Multiconsult

Experiences from the oil and gas industry

buildingSMART Norge konferanse 2015

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Industrial PhD | Multiconsult - NTNU

20.04.15

Agenda

- Background
- Status and key findings
  - Generalization and adaption of findings from oil and gas to construction industry
  - Processing change with change control system and BIM
  - Relation between milestones, PEM and BIM
- Competition with global (low cost) actors

Øystein Mejlænder-Larsen

Education

- M.Sc. Civil and Environmental Engineering (Building and construction), NTNU (1996-2000)
- Master of Technology Management, NTNU, NHH, MIT (2007-2009)

Work experience

- Selvaag Bluethink (2000-2009)
  Technology Manager
  Development of design applications for industrial housing
- Multiconsult (2009-)
  Technology Manager
  BIM strategy, software coordination, BIM coordinator, project execution methodology

PhD | At a glance

- Title: “Increased efficiency of the building process with the use of BIM, based on experience from the oil and gas industry”
- PhD: 4 years (75% PhD - 25% Multiconsult)
- PhD start: 01.01.2013
  PhD finish: 01.08.2017*
- The PhD is part of the research project "Collaboration in the building process - with BIM as a catalyst" ("Sam-BIM"), Industry partners; Statsbygg, Skanska, Link Arkitektur and Multiconsult. Research partners; NTNU, SINTEF and FAFO.

PhD | Background

- Construction industry has seen an increase in larger and more complex building projects. Would benefit from gathering knowledge on project execution from other relevant industries.

- Oil and gas industry has invested heavily in development of new technology and in managing large and complex projects. The similarities of project execution are many (project phases, actors, management principles, application of technology).

PhD | Background

- Assess how major oil and gas projects are executed, through Kvaerner (EPC contractor). Identify findings that can be adapted to the construction industry and lead to improved efficiency of the building process.

- An important factor to successful management and execution of major oil and gas projects is the use of a **project execution model (PEM)**. This, combined with the utilization of **building information modeling (BIM)** will be the main scope of my research.

PhD | Research design

- Research approach: Qualitative
- Empirical design: Case study
  - 3 case projects in the oil and gas industry (Kvaerner)
    - Edvard Grieg (topside), Eldfisk (topside, jacket), EPC contract (one with engineering on a subcontract), Nyhamna (onshore facilities), EPCM contract, with engineering on a subcontract
  - (Access to case projects in the construction industry (Sam-BIM))
- Data collection method: Interviews/documentation observation
  - Data collection through ongoing projects (cases)
  - Primary data source: interviews with resources in key positions, relevant company/ project documentation
  - Secondary data source: observations (and surveys)
- Data analysis method: SDI
  - Analyze the collected data using the SDI method and develop concepts related to PEM and BIM

PhD | Themes

- **Theme 1: Generalization and adaption of findings between industries**
  - Conference: 8th Nordic Conference on Construction Economics and Organization (May 2015)
  - Journal: Elsevier Procedia Economics and Finance
- **Theme 2: Processing change with change control system and BIM**
  - Conference: CIB W78 (Information Technology for Construction) conference (October 2015)
  - Journal: TBA
- **Theme 3: Relation between project milestones, PEM and BIM**
  - Conference: BIM 2015 (International Conference on BIM in Design, Construction and Operations) (September 2015)
  - Journal: TBA

Theme 1

Generalization and adaption of findings between industries

- Question: How can the building industry adapt findings on project execution from the oil and gas industry?
- Objective: Assess how we can **generalize** findings on **project execution** related to project execution models and model based 3D environment (BIM) from cases and **adapt** these to the **construction industry**
- Paper: "Generalization in case studies and adaptability of concepts in project execution from the oil and gas to the construction industry”

Generalization of findings between industries

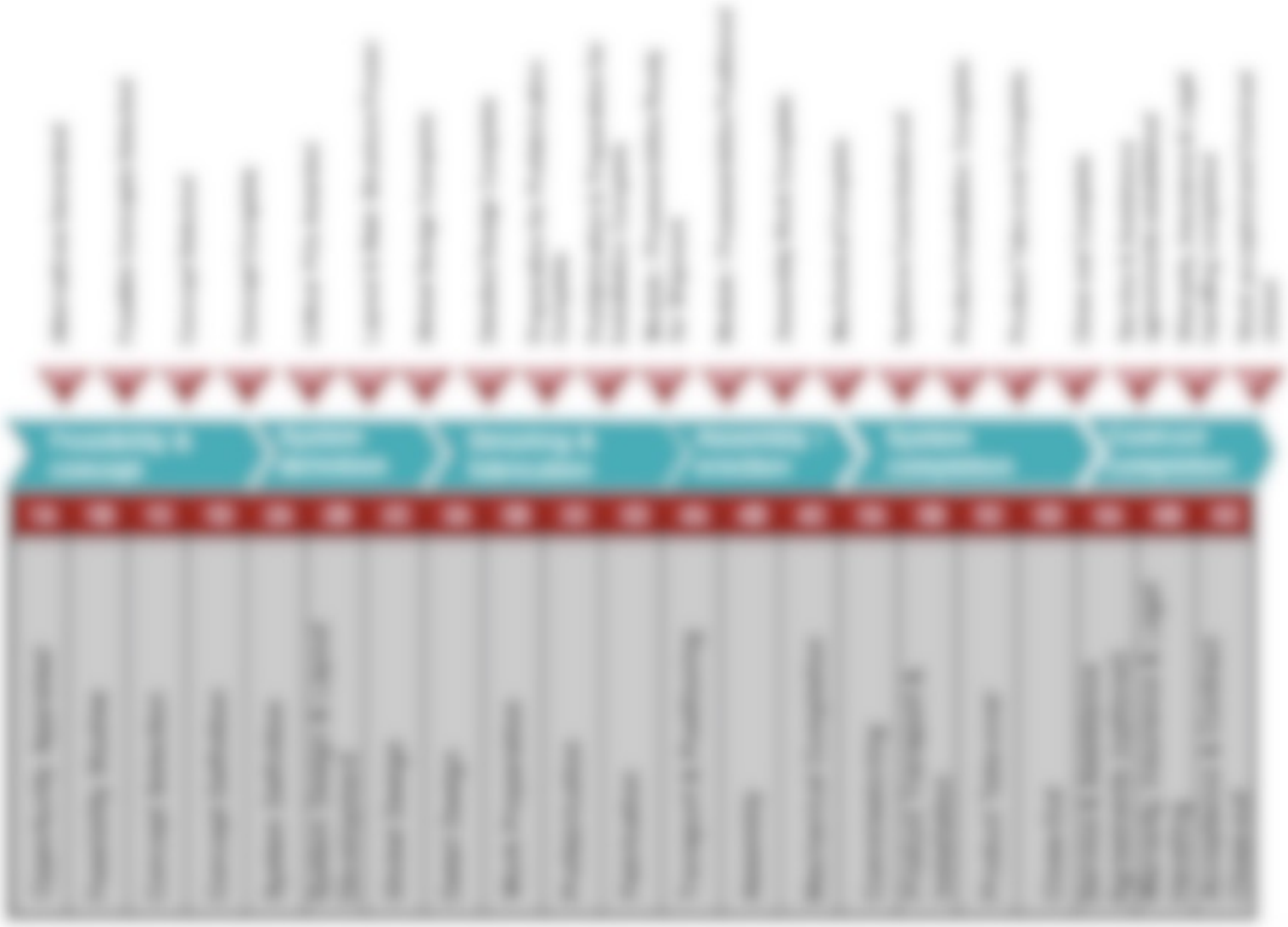
- Hypothesis: the more similar the characteristics of the two industries are, especially on project execution, and the variables related to PEM and BIM, the more likely the possibility is to generalize and transfer findings between these industries.
- Case **projects** have several similarities on a principal level, but the extent of use of PEM and BIM differs.

Similarities in projects

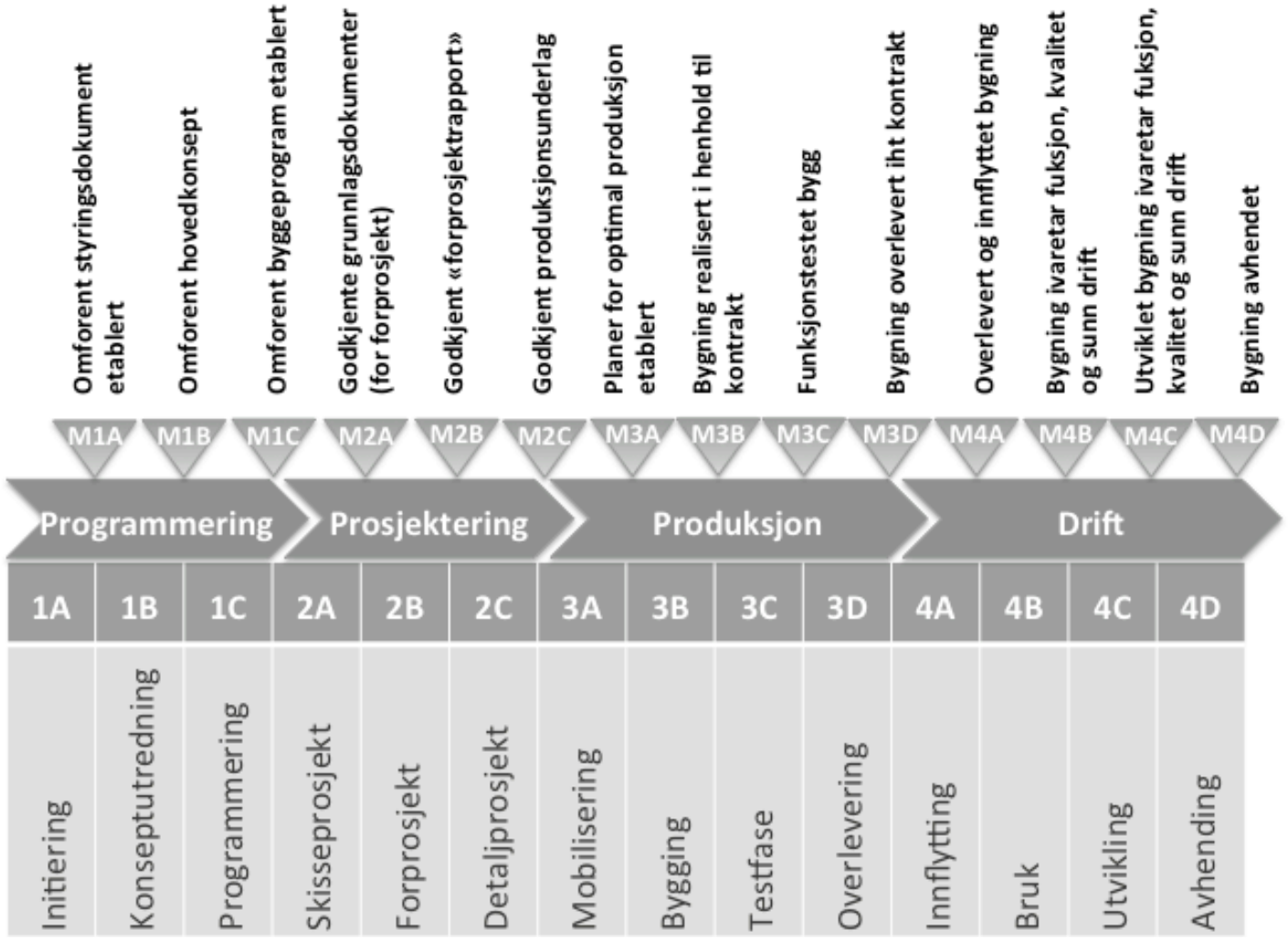
Character-istics	Kvaerner cases	"Sam-BIM" cases	Degree of similarity
Contract	EPC (design-build)	Design-build, design-bid-build	Medium
Project phases	Feasibility & Concept, System Definition, Detailing & Fabrication, Assembly/Erection, System Completion	Strategic Definition, Preparation and Brief, Concept Design, Developed Design, Technical Design, Construction, Handover and Close Out, In Use	Medium
PEM	Strategic, Control, Execution level. Use in all phases.	Not in use (only on a high/ principal level)	Low
BIM	Large size and complexity of BIM and information related to each object. Large number of connected support systems. less information on each object. Connected with unique tag numbers	Smaller size and complexity of BIM. Much information related to each object. No support systems. Unique ID on each object	Low

Kværner contract / delivery models

Project phases (Kværner)



Project phases (“Sam-BIM”)



Generalization of findings between industries

- Hypothesis: the more similar the characteristics of the two industries are, especially on project execution, and the variables related to PEM and BIM, the more likely the possibility is to generalize and transfer findings between these industries.
- Case **projects** have several similarities on a principal level, but the extent of use of PEM and BIM differs.
- The two **industries** are both project-based industries with many of the same stakeholders. Both industries highly depend on a project team with relevant core competences including engineering know-how and technical competence.

Similarities in industries

Character-istics	Oil and gas industry	Construction industry	Degree of similarity
Market	Global	National/Local	Low
Project size	Large projects	Small to medium projects	Low-Medium
Execution	Project based	Project based	High
Stakeholders	Clients, end-users, contractors, suppliers, consultants	Clients, end-users, contractors, suppliers, architects, consultants	High
Project team composition	Engineering know-how and technical competence	Engineering know-how and technical competence	High

Generalization of findings between industries

- Hypothesis: the more similar the characteristics of the two industries are, especially on project execution, and the variables related to PEM and BIM, the more likely the possibility is to generalize and transfer findings between these industries.
- Case **projects** have several similarities on a principal level, but the extent of use of PEM and BIM differs.
- The two **industries** are both project-based industries with many of the same stakeholders. Both industries highly depend on a project team with relevant core competences including engineering know-how and technical competence.
- **PEM** is based on codified knowledge from project execution, which makes it easier to transfer to other organizations and to a certain degree industries.

Kværner | PEM

- A **project execution model (PEM)** is a logic sequence in critical project activities where progress and quality requirements are aligned at significant milestones to ensure predictable project execution. (Kvaerner, 2012)
- Based on the knowledge areas (mainly Project Integration Management knowledge area) defined in PMBOK Guide
- Aker Solutions and Kværner built their PEM based on 30 years of experience in project execution

Generalization of findings between industries

- Hybothesis: the more similar the characteristics of the two industries are, especially on project execution, and the variables related to PEM and BIM, the more likely the possibility is to generalize and transfer findings between these industries.
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- **PEM** is based on codified knowledge from project execution, which makes it easier to transfer to other organizations and to a certain degree industries.
- The use of **BIM** is on a principal level similar, except on model complexity and object information.

Kværner | 3D model (PDMS)

Generalization of findings between industries

- Hypothesis: the more similar the characteristics of the two industries are, especially on project execution, and the variables related to PEM and BIM, the more likely the possibility is to generalize and transfer findings between these industries.
- Case **projects** have several similarities on a principal level, but the extent of use of PEM and BIM differs.
- The two **industries** are both project-based industries with many of the same stakeholders. Both industries highly depend on a project team with relevant core competences including engineering know-how and technical competence.
- **PEM** is based on codified knowledge from project execution, which makes it easier to transfer to other organizations and to a certain degree industries.
- The use of **BIM** is on a principal level similar, except on model complexity and object information.
- To summarize, there are several similarities on project execution in the two industries, especially related to the variables PEM and BIM. This creates a basis for **generalization of findings** on project execution between the two industries.

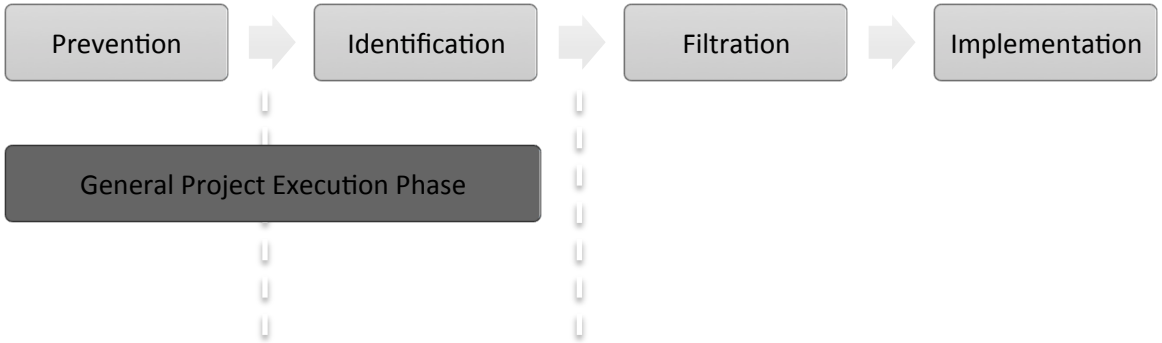
Theme 2

Processing change requests using a change control system and BIM

- Question: How can a change control system and BIM be used to process changes?
- Objective: Introduce a change management process and assess how a change control system and BIM can be used to process change
- Paper: "Using a change control system and BIM to manage change requests in design"
- Limitations/scope: Focus on change requests related to design

Change management process

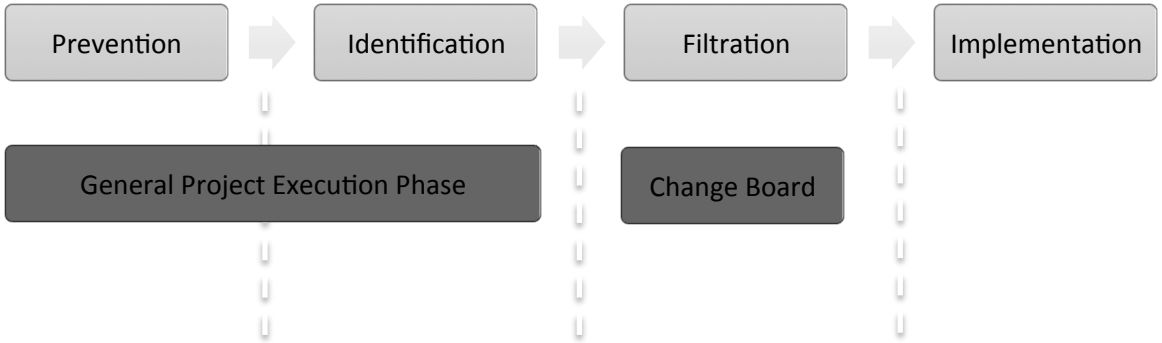
- Change: any unplanned, out-of-sequence design development or change to execution method/sequence. (Kvaerner)



  - General Project Execution Phase
    - routines are established (to prevent undesired handling of changes)
    - internal and external changes are identified

Change management process

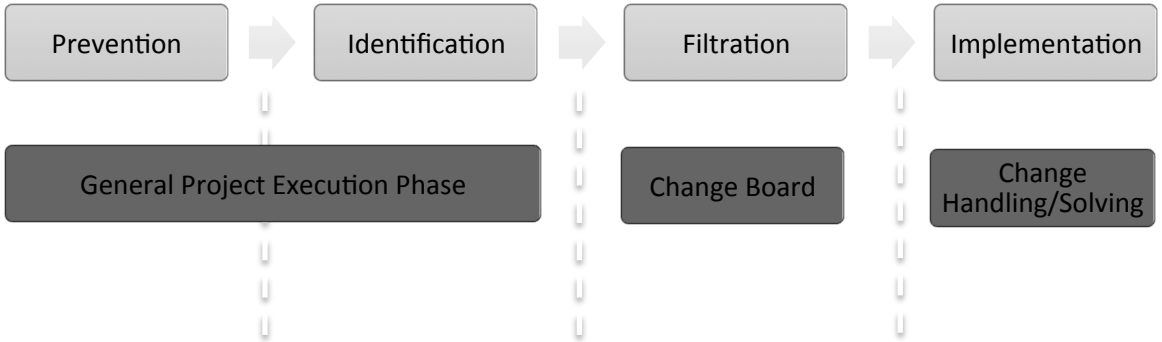
- Change: any unplanned, out-of-sequence design development or change to execution method/sequence. (Kvaerner)



  - Change Board
    - change requests are formally processed

Change management process

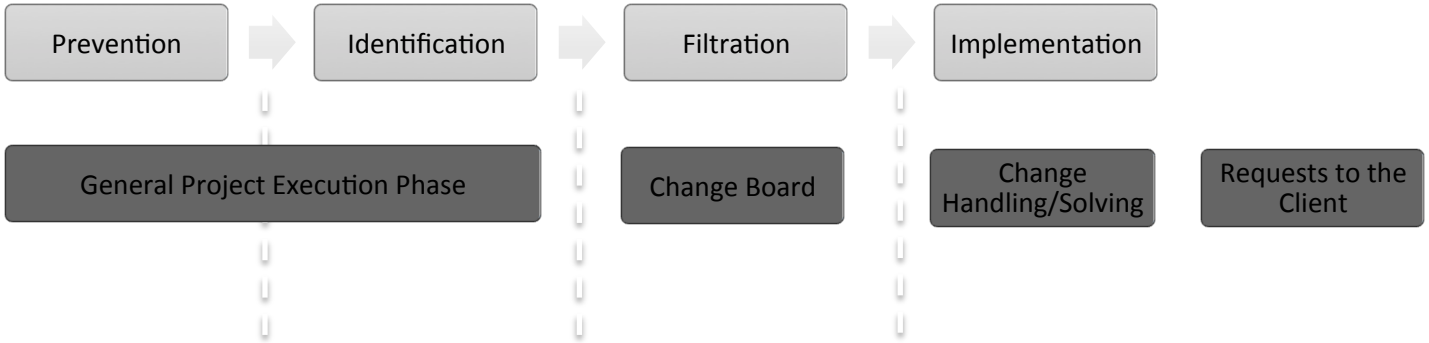
- Change: any unplanned, out-of-sequence design development or change to execution method/sequence. (Kvaerner)



  - Change Handling/Solving
    - changes are communicated, implemented, and monitored

Change management process

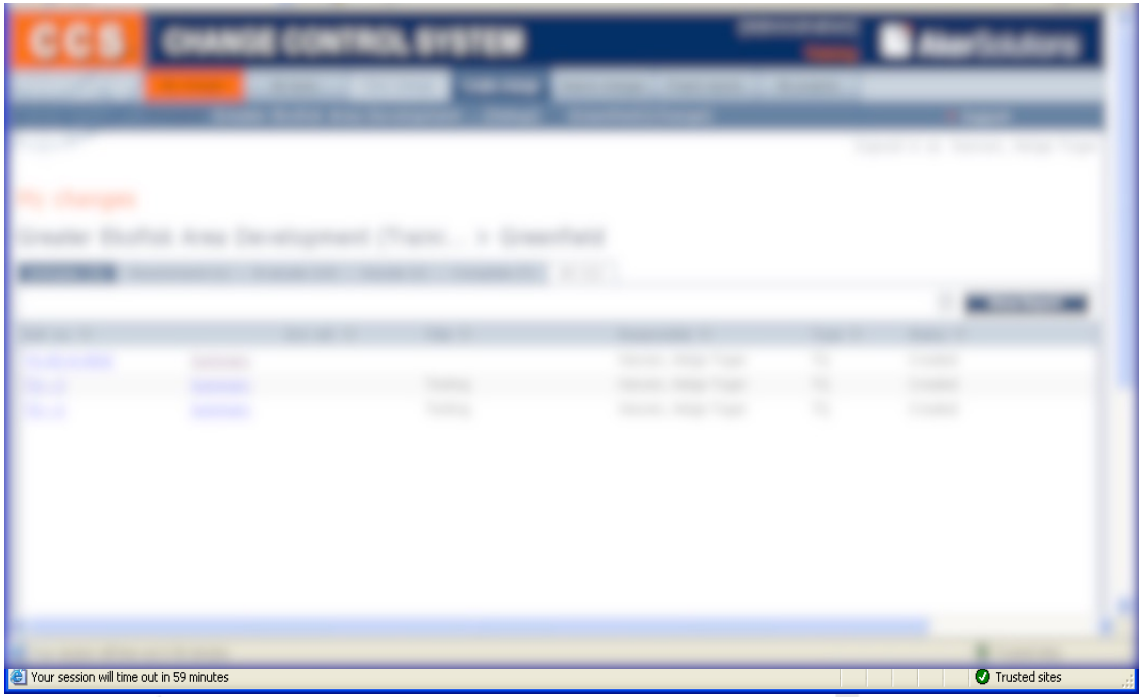
- Change: any unplanned, out-of-sequence design development or change to execution method/sequence. (Kvaerner)



  - Requests to the Client
    - change requests that are approved from the client, and any additional change requirements from the client, are implemented and monitored

Change Control System (CCS)

- Kvaerner has developed a change control system (CCS), which is a system to store, control, report and follow up project changes and deviations.
- CCS is central in the change management process.



Change Control System (CCS)

- Internal and external changes are identified with a design change request (DCR).
- The DCR contains a description of the change and identify any consequences for the discipline(s).

Change Control System (CCS)

- BIM can be used to identify consequences of a change, and relevant excerpts of the BIM can be attached to the DCR, in addition to relevant drawings and descriptions

Change Control System (CCS)

- Change Board, through a change manager and other relevant delegates, has a key role in deciding if a change is to be implemented or not.
- An important basis for decision is to identify consequences and relevant disciplines.
- In order to have an efficient process it is crucial that only those disciplines directly affected in a change is included.

Change Control System (CCS)

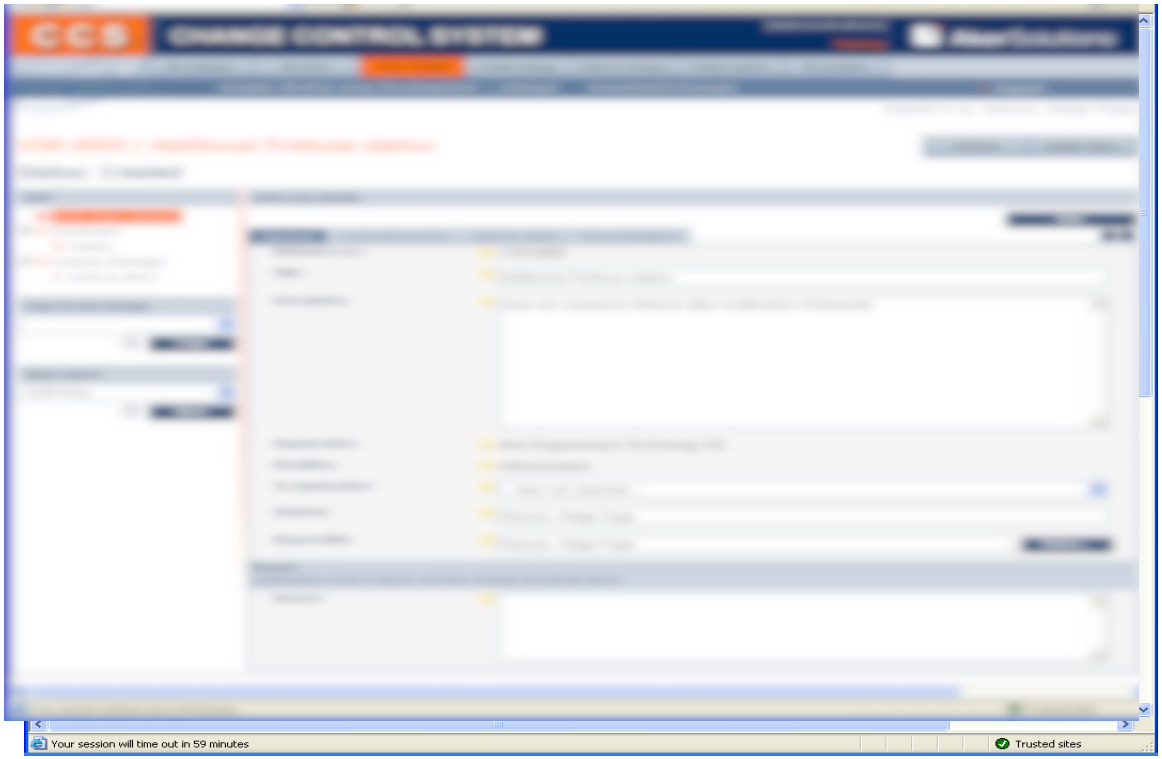
- The DCR is updated with input from the disciplines and status.
- The Change Board has the necessary information to decide if the change is to be implemented or need to be sent to the client for consideration and approval.

Available statuses for the DCR:

- "Initiate"
- "Recommend"
- "Evaluate"
- "Decide"
- "Complete"

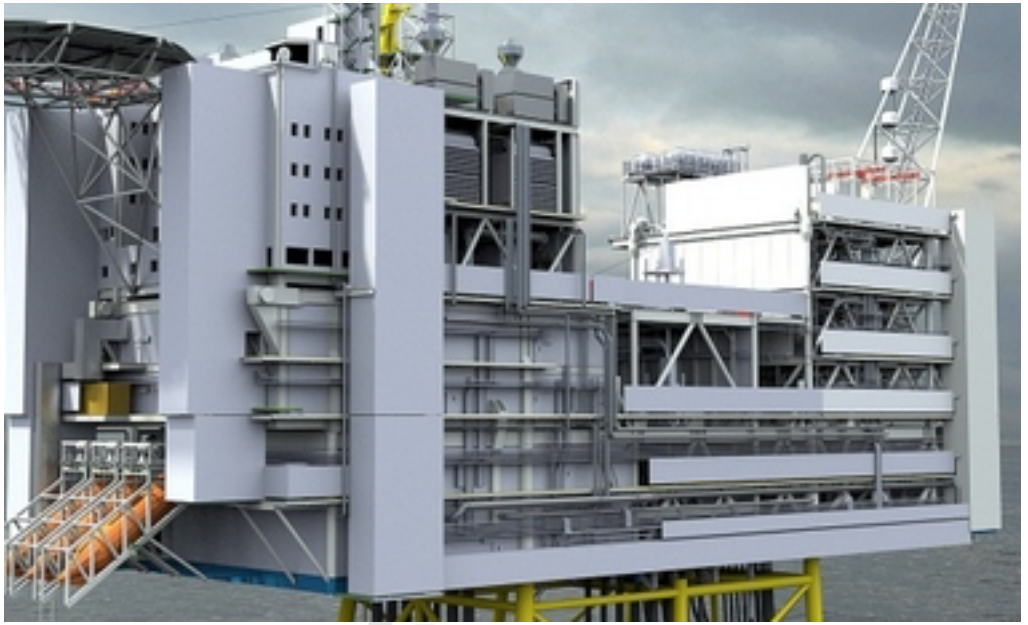
Change Control System (CCS)

- If the change is to be implemented, a design change notice (DCN) is created from the DCR. DCN is an instruction for implementation of a DCR and is issued when the project is influenced.
- If the change is sent to the client for approval, cost and schedule impact is identified and a variation order request (VOR) is created from the DCR.



BIM and change

- In a design change request (DCR), BIM is used to assess if the change is **feasible** and identify downstream **consequences** of the change. Extract is taken out from the BIM so that disciplines that receive it can identify the change visually in the model.
- Development of BIM is based on what is frozen. **Color codes** can be added to the objects in the BIM software, which identify what is still being developed and what is frozen.
- CCS relate to BIM in the sense that if there is a change that touches objects with the red color code (frozen) it must be addressed.



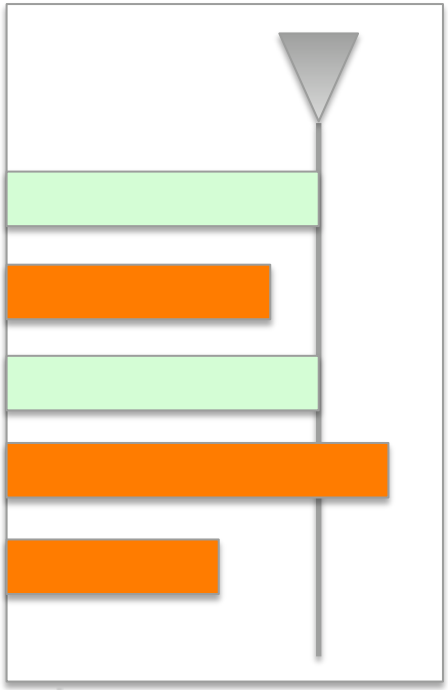
Theme 3

Relation between project milestones, PEM and BIM

- Question: How can a project execution model and BIM be used to follow up milestones in a project plan?
- Objective: Assess how the project execution model can reflect the project plan and how milestones in a project plan can be directly related to object status and check lists in the BIM
- Paper: "Using (PEM and) BIM to follow up milestones in a project plan”
- Limitations/scope: Focus on the engineering phase in EPC contracts (design-build)

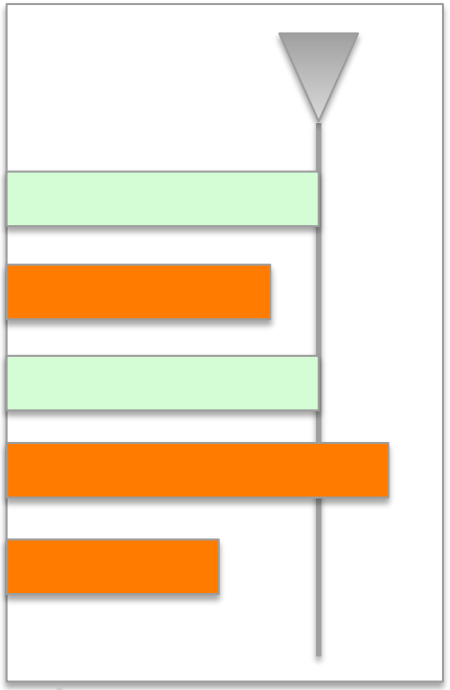
PEM and change

- Change can be perceived as an internal or external alteration in conditions for the contract, or alterations to frozen design/design milestones. (Kvaerner)
- PEM describes a milestone with all main activities on the line. PEM defines what should be frozen at the individual milestones, typically related to the milestones M2A, M2B and M2C in the design phase.
- Once you have frozen the design and some of that still must be changed, the design change process begins.
- The challenge is that often you have disciplines that lie ahead and disciplines that lie behind the milestone. As soon someone goes beyond, it changes afterwards. As soon someone is behind, there will be changes, because all the others have worked on a basis that is not frozen. There is the risk that when he reach the line, they must go back to redo some of their work.
- The main challenge (in a gate review) is to take care of those behind and decide what to do with them onwards.



PEM and change

- PEM controls what is the optimum picture at any given time you should have in project progress so that everyone are in balance with each other. The more balance on the line, the fewer changes.
- Knowledge of where you are is equally valuable whether you are on, ahead of or behind the milestone.
- If you do not measure in proportion to the milestone, you in fact don't know if you have a problem. And you also don't know how to deal with the problem ahead. It is only when you set the milestone and measure against it you know.
- PEM is valuable either you comply with it or not, because you are measuring against it.



Konkurranseevne med internasjonale aktører

Hvorfor er det slik?

- E: Koreanerne har like kostnader på engineering. Utgjør ca 10-15% av kontraktssummen.
- P: Innkjøpet er det samme, fordi det er kunden (oljeselskapet) som bestemmer utstyret. Utgjør ca 50% av kontraktssummen.
- C: Byggingen Kværner konkurrerer på. Lage en byggesekvens som er kostnadseffektiv. Her **PEM** har sin store styrke. Kværner flinke til å **levere riktig tegning, riktig komponent og material til verkstedet på rett tid, for å sikre effektiv gjennomføring av byggingen**. Koreanerne bruker ca 1,6-1,7 timer mer (60-70% mer timer). Det er dermed lønnsnivået i Norge Kværner konkurrerer på i construction.

Konkurranseevne med internasjonale aktører

- Kværner er i en konkurransesituasjon og skal vinne en kontrakt, klarer ikke helt å matche prisnivået; det blir likevel dyrere med Kværner sine få timer med høy rate, enn koreanerne sine flere timer med lavere rate.
- Kværner vinner kontrakter fordi de har et bedre rykte på **leveringstid** og **kvalitet** enn konkurrentene i Asia.