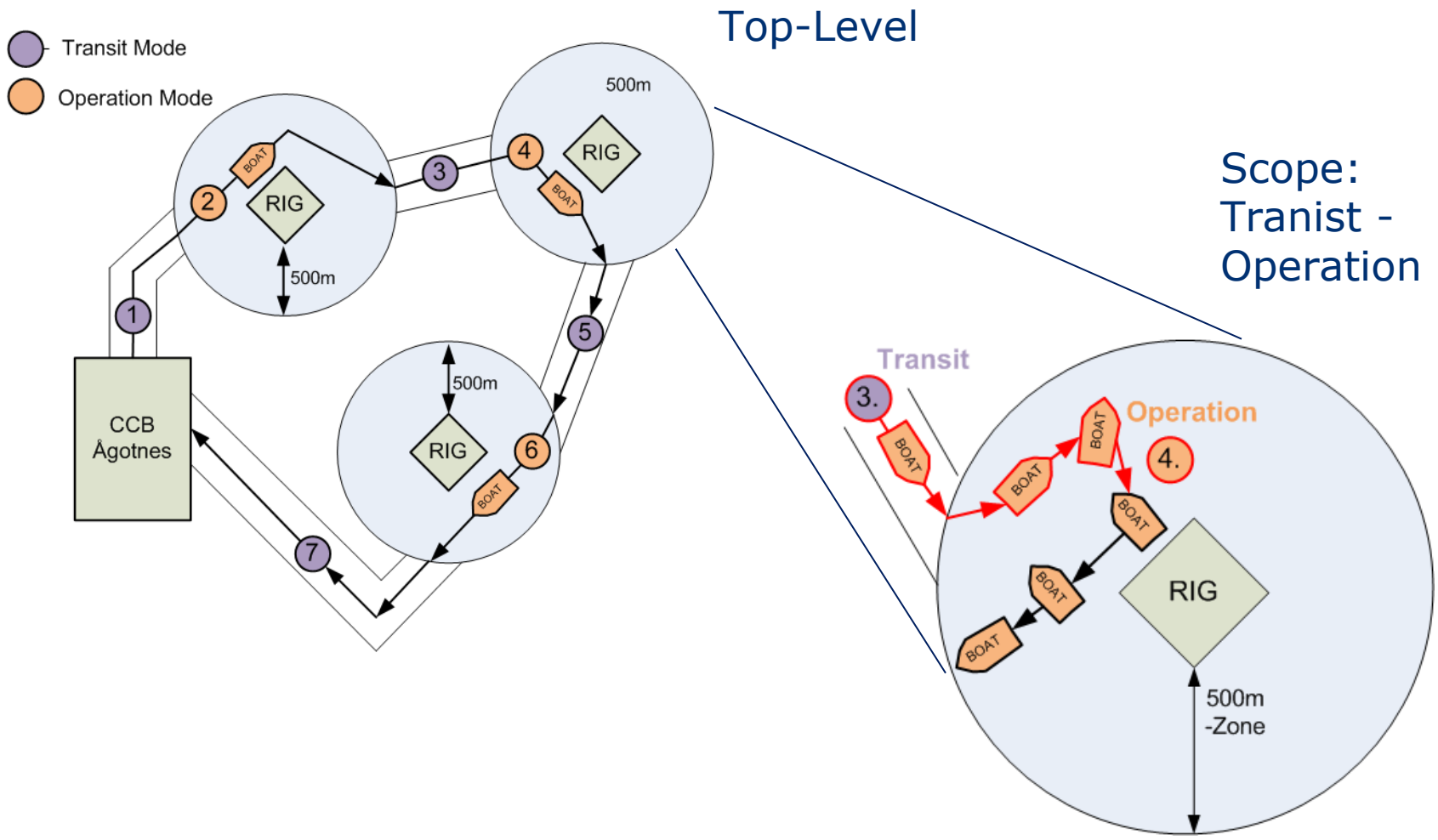
A3 – The Layout

KONGSBERG



The Levels - Scope

KONGSBERG



Top-level Overview – Version 1

KONGSBERG

Load Voyage in SYS
Distribue Voyage to SeS
Client Read Voyage
Execute Voyage

Function Goal
Safe and efficient voyage from Aberdeen to Bergen, including operation on Rig

Model Goal
Safe and efficient transit from Transit Mode to Operation Mode

Considerations

There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interface

Legend

2. = Mode

1. X = Operation Flow Block (w. ID)

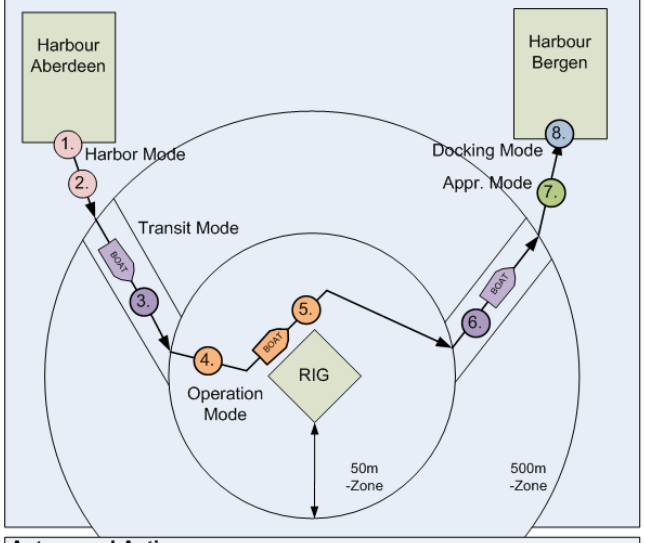
A3 Operation Load Containers V11

Author: Martin K / Kristian F
Version Comment: This A3 is updated after a coversation with Hans Numme 8/2
Last Update: 18.02.2011

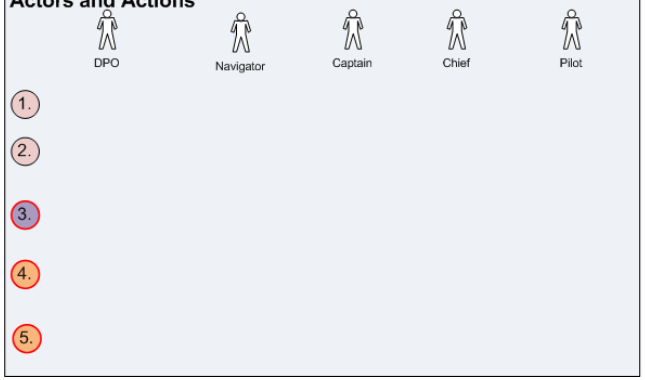
Scope: Transit - Operation
Status: Approved V 1.0

Operation flow

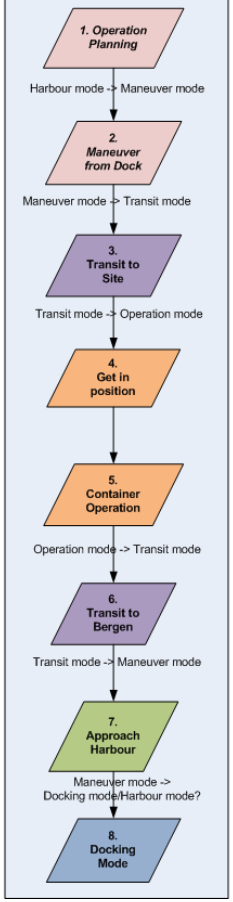
Operation: Load/Transport Containers



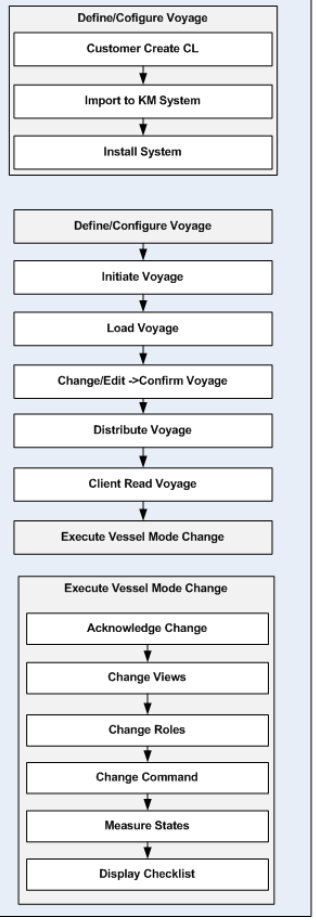
Actors and Actions



Flow Diagram



Top-Level Functional Flow



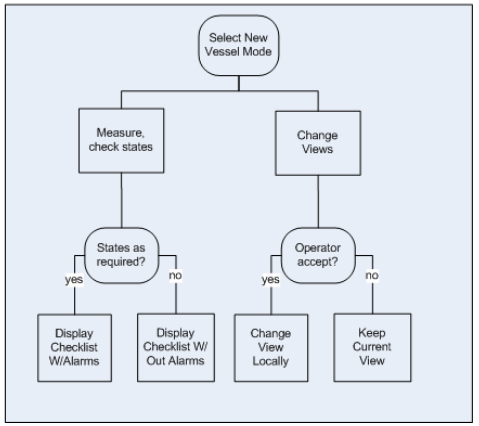
Key Drivers

1. Safety in Operations
All functionality must support safety for people, vessel, equipment and environment.

2. Ease of Operation

3. Time savings in operation

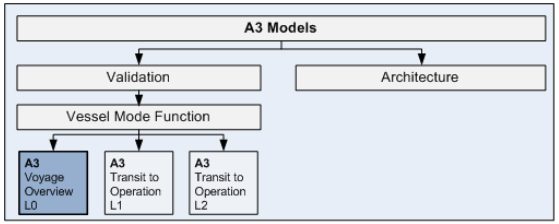
4. Reliability



 THE FULL PICTURE

Top-level Overview – Version 2

KONGSBERG



Function Goal
Safe and efficient voyage from CCB Ågotnes to Veslefrikk, Deepsea Atlantic and Gullfaks

Model Goal
Model the real events of a container loading operation with a OSV (Viking Energy)

Considerations

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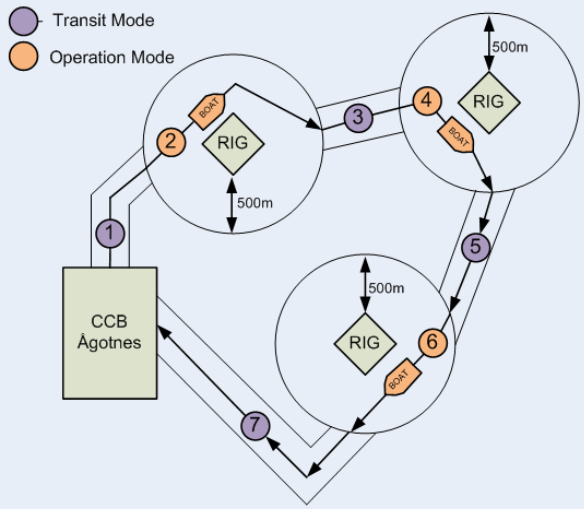
A3 Operation Load Containers V11

Author: Martin K / Kristian F
Version Comment: This A3 is updated after after interviews with operators, sales and marketing
Last Update: 04.03.2011

Scope: Transit - Operation
Status: Approved V 1.0

Operation flow — **Operation: Load/Transport Containers**



Active stakeholders

	Chief Officer On Watch	First Officer On Watch	Chief
1	Navigation	Navigation Support	Controlling Machinery
2	DP Operation	DP Operation Support	
3	Navigation	Navigation Support	
4	DP Operation	DP Operation Support	
5	Navigation	Navigation Support	
6	DP Operation	DP Operation Support	
7	Navigation	Navigation Support	

Passive Stakeholders

Chief Officer Off Watch
First Officer Off Watch
Rig. Bridge Operator
Rig. Crane Operator
Dock Officer
Deck Crew
Shipping Company

Flow Diagram

1 Operation Planning, Manuever from Dock, Transit to Rig
2 Navigate close to Veslefrikk, Maneuver closer w/ Joystick, Set Waypoints, Start Operation
3 Navigate from Veslefrikk, Set heading and route to Deepsea Atlantic (DA)
4 Navigate close to DA, Maneuver closer w/ Joystick, Set Waypoints, Start Operation
5 Navigate from DA, Set heading and route to Gullfax
6 Navigate close to Gullfax, Maneuver closer w/ Joystick, Set Waypoints, Start Operation
7 Navigate from Gullfax, Set heading and route to Statfjord field
8 Cancel trip to Statfjord due to bad weather conditions, return to CCB

Need Statement

A system/function for guidance and operational support for safety and efficency is needed, as there is a trend towards higher safety and increased efficiency.

Vessel Mode Function

What shall the Vessel Mode function do/contain of?

- Create Electronic Checklists
- Manage Electronic Checklists
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- Bridge Setup
- Change screen layouts
- Auto start sequences
- Role Change

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Vessel Mode are probably more suitable for other markets

A mapping of where Vessel Mode suits the most and a design focus towards this application would be perferable

Sources

Operators From Viking Energy and KM external stakeholders.

Communication Plan – Version 1

KONGSBERG

Load Voyage in SYS
Distribue Voyage to SeS
Client Read Voyage
Execute Voyage
Vessel Mode: Transit -> Communication in Transition for Operation (L1)

Function Goal
Safe and efficient transit from Transit Mode to Operation Mode

Model Goal
Validate the operation of going from Transit Mode to "Load Container" Mode/Operation Mode

Considerations
There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interface

Abbrevations
* MFOS - Multi Function Operator Station
* CL - Checklist
* Vessel Mode – Various system setups tailored for the wanted vessel operation.
* OS Role - Describes the task that can be performed at that OS. An OS can be able to take different roles.
* OS Layout - The OS layout is a predefined setup of elements on the display(s). Views, Panes etc.

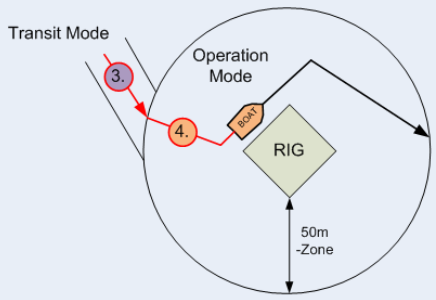
Legend
= Mode
= Operation Flow Block (w. ID)
= Operation Flow Block (w. ID)

A3 Operation Load Containers - Transit to Operation - V4

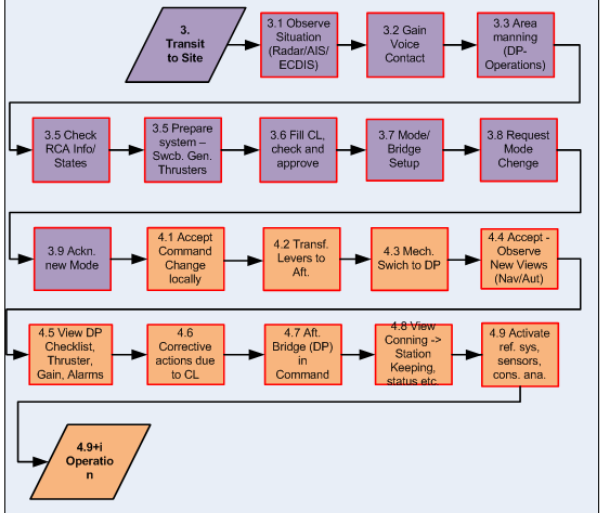
Author: Martin K / Kristian F
Version: 1.0
Version Comment: Updated after advicing with SR. Amund, SB
Last Update: 18.02.2011

Scope: Transit - Operation
Status: Approved Version 1.0

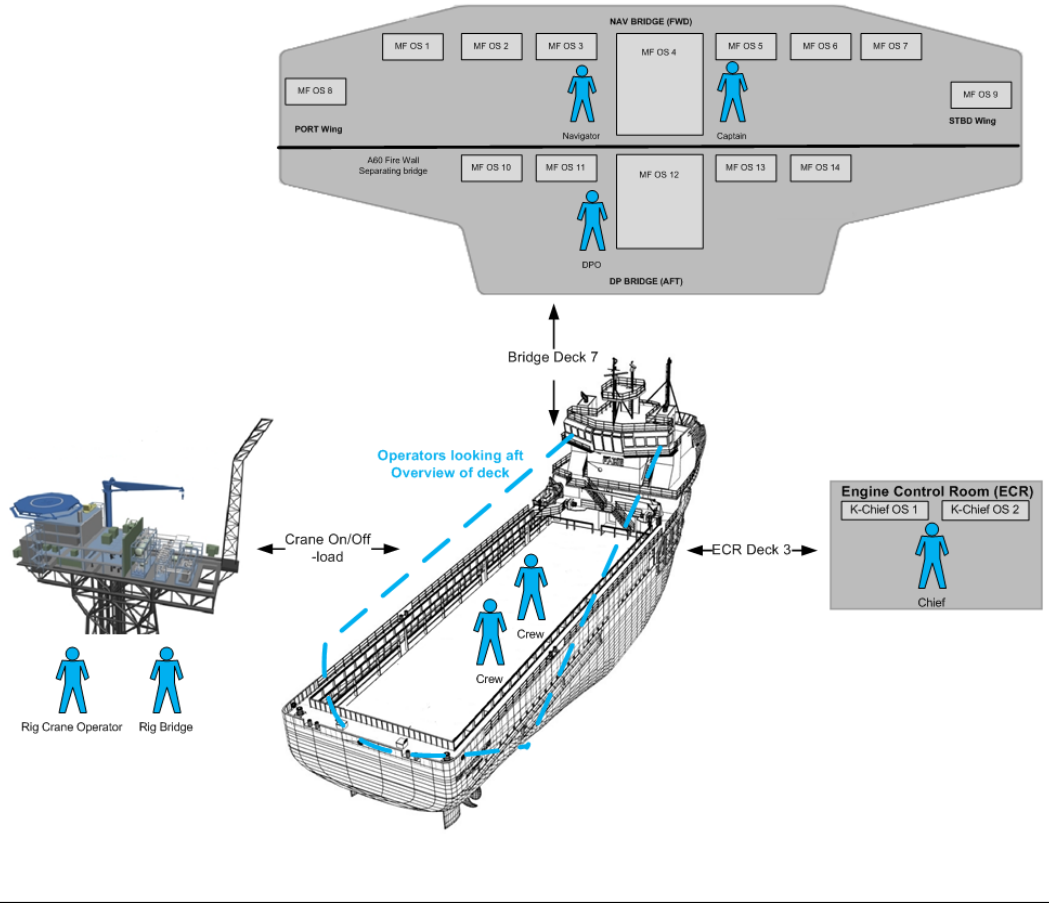
System of Interest From transit to load Containers



Operation flow Focus: 3 Transit Mode – 4/5 Operation Mode

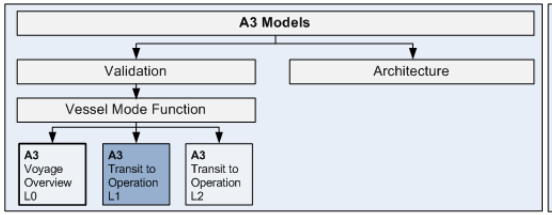


Communication plan



 THE FULL PICTURE

Communication Plan – Version 2



Function Goal
Safe and efficient transition from Transit Mode to Operation Mode

Model Goal
Validate the operation of going from Transit Mode to "Load Container" Mode/Operation Mode.

Considerations
There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interface

Abbrevations
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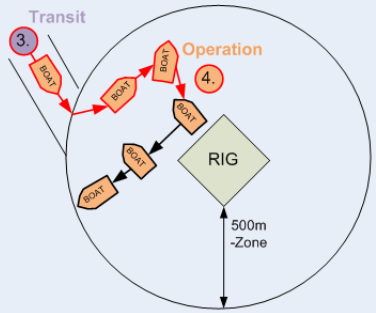
Legend
= Mode
= Operation Flow Block (w. ID)

A3 Operation Load Containers - Transit to Operation - L2 - V1

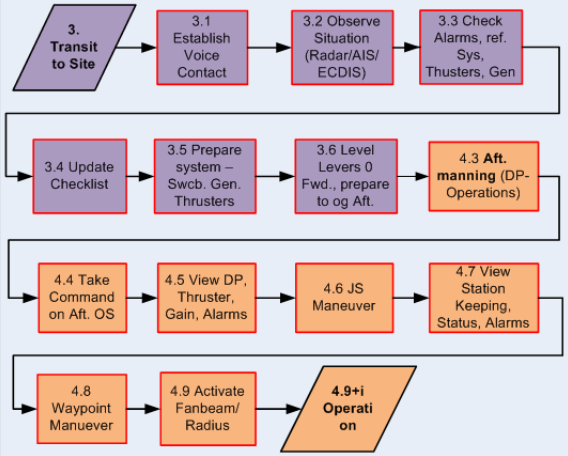
Author: Martin K / Kristian F
Version: 1.0
Version Comment: Updated after advicing with SR. Amund, SB
Last Update: 18.02.2011

Scope: Transit - Operation
Status: Approved Version 1.0

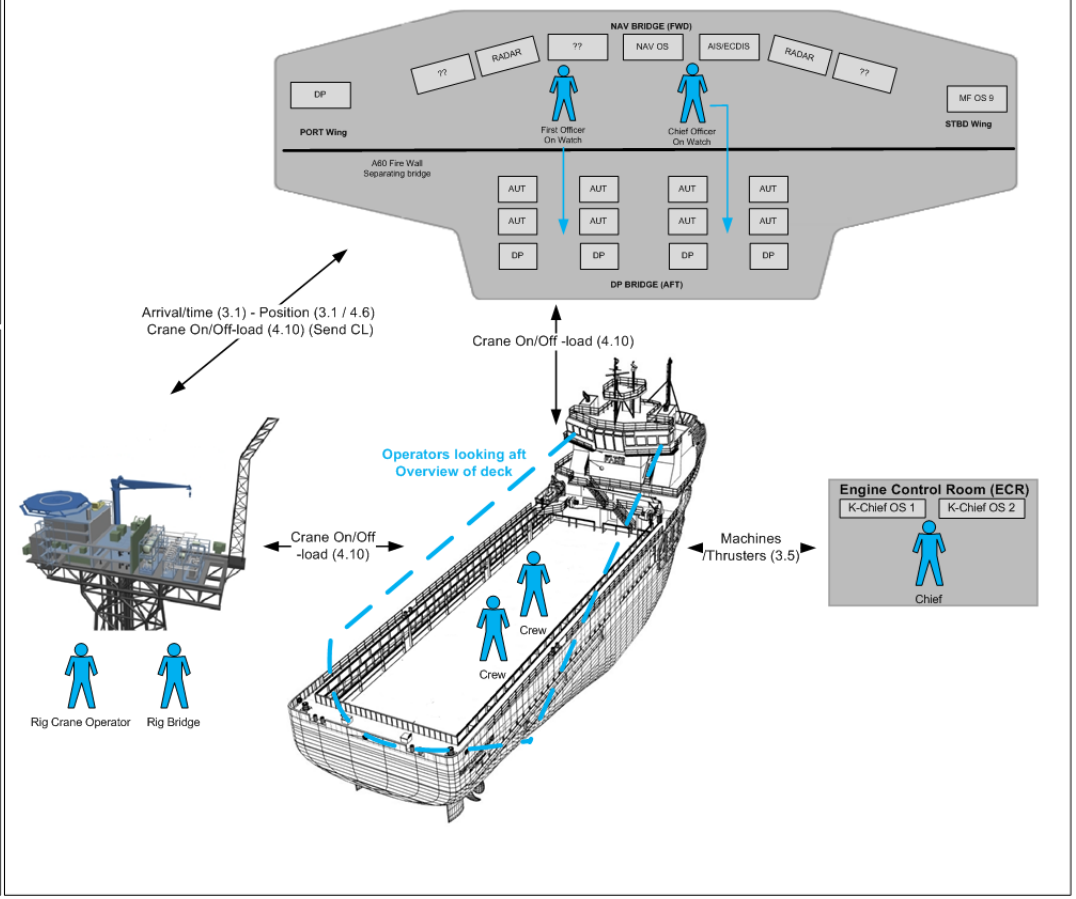
System of Interest Operation: Load/Transport Containers



Operation flow Focus: 3 Transit Mode – 4/5 Operation Mode

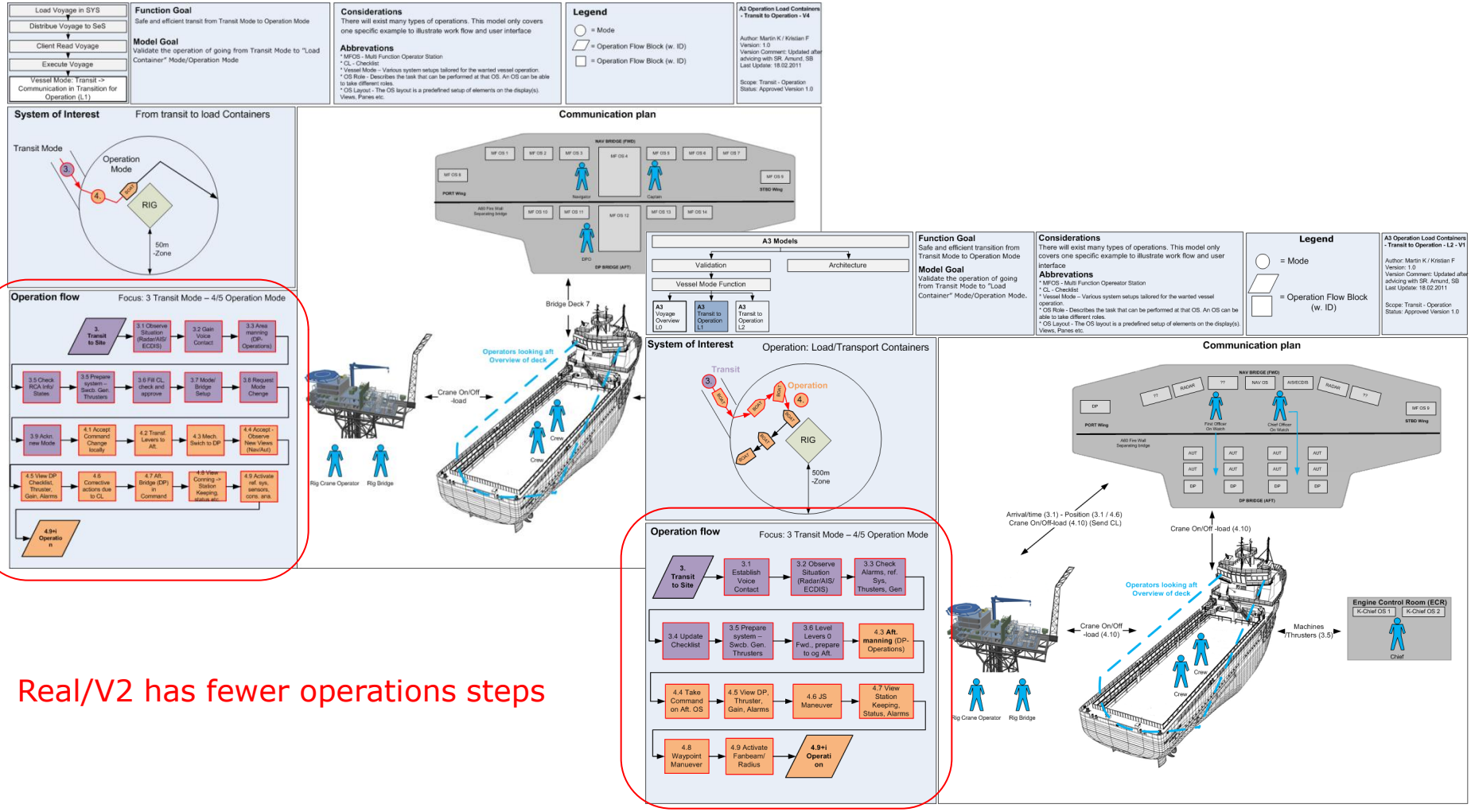


Communication plan



Before (internal) and After (external)

KONGSBERG



Real/V2 has fewer operations steps

Iteraction/Screen pictures – Version 1

Load Voyage in SYS
↓
Distribue Voyage to SeS
↓
Client Read Voyage
↓
Execute Voyage
↓
Vessel Mode: Transit -> Operation (L2)

Function Goal
Safe and efficient transition from Transit Mode to Operation Mode

Model Goal
Validate the operation of going from Transit Mode to "Load Container" Mode/Operation Mode.

Considerations
There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interface

Abbrevations
* MFOS - Multi Function Opereator Station
* CL - Checklist
* Vessel Mode – Various system setups tailored for the wanted vessel operation.
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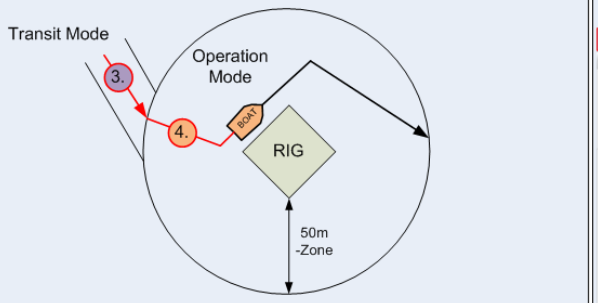
Legend
◯ = Mode
▱ = Operation Flow Block (w. ID)
□ = Operation Flow Block (w. ID)

A3 Operation Load Containers - Transit to Operation - L2 - V1

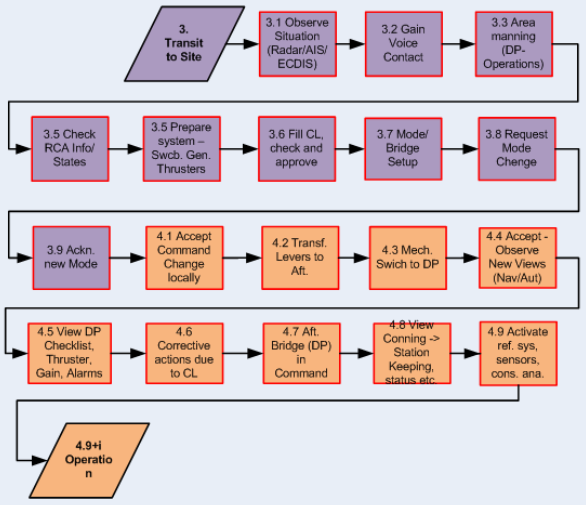
Author: Martin K / Kristian F
Version: 1.0
Version Comment: Updated MFOS screen view page to correlate with flow model
Last Update: 18.02.2011

Scope: Transit - Operation
Status: Approved V 1.0

System of Interest Operation: Load/Transport Containers

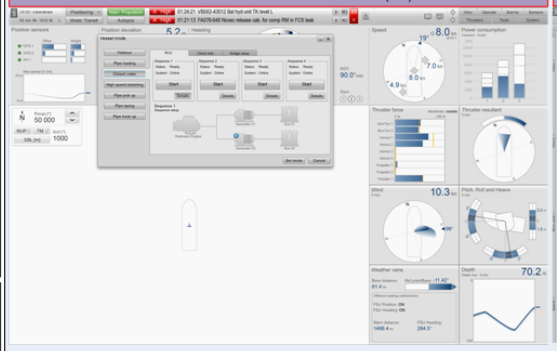


Operation flow Focus: 3 Tranist Mode – 4/5 Operation Mode

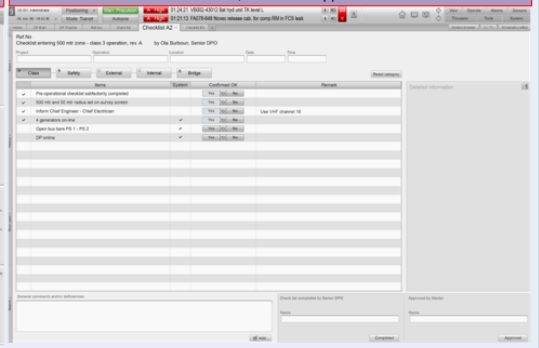


Screenshots from the MFOS screens

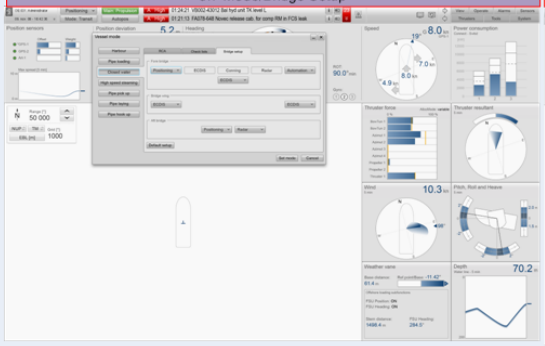
3.5 Check Measurements and States (CL)



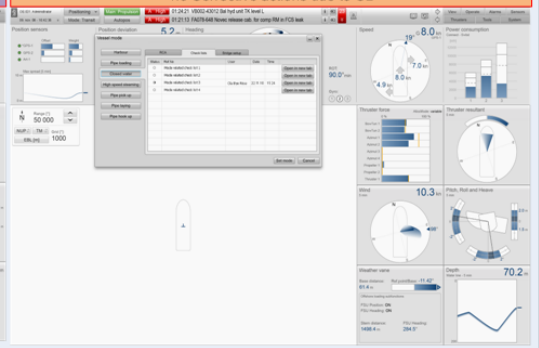
3.6 Fill CL, check and approve



3.7 Mode/Bridge Setup

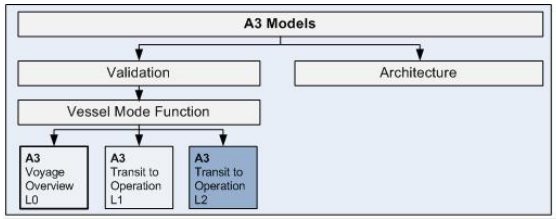


4.6 Corrective actions due to CL



 THE FULL PICTURE

Iteraction/Screen pictures – Version 2



Function Goal
Safe and efficient transition from Transit Mode to Operation Mode

Model Goal
Validate the operation of going from Transit Mode to "Load Container" Mode/Operation Mode.

Considerations
There will exist many types of operations. This model only covers one specific example to illustrate work flow and user interface

Abbrevations
* MFOS - Multi Function Opereator Station
* CL - Checklist
* Vessel Mode – Various system setups tailored for the wanted vessel operation.
* OS Role - Describes the task that can be performed at that OS. An OS can be able to take different roles.
* OS Layout - The OS layout is a predefined setup of elements on the display(s). Views, Panes etc.

Legend
= Mode
= Operation Flow Block (w. ID)

A3 Operation Load Containers - Transit to Operation - L2 - V1

Author: Martin K / Kristian F
Version: 1.0
Version Comment: NA
Last Update: 18.02.2011

Scope: Transit - Operation
Status: Approved V 1.0

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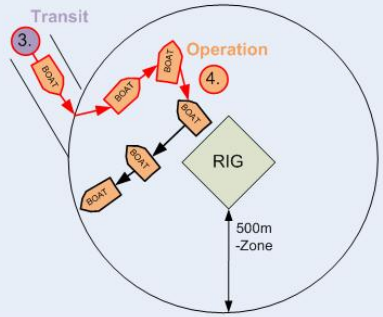
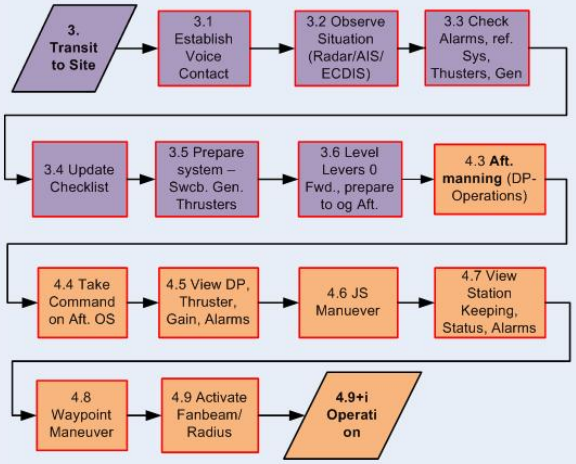
System of Interest Operation: Load/Transport Containers



Operation flow Focus: 3 Tranist Mode – 4/5 Operation Mode



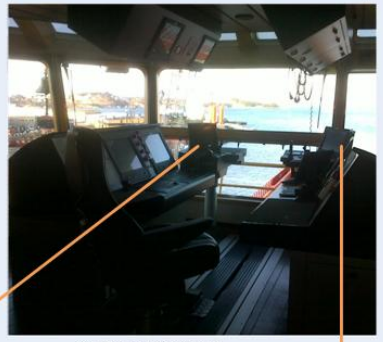
Observations from Viking Energy

Tranist - Fwd. Bridge

Transit/Navigation
This picture shows parts of the Fwd. Bridge at Viking Energy, when the Ship is in transit this is from where the Ship is controlled, usually Autopilot, but also Thruster Control. Circled screen shows the "Navigation OS"/DP-OS used. This position is also used for radio communication

Transit/Navigation
Operators also focused on 2x radar screens w/ different resolution. All control exept route mgmt done from DP-OS.

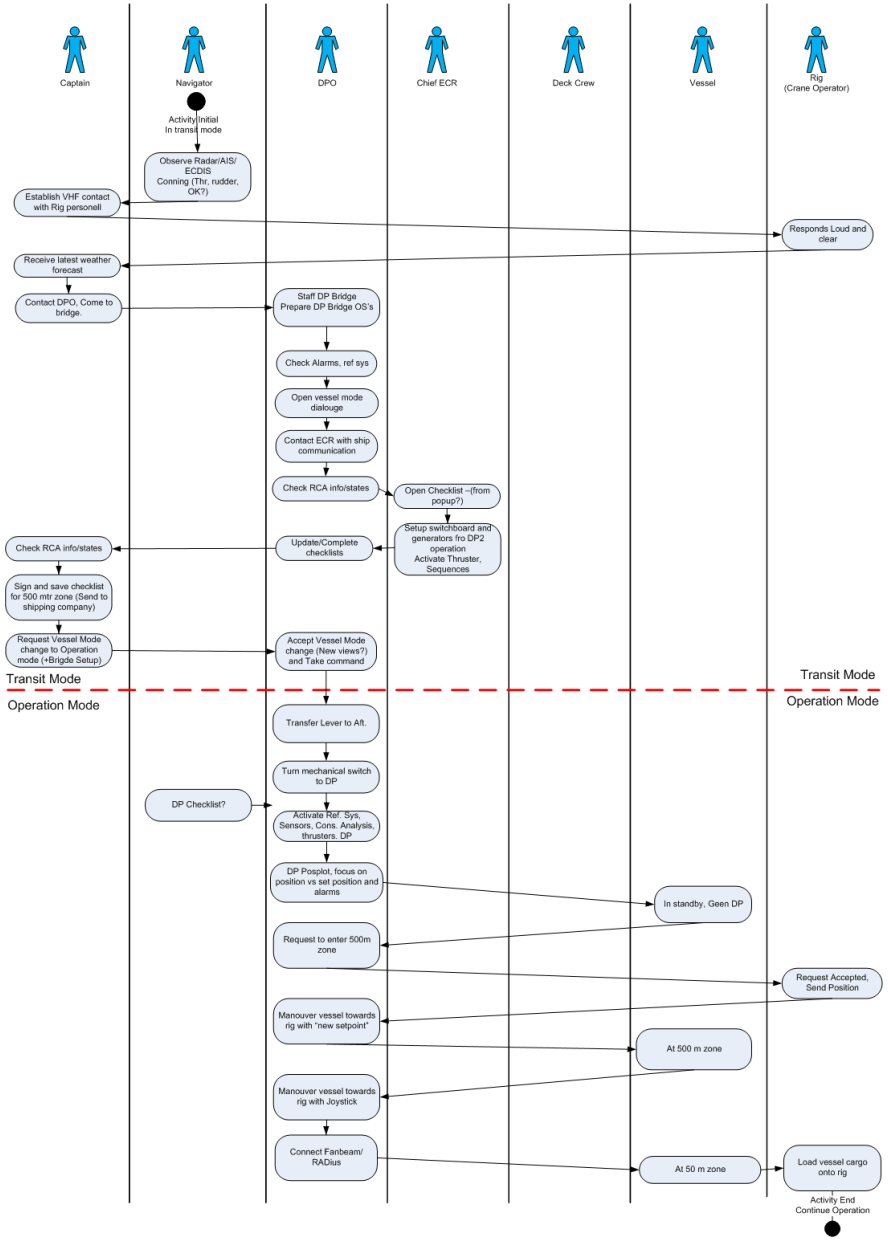
Operation - Aft. Bridge

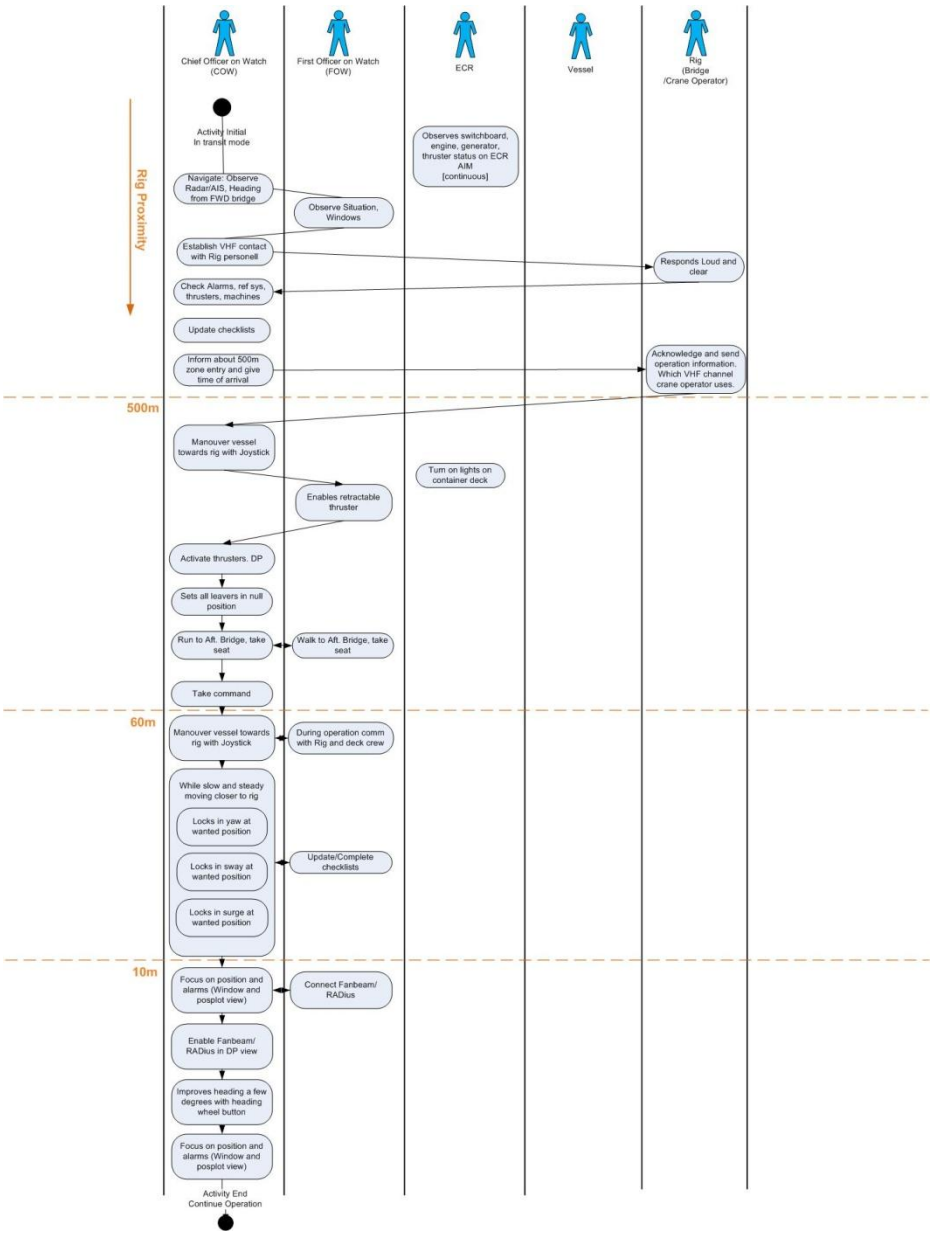


Aft. Bridge Chair (x2)
This picture shows left Aft. Bridge Control position, when operators are going from Transit to Operation these positions are manned, And

Aft. Bridge Screens (During Operations) Picture 1 and 2: Left and Right DP view. This was the same at all times. Additional observations: Wind Sensor Display, CCTV View. At this point both Operator seats in each chair with same set-up. Fwd. Bridge Unmanned. MRU Roll View

 THE FULL PICTURE





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Findings - Result

Findings

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- Too little knowledge about the function and why it existed within the project
- We found that the market situation, and the story the project was based on was not in the optimal market
- Many new and improved requirements was collected and reported
- We were able to document and agree on important statements like needs, key drivers and market

Findings

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- Easy and fast method to collect, document and share information from peoples head
- Everybody was able to work with the same tool
  - Different focus
  - Cross fertilization
- Developing the function through common understanding/agreement
- People will have to consider the operational view and not only the technical perspective

Findings

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- Low effort training and implementation costs
- Bridges development with sales and marketing, and experienced operators (internal + external)
- A fact based starting point. Easy to go back and see why this was done (easy to forget between the battles)
- The process has built up a standard/template for how we effectively can proceed with this in the future
- The stakeholders saw advantages of model based communication

Findings

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- Easy to provide feedback
- Broader involvement of stakeholders
- Increased discussions and communication with A3 reports
- Gives the developers a clearer picture of what to make, a good overview of the function
- Piece of the puzzle
- Can be other ways to fail an early validation

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Thank you for your time!