Abstract

Architecting is an activity that each organizational entity has to apply recursively. This presentation briefly introduces architecting, and then steps through various levels of architecting in an offshore example. The purpose is to show the change of perspective when going from level to level.
introduction to architecting

case

operator control

vessel data

control of

position

thrusters

orientation

and other

v a

actuators

dynamic

positioning

vessel

dynamic

characterization

configuration

offshore support

vessel

anchor handling

field development

thruster

propulsion

systems architecting

From Thruster to Field; an Architecting Example
Gerrit Muller

version: 0
March 31, 2019
From Thruster to Field; an Architecting Example

Gerrit Muller

version: 0
March 31, 2019
FTTFlogointro
Parts, Dynamics, Characteristics

parts characteristics dynamics interact results in prime interest of organization prime interest of customer prime system responsibility

dynamics functionality

parts prime interest of organization
From Thruster to Field; an Architecting Example

Gerrit Muller

version: 0
March 31, 2019
SPFengineering
Partitioning is Applied Recursively
the part is cohesive

  functionality and technology belongs together

the coupling with other parts is minimal

  minimize interfaces

the part is selfsustained for production and qualification

  can be in conflict with cost or space requirements

clear ownership of part

  e.g. one department or supplier
Decoupling via Interfaces

From Thruster to Field; an Architecting Example

version: 0
March 31, 2019
System is composed

by using standard interfaces

limited catalogue of variants (e.g. cost performance points)
Overview of Visualizations of Dynamic Behavior

Information Transformation Flow

Timeline and Functional Flow

Signal Waveforms

Concrete “Cartoon” Workflow

Abstract Workflow

Flow of Light

Timeline of Workflow

Swimming Lanes

Concurrency and Interaction

State Diagram

From Thruster to Field; an Architecting Example

Gerrit Muller
Example Functional Model of Information Flow

1. Get sensor data
2. Transform into image
3. Fuse sensor images
4. Detect objects
5. Classify objects
6. Update world model
7. Get external data
8. Analyze situation
9. Get goal trajectory
10. Determine next step

- Get GPS data
  - Calculate GPS location
  - Update location
- Get v, a
  - Estimate location
- Update location
- Objects
- Location
- World model
"Cartoon" Workflow

From Thruster to Field; an Architecting Example
14  Gerrit Muller

version: 0  March 31, 2019
SSMtypicalWorkoverOperationCartoon
Workflow as Functional Model

1. assembly, functional test
2. run EDP/LRP
3. run risers
4. hook up SFT and TF
5. move above well
6. ROV assisted connect
7. hook up coil tubing and wireline BOP
8. system function and connection seal test
9. run coil tubing and wireline
10. perform workover operations
11. retrieve coil tubing and wireline BOP
12. retrieve SFT and TF
13. move away from well
14. unhook coil tubing and wireline BOP
15. ROV assisted disconnect
16. move above well
17. retrieve risers
18. retrieve EDP/LRP
19. disassembly

From Thruster to Field; an Architecting Example

version: 0
March 31, 2019
SSMTypicalWorkoverOperation
Workflow as Timeline

assumptions:
running and retrieving risers: 50m/hr
running and retrieving coiled tubing/wireline: 100m/hr
depth: 300m
Swimming Lane Example

- clean wafer
- robot
- prealign
- clean master
- prefill
- print

0 100b 200b
Example Signal Waveforms

imaging = repeating similar pattern many times

G_y=0

G_y=127

typical TE: 5..50ms

transmit

receive

From Thruster to Field; an Architecting Example
Example State Diagram

idle

start

operating

event

reset

pre-alarm mode

acknowledge

alarm handled

alarm mode
Quantification

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>$2.4m \times 0.7m \times 1.3m$</td>
</tr>
<tr>
<td>Weight</td>
<td>1450 Kg</td>
</tr>
<tr>
<td>Cost</td>
<td>30000 NoK</td>
</tr>
<tr>
<td>Reliability</td>
<td>MTBF 4000 hr</td>
</tr>
<tr>
<td>Throughput</td>
<td>3000 l/hr</td>
</tr>
<tr>
<td>Response time</td>
<td>0.1 s</td>
</tr>
<tr>
<td>Accuracy</td>
<td>+/- 0.1%</td>
</tr>
</tbody>
</table>

many characteristics of a system, function or part can be quantified

Note that quantities have a unit
Architecting = considering parts and dynamic behavior and quantified characteristics. Dynamic behavior is the core of understanding; unfortunately it is often missing. Quantification makes issues specific and tangible; it can be scary 😞.
The Case: Anchor Handling in Field Development

introduction to architecting

case

dynamic positioning

offshore support vessel

anchor handling

field development

systems architecting

From Thruster to Field; an Architecting Example

version: 0
March 31, 2019

FTTFlogoCase
Our Case: Offshore subsea Field Development

Courtesy FMC Technologies [CC BY 3.0 (https://creativecommons.org/licenses/by/3.0)]
Mission: Anchor the Platform
### Worksheet: Note 3..5 Main Functions and KPPs per Level

<table>
<thead>
<tr>
<th>main functions</th>
<th>key performance parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>thruster</td>
<td></td>
</tr>
<tr>
<td>propulsion</td>
<td></td>
</tr>
<tr>
<td>dynamic positioning</td>
<td></td>
</tr>
<tr>
<td>offshore support vessel</td>
<td></td>
</tr>
<tr>
<td>anchor handling</td>
<td></td>
</tr>
<tr>
<td>field development</td>
<td></td>
</tr>
</tbody>
</table>
introduction to architecting

From Thruster to Field; an Architecting Example

version: 0
March 31, 2019
What are the 3 to 5 Main Functions of the thruster?

What are the 3 to 5 Key Performance Parameters of the thruster?
From Thruster to Field; an Architecting Example

version: 0
March 31, 2019

From Thruster to Field; an Architecting Example

Gerrit Muller
What are the 3 to 5 **Main Functions** of the propulsion system?

What are the 3 to 5 **Key Performance Parameters** of the propulsion system?
Dynamic Positioning

introduction to architecting

case

dynamic positioning

From Thruster to Field; an Architecting Example
32 Gerrit Muller
Dynamic Positioning Input-Process-Output

operator control

vessel data
position
orientation
\( v, a \)

dynamic Positioning

control of thrusters and other actuators

vessel characterization
configuration
<table>
<thead>
<tr>
<th>What are the 3 to 5 <em>Main Functions</em> of dynamic positioning?</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the 3 to 5 <em>Key Performance Parameters</em> of dynamic positioning?</td>
</tr>
</tbody>
</table>
Offshore Supply Vessel

Introduction to architecting

Case

Vessel data position orientation
Dynamic Positioning
Vessel characterization configuration
Control of thrusters and other actuators
Operator control

Dynamic positioning

Offshore support vessel

Anchor handling

Field development

Systems architecting

From Thruster to Field; an Architecting Example
35  Gerrit Muller

version: 0
March 31, 2019
FTTFlogoVessel
What are the 3 to 5 **Main Functions** of the vessel?

What are the 3 to 5 **Key Performance Parameters** of the vessel?
introduction to architecting

---

From Thruster to Field; an Architecting Example
38  Gerrit Muller
Anchor Handling Workflow (Where)

From Thruster to Field; an Architecting Example
Gerrit Muller

version: 0
March 31, 2019
FTTFanchorHandling

from: master project papers
Ola Gustav Kalager
and Håvard Ruden, 2009

2 to 8 anchors
<table>
<thead>
<tr>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Functions of anchor handling?</strong></td>
</tr>
<tr>
<td><strong>Key Performance Parameters of anchor handling?</strong></td>
</tr>
</tbody>
</table>
WorkFlow of Anchor Handling (What, When)

1. Operation planning 4.5 hours
2. Trip to site 3 hours
3. Secure zone approval 15 min
4. Get in position 30 min
5. Secure anchor 2 hours

6. Transport anchor to drop point 2 hours
7. Lower anchor to seabed 30 min
8a. Return slide ring to rig 2 hours
8b. Deploy anchor buoy 1 hour

1.1 Read through procedure 15 min.
1.2 Meeting with customer 1 hour
1.3 Collect equipment 3 hours
1.4 Place equipment 1.5 hours
1.5 Input wire data 15 min
1.6 Make risk assessment 30 min

5.1 Contact rig crane handler 5 min
5.2 Receive wire from crane 20 min
5.3 Connect wire to winch 15 min
5.4 Increase distance from rig, 40 min
5.5 Activate Auto heading 2 min
5.6 Get anchor on deck 40 min

from: master project paper Håvard Ruden, 2009
Control from Operator Stations

from: master project paper Håvard Ruden, 2009
Work Breakdown Anchor Handling

Dynamic Positioning department
Automation department
Navigation department
Training department
Documentation department

Anchor handling system

from: master project paper Håvard Ruden, 2009
Field Development

Introduction to architecting

Case

- Thruster
- Propulsion
- Dynamic positioning
- Offshore support vessel
- Anchor handling

Systems architecting

From Thruster to Field; an Architecting Example

version: 0
March 31, 2019
Courtesy FMC Technologies [CC BY 3.0 (https://creativecommons.org/licenses/by/3.0)]
What are the 3 to 5 **Main Functions** of field development?

What are the 3 to 5 **Key Performance Parameters** of field development?
DP Architecting: ca. 8 Orders Zoom in-out

field development
anchor handling
offshore support vessel
dynamic positioning
propulsion
thruster
concepts
design
technologies

3..5 key performance parameters or characteristics and functions per level
iterate

From Thruster to Field; an Architecting Example
Gerrit Muller
A good designer zooms at least 1 step in and out.

A good architect zooms at least 3 steps in and out.

All designers and architects need to consider:

- Parts (static)
- Dynamic behavior (functionality)
- Quality attributes (performance parameters, quantification)

From Thruster to Field; an Architecting Example
Gerrit Muller