26th annual INCOSE international symposium
Edinburgh, UK
July 18 - 21, 2016

Evaluating the effectiveness and effort in applying a Requirements Management Tool on a Subsea Oil and Gas Workover System

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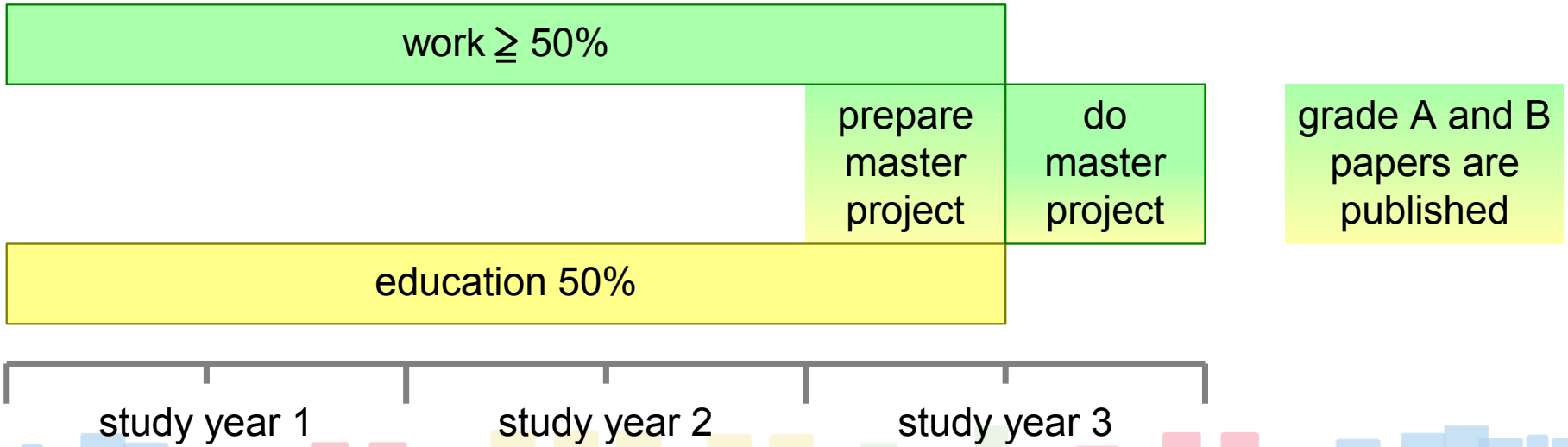
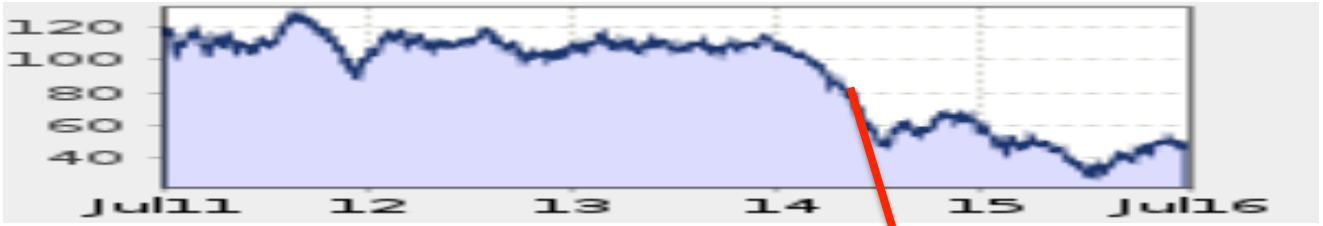
students know:
+ domain
+ SE methods and techniques

students:
+ apply
+ reflect
+ evaluate



Context: Low oil prices hit Norway hard.



oil price

From oil-price.net

Norwegian Unemployment rate

Content

1) Goal

2) Approach and Rationale

3) Subsea Workover System requirements

4) Workings and Implementing Requirements Management System

5) Findings and Discussions

6) Conclusion and Future work

7) Questions and Answers

Motivation

FMC Technologies (FMC) is currently developing and implementing a Requirements Management System (RMS) on projects in the Company.

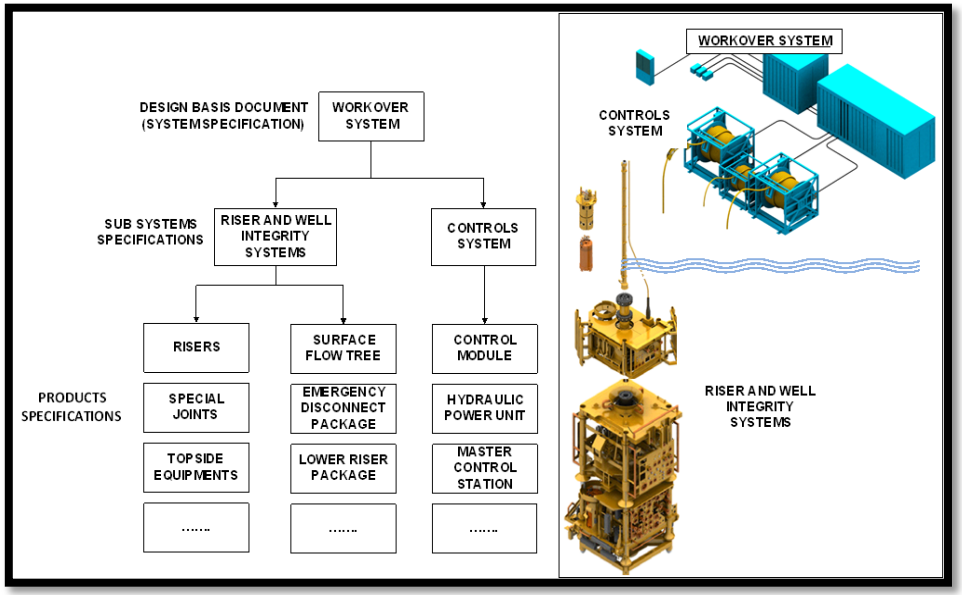
There are currently no solutions to capture or manage requirements. High risks of requirements being miss out or mis-interpretated, cost overrun and schedule delayed in projects.

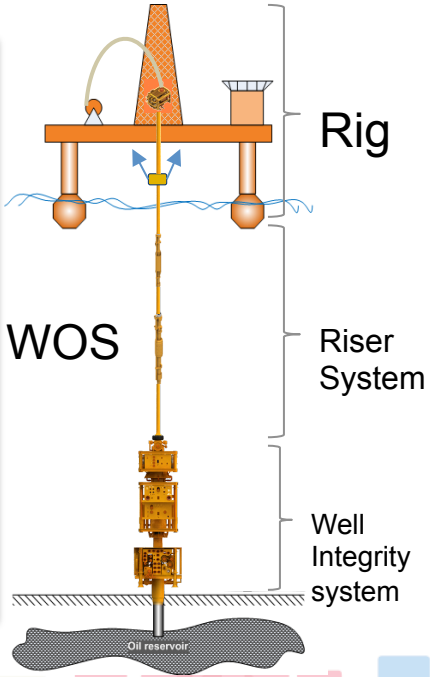
Goal and Research Question:

How effective is the RMS in managing Subsea Workover Systems (WOS) requirements and what is the amount of effort required to implement the RMS in FMC Technologies?

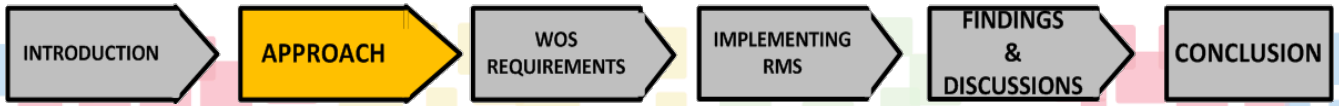
Subsea Workover System (WOS)

System to provide well control and access for production and intervention operations on subsea oil and gas wells





Approach and Rationale



Requirements Management System on WOS requirements

Effort

Effectiveness

Research WOS requirements

Changes and Root causes

Apply RMS for WOS requirements in an ongoing project

Measurement of effort (hours) to use RMS

Peer Review Assessment

Industry standards Assessment

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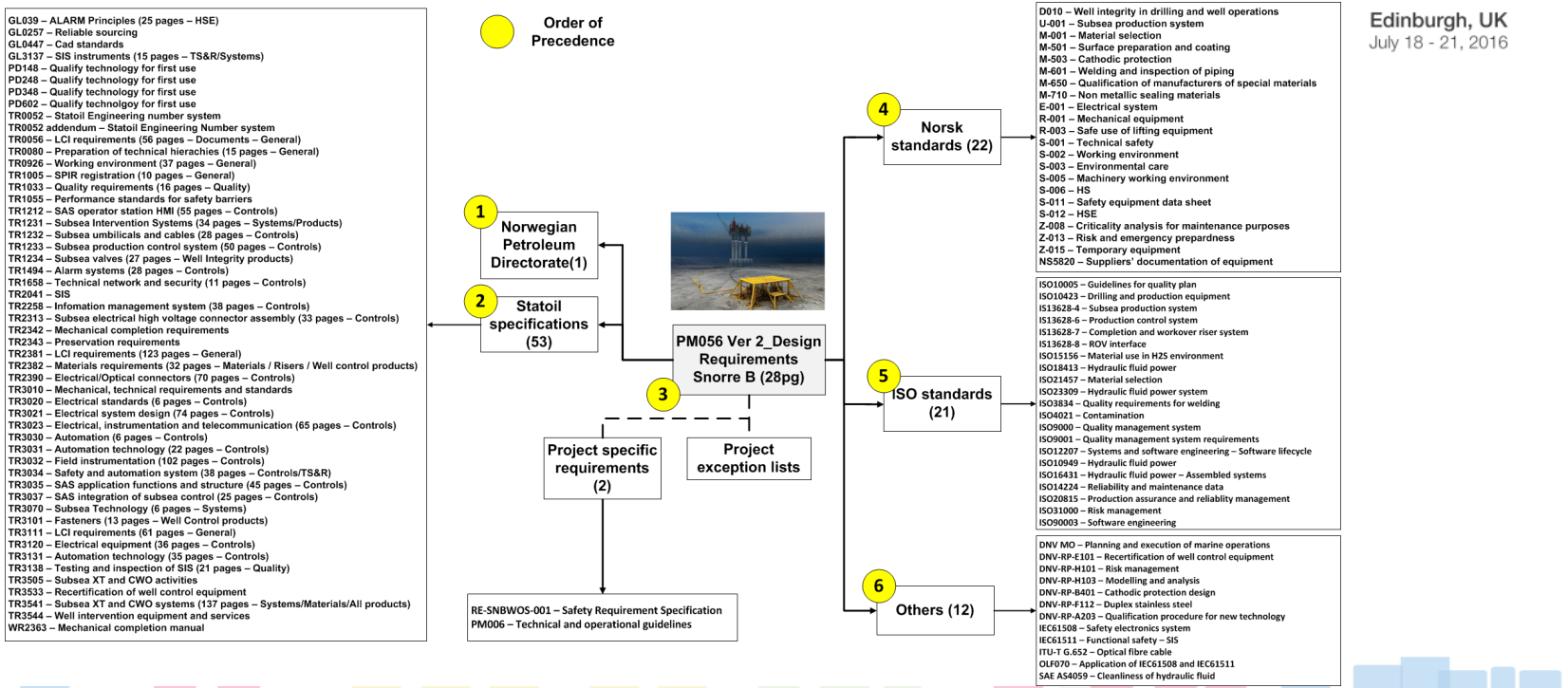
WOS requirements – Key Challenges

3) Overview of requirements – Snorre B

112 documents!

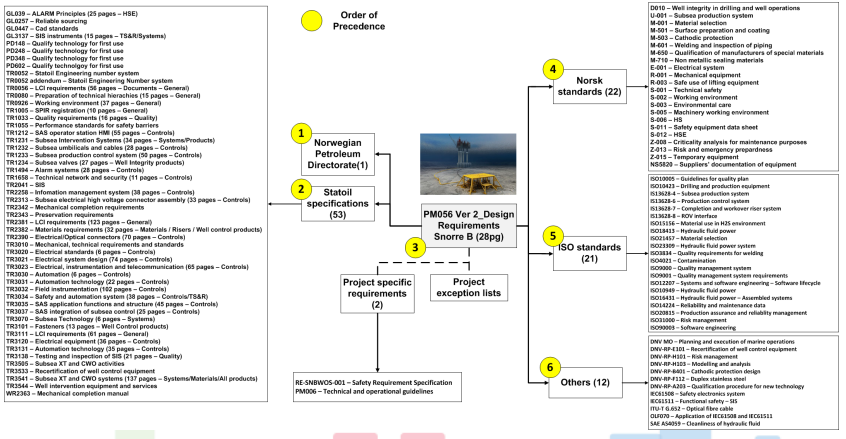


WOS requirements key challenges – Numerous requirements

Requirement

The Snorre B WOS functional design requirements shall be read in conjunction with TR3541, ISO13628-7, Snorre B TORG Document, Snorre B Contract Appendixes, Statoil Governing documents (TR documents), relevant international standards and PSA regulations

112 documents!

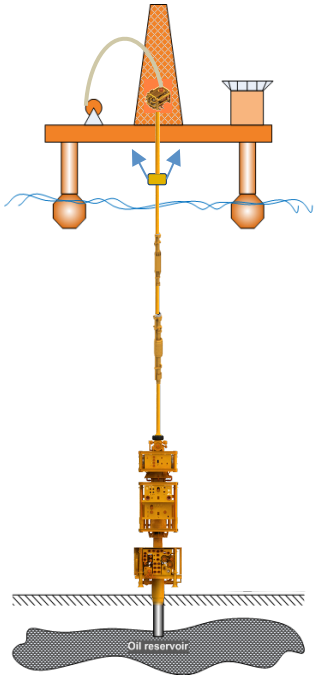


WOS requirements key challenges – Unknown operating conditions

- ***Requirement***

  Two rigs may be used for drilling and completions, with unknown requirements for future rigs.

  - ➢ Lack of information regarding type of rigs to be used



WOS requirements key challenges - Dependencies

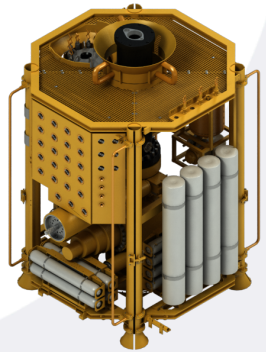
- ***Requirement***

  - The Well Control Package shall have a maximum weight of 40 metric tonnes to allow for handling on the chosen rig.

  - The production isolation valve on the Well Control Package shall be able to cut and seal 2.5in OD, 105ksi YS coil tubing in 10s

  Requirement for disconnect time will affect the size of accumulation on the Well Control Package. This will in turn affect the weight of the Well Control Package. This is usually only verified with hydraulic analysis during detail design phase

How can RMS help to tackle these 3 main challenges for WOS requirements?



Well Control Package

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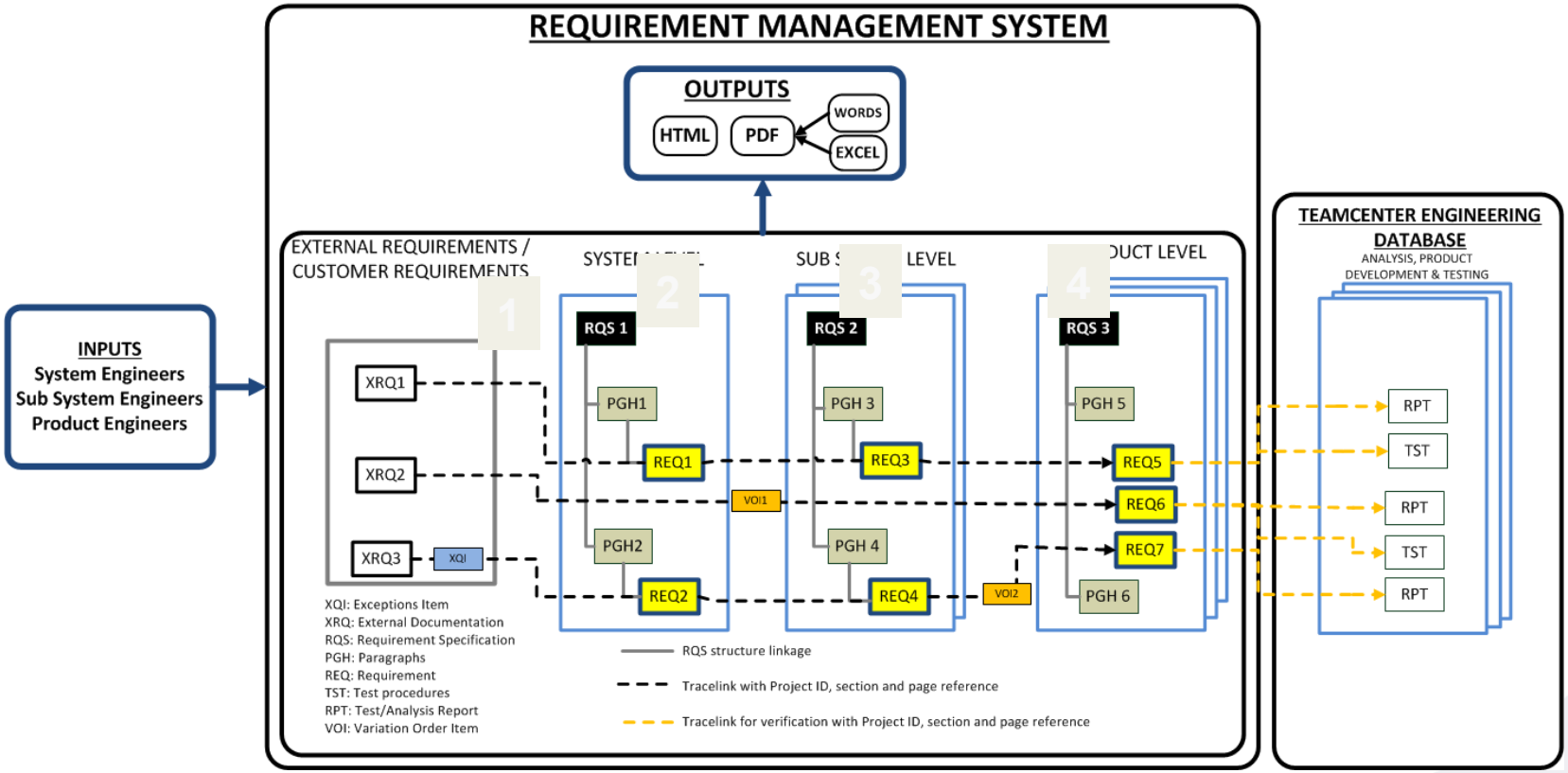
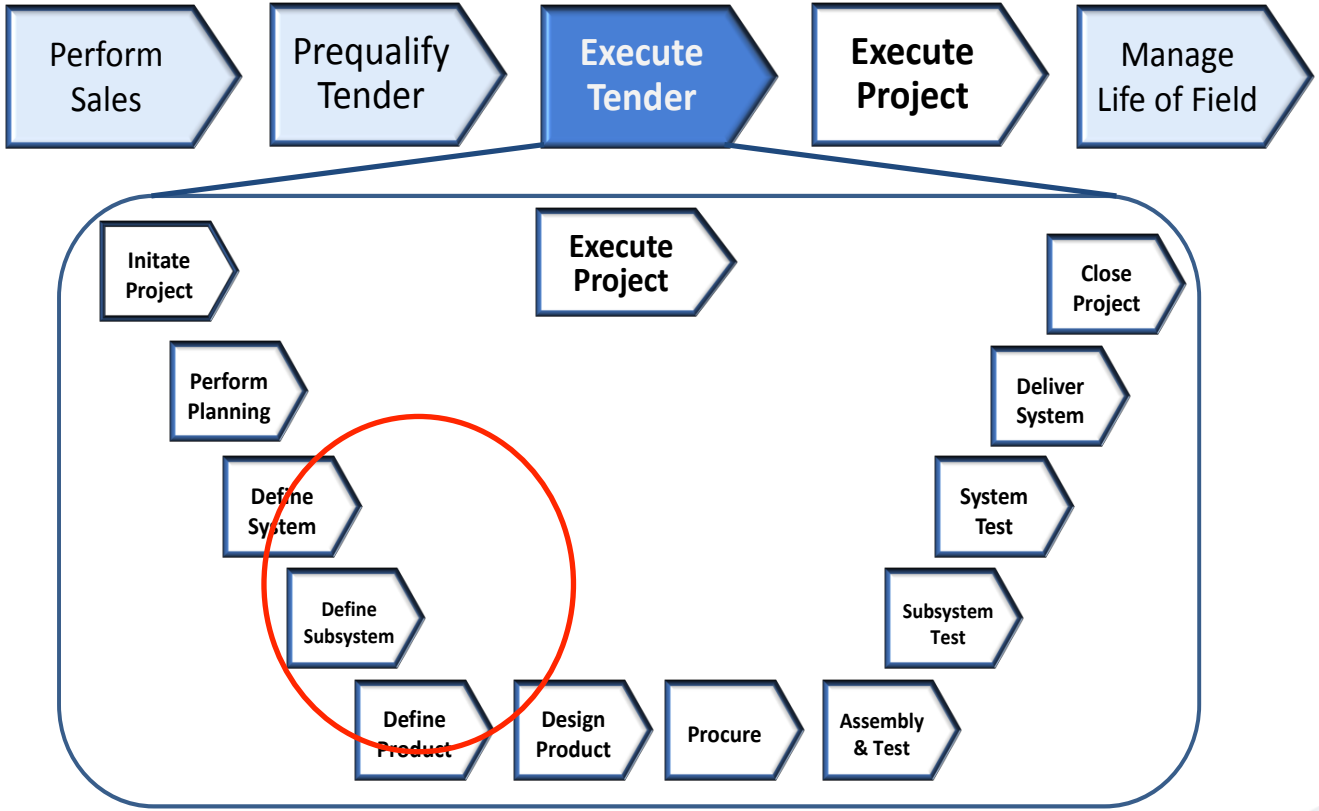
Implementing RMS

4) Implementing RMS

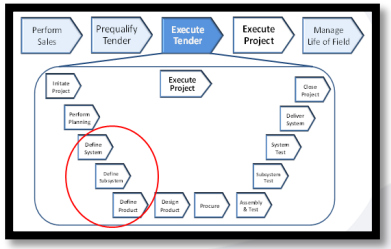


4) Implementing RMS Business Process Management System

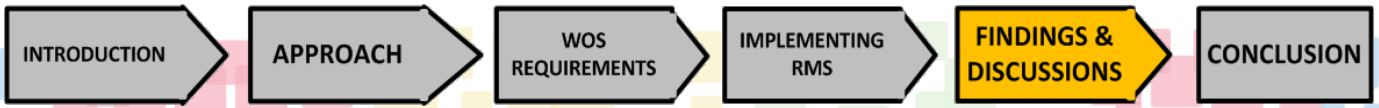


4) Implementing RMS

S/No	Title	Requirement Specification number	Specification number	No. of requirements
1	Snorre B System Specification	RQS80010128	SPC60108714	78
2	Snorre B Subsystem Specification	RQS80010137	SPC60108743	190
3	Snorre B Riser Product Specification	RQS80010163	SPC60108994	82
4	Subsystem Master Template	RQS80010181	SPC60108882	249



Findings and discussions



Effort required to use RMS

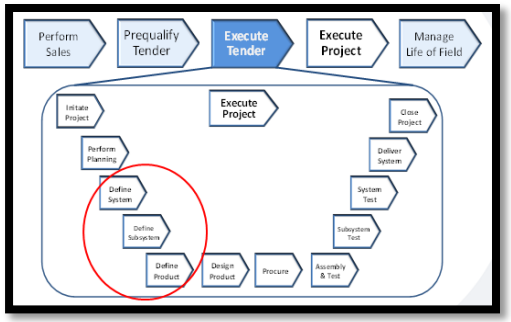
S/No	Title	Requirement Specification Number	Specification Number	No. of requirements	Time taken(hrs) (includes review and formatting)
1	Snorre B System Specification	RQS80010128	SPC60108714	78	**35**
2	Snorre B Subsystem Specification	RQS80010137	SPC60108743	190	**80**
3	Snorre B Riser Product Specification	RQS80010163	SPC60108994	82	**50**
4	Subsystem Master Template	RQS80010181	SPC60108882	249	**50**

$$t_{RQS} = t_{training} + (N_{REQ} * t_{REQ})$$

t_{RQS} - Time taken to generate requirements specification
$t_{training}$ - Time taken to train personnel to use RMS
N_{REQ} - Number of requirements
t_{REQ} - Time taken to generate each requirement

Effort required to use RMS

Execution stage	Estimated average number of requirements/document	Total Hours (hrs)	No. of documents	Remarks
Perform Sales	100	>80	>10	Feedback from RMS developers
Execute Tender	80	15 to 25	1	Extrapolate from research
Define System	80	25 to 35	1	Research and partial extrapolate
Define Subsystem	190	120 to 160	2	Extrapolate from research
Define Product	90	2000	50	Extrapolate from research
Assembly & Test	To be determined	To be determined	50	To be determined
Subsystem test	To be determined	To be determined	2	To be determined
System Test	To be determined	To be determined	1	To be determined
Deliver system	To be determined	To be determined	>3	To be determined
Operation of system (Change management)	To be determined	To be determined	>3	To be determined
	Assumed hours			
	Research hours			



Discussions - Peer Review

Advantages

+ Enable focus on requirements
+ Good platform for storing and reviewing requirements, creating a good environment for writing SMART* requirements
+ Aid in impact analysis during change management process

Concerns

− Unknown amount of hours use on the RMS throughout project lifecycle
− Unclear roles and responsibilities
− Insufficient experienced personnel to review and approve the RQSs

*SMART – Specific, Measurable, Attainable, Realistic, Timely

Discussions – Industry Assessment (ISO/IEC 24766)

S/NO	Requirements	Definition	Rating(RMS)	Rating(Current method)
1	**Elicitation**	How effective is the RMS in seeking, uncovering, acquiring and elaborating requirements?	11/24	0/24
2	**Analysis**	Does the RMS allow for decomposition of high level requirements into details, evaluating feasibility, analyzing overlaps or conflicts between requirements, and negotiating priorities?	3/20	0/20
3	**Modeling**	Does the RMS has the ability to provide features for the physical, functional and performance modelling of the system?	0/8	0/8
4	Specification	Does the RMS allow for documenting the requirements in a consistent and reviewable way?	6/8	0/8
5	Verification and Validation	Does the RMS supports the Verification and Validation of requirements (ensuring the system is built to the correct requirements) and Validation	5/8	0/8
6	Management	Does the RMS has the ability to support the monitoring of changes and maintenance of requirements, ensuring that the requirements accurately reflect the product?	11/16	7/16
7	Traceability	Does the RMS has the ability to document the life of a requirement, providing linkage mechanism between associated requirements and tracking changes made to each requirement?	11/24	0/24
8	User friendliness	Is the RMS simple to comprehend and control? Even for non-users of the system?	8/12	5/12
9	Support and Maintenance	Does the RMS allow for multiple users licenses to be used in different projects? The system shall not be overly costly to maintain and support for the system shall be readily available during normal working hours.	5/8	7/8
Total			**60/128**	**19/128**

9 categories, 32 assessment criterias

Points scoring: 0 – Not Useful / 1 – Useful / 2 – Very Useful / 4 – Extremely Useful

Discussions - Industry Assessment

- Industry assessment per ISO/IEC 24766 (Guide for requirements engineering tool capabilities)
- RMS scores 60 out of 128 possible points

S/NO	Requirements	Definition	Rating(RMS)	Rating(Current method)
1	**Elicitation**	How effective is the RMS in seeking, uncovering, acquiring and elaborating requirements?	11/24	0/24
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Total			**60/128**	**19/128**

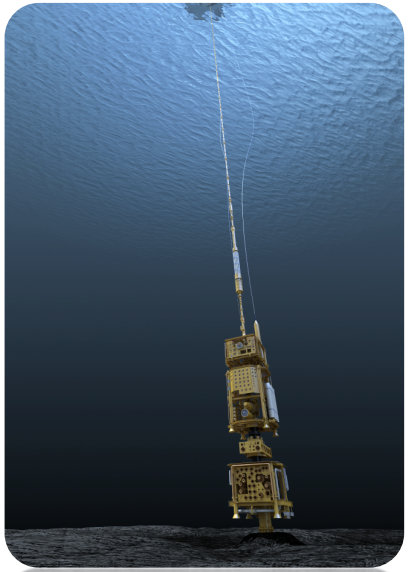
Traceability	**Elicitation**
Specification	**Analysis**
Management	**Modelling**
User Friendliness	

Conclusion

Conclusion

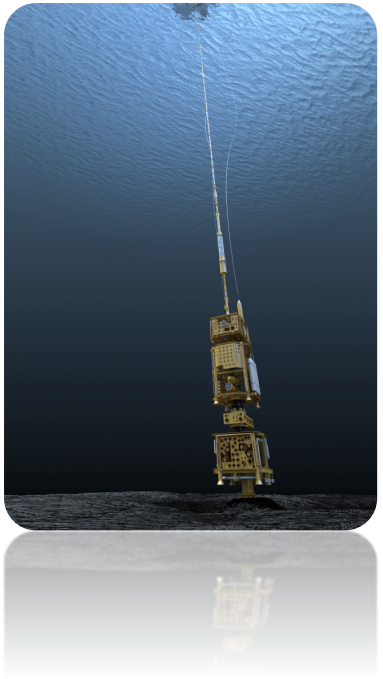
How effective is the RMS in managing Subsea Workover Systems (WOS) requirements and what is the amount of effort required to implement the RMS in FMC?

- Effectiveness
  - Qualitative measurement from peer review (Positive reviews)
  - Quantitative measurement from assessment by industry standards (Score of 60 out of 128)
- Effort
  - Measurement of hours needed to use the RMS through system, subsystem and product lifecycle stages only



Conclusion

- Provides a platform for requirements to be identified and tracelinked to each other
- RMS promotes focus on reviewing and writing SMART requirements, enhances communication with Clients and project team and will help change the mindset of the entire organization towards managing requirements
- Success of the RMS will depend on availability of skilled resources to support this throughout project execution and life of field stages



Future work

- Change mangement module to be tested
- Verification and validation module to be tested
- Quantitative measure of effectiveness of RMS using Price of Non Conformances (PONCs)
- Training hours and time required to process requirements to be determined
- Effectiveness of templates

Execution stage	Estimated average number of requirements/document	Total Hours (hrs)	No. of documents	Remarks
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Execute Tender	80	15 to 25	1	Extrapolate from research
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Questions and Answers