

A Lean and Agile approach to design and construction



LCI UK Birmingham
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Content

1. Introduction
2. Film from the Norwegian KHiB-Project
3. LEAN and Agile approach to design
4. Systematic Completion
5. LEAN Construction and use of BIM
6. How did we make it happen?

Atkins and Statsbygg

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Statsbygg is a public sector administration company responsible to the Ministry of Local Government and Modernisation (KMD). Statsbygg provides appropriate, functional premises to public sector enterprises.

About us



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3 things to remember

1. Manageable deliveries
2. Transparency and visualisation
3. Involvement and ownership



Film

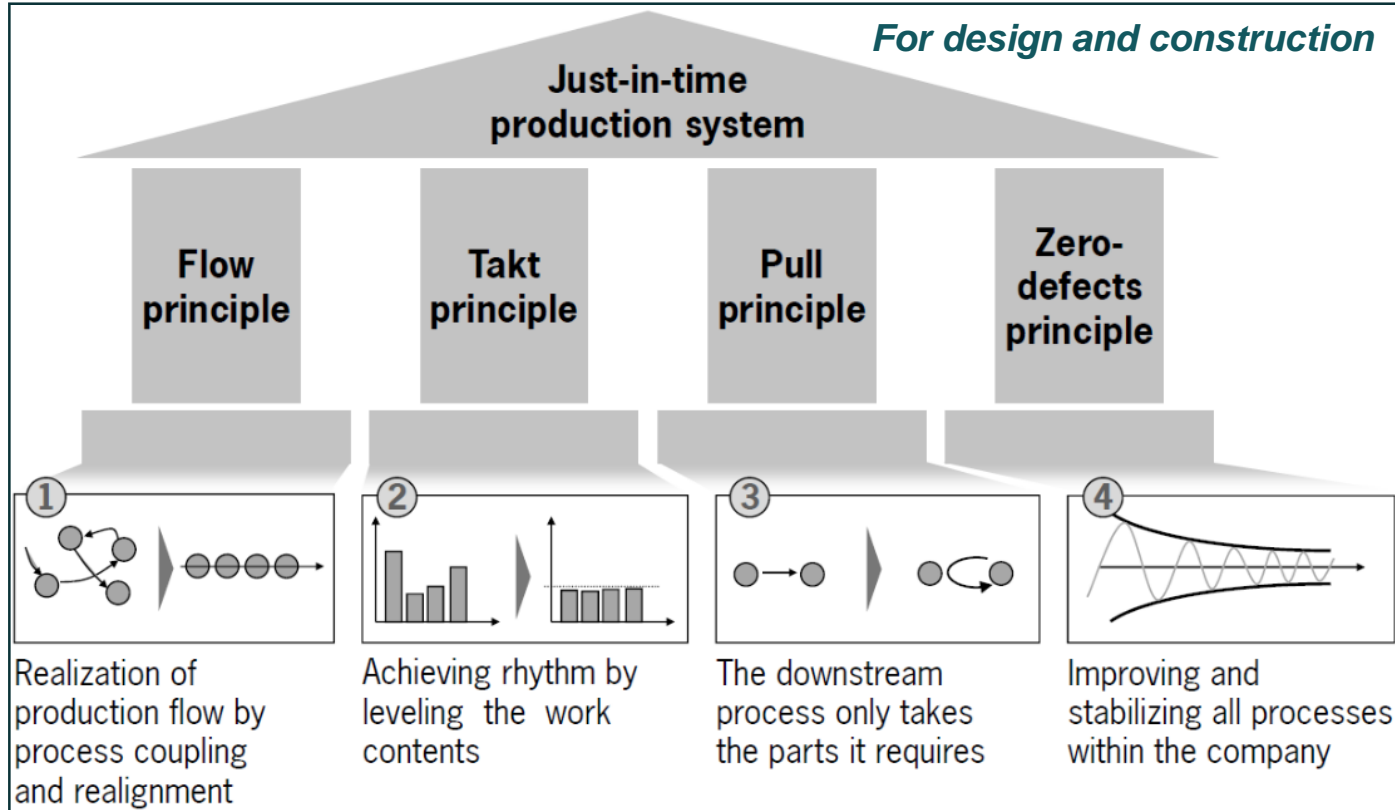


Project: KHiB, Bergen, Statsbygg. Photo: Hans Thomas Holm
URL: <https://www.youtube.com/watch?v=dRR6xeuQdaM&sns=em>

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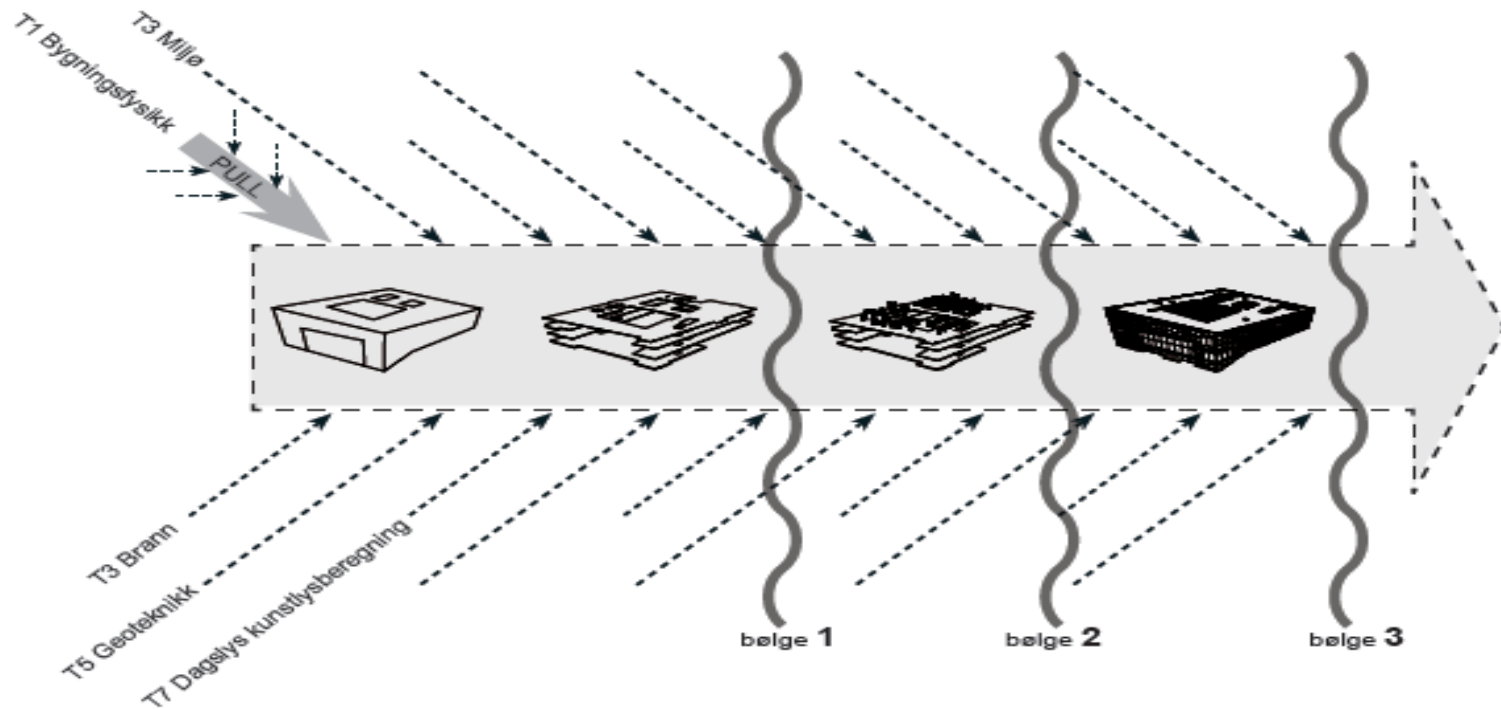
Project LEAN principles



Kilde: Porsche Consulting

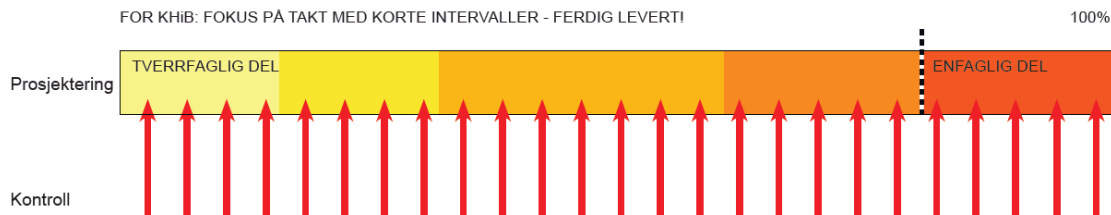
Lean and Agile design @KHiB

FLOW: Continuous value adding to our product, the BIM-model!



Lean and Agile design @KHiB

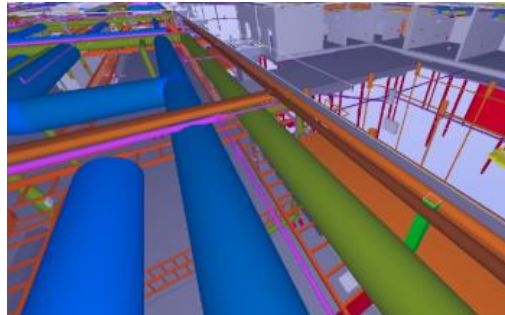
TAKT/ interval and manageable deliveries



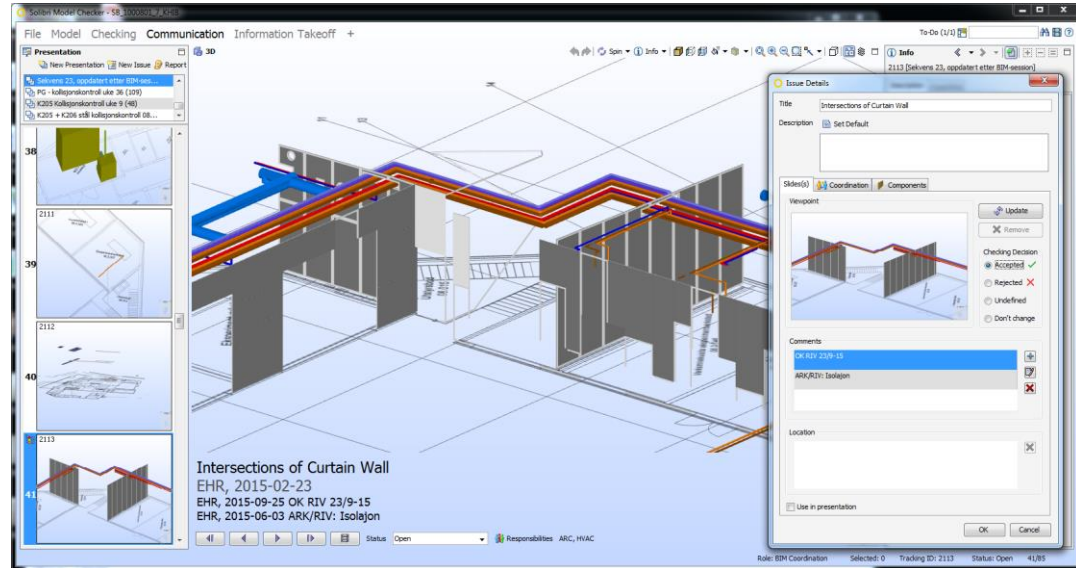
- ✓ A 3 day **co-location** every **14 days**
- ✓ Devided into themes (**product backlogg**)
- ✓ Interdisciplinary deliverables every **14 days (sprint)**.

Lean and Agile design @KHiB

PULL: related to 5R principles

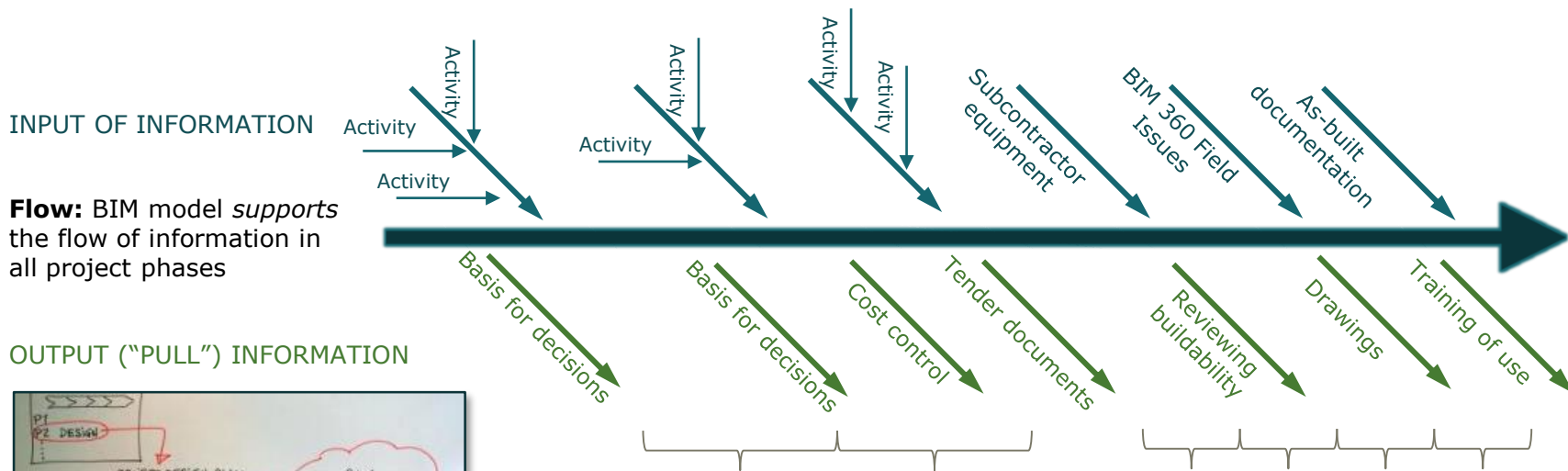


Right product
Right detailed level
Right time
Right quantity
Right place

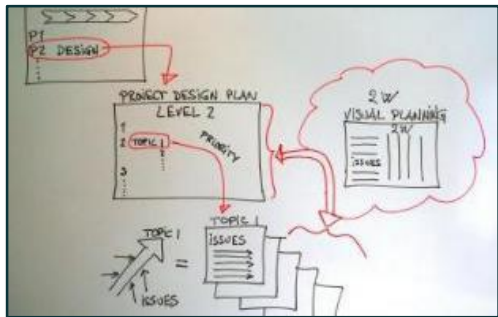


Lean and Agile design @KHIB

PULL: related to 5R principles



Flow: BIM model *supports* the flow of information in all project phases



Takt interval time DD phase: The design team has biweekly 3 day big-room meetings (co-location)

Takt interval time construction: Weekly review of the BIM model for predefined "control areas"



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RAMBOLL

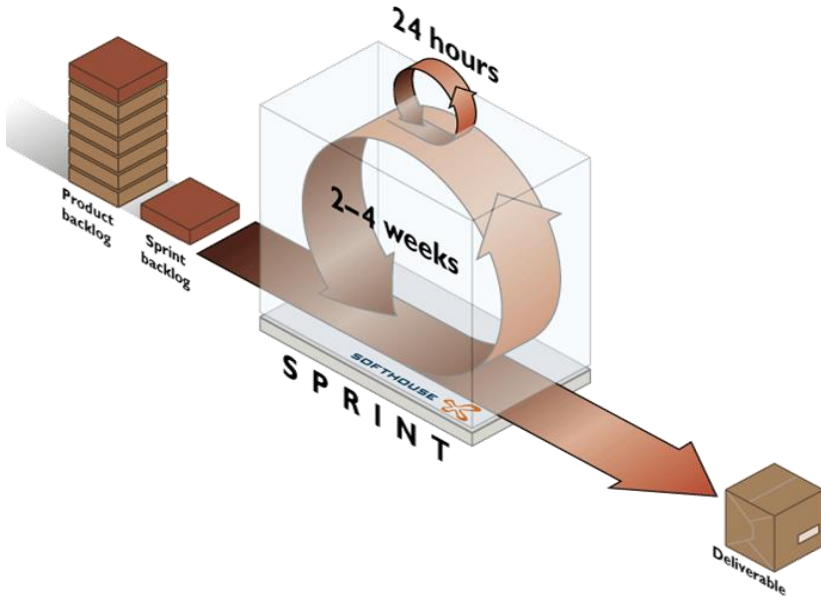
Snøhetta

Lean and Agile design @KHIB



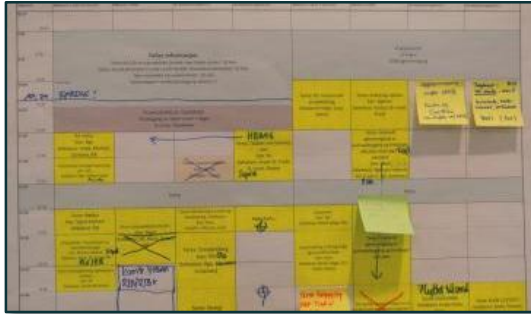
Culture!

Working processes are similar to agile processes (SCRUM)



- ✓ Interdisciplinary themes (product backlog)
- ✓ Always one responsible theme owner.
- ✓ Scope for themes are defined, but evaluated constantly
- ✓ Scope for sprint is defined according to time and content
- ✓ Review and learning from sprints every 14 days
- ✓ Product backlog reviewed at all times
- ✓ Self organising sprint teams

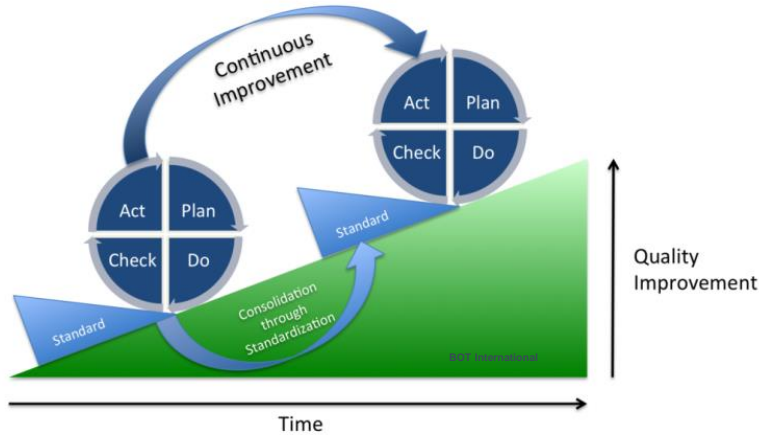
Working processes are similar to agile processes (SCRUM)



KEEP IT SIMPLE!



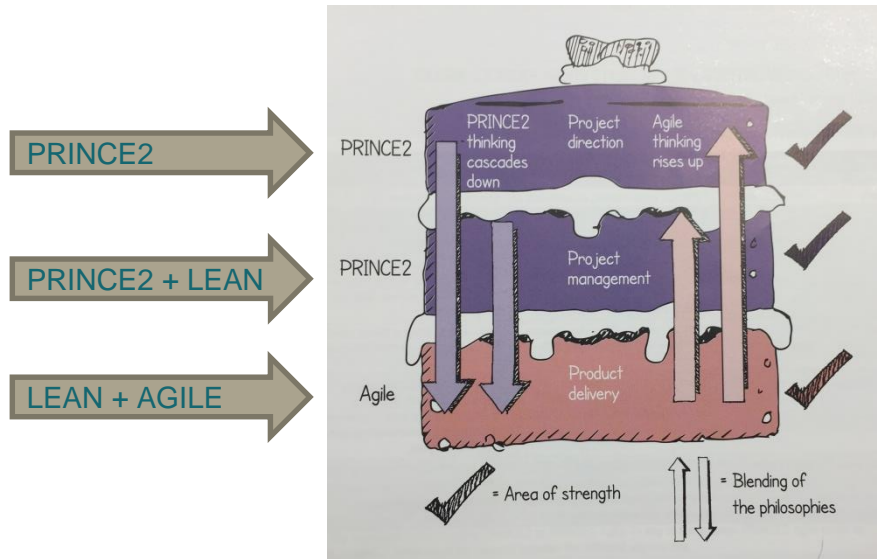
Lean and Agile design @KHiB



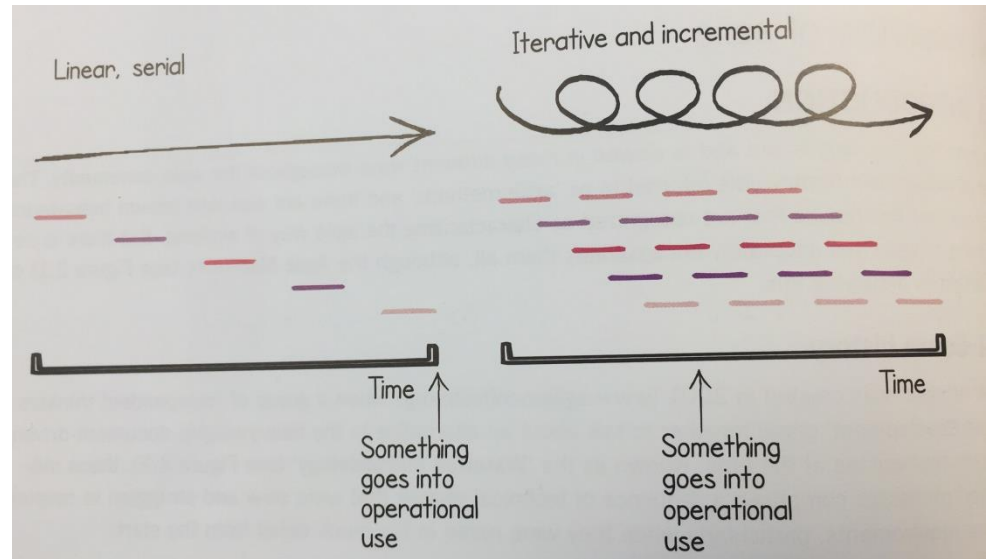
CONTINUOUS IMPROVEMENT

- ✓ Continuous feedback and evaluation of the processes
- ✓ Sharing is caring based on trust
- ✓ MIND SET

Agile in product delivery



Source: Axelos.com



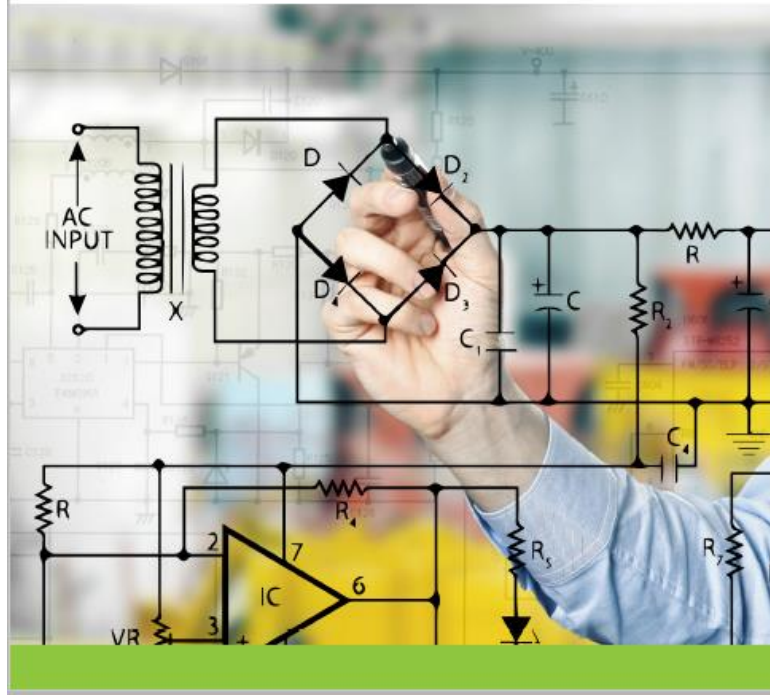
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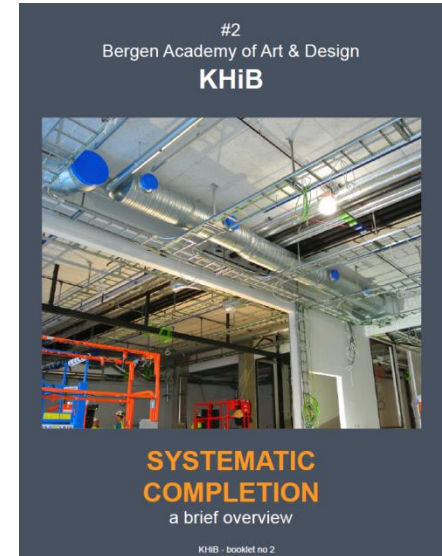
SYSTEMATIC COMPLETION

GUIDE

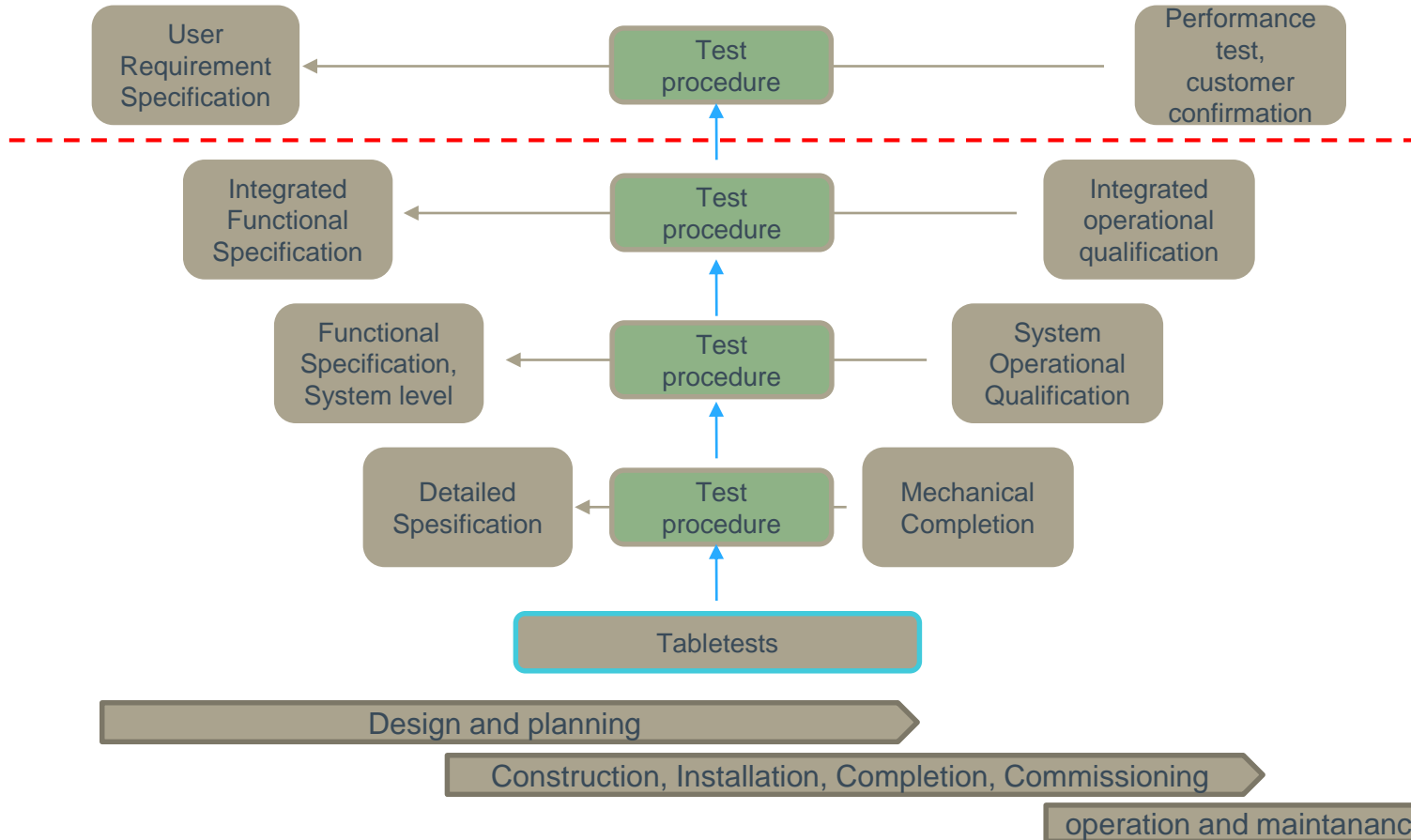
Systematic Completion – definition ‘An assurance that the project meets all *functional* requirements within given time, cost and quality requirements, *planned* and *verified* through a structured process management controlled from planning to takeover’.



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Tor I. Hoel ÅF Advansia



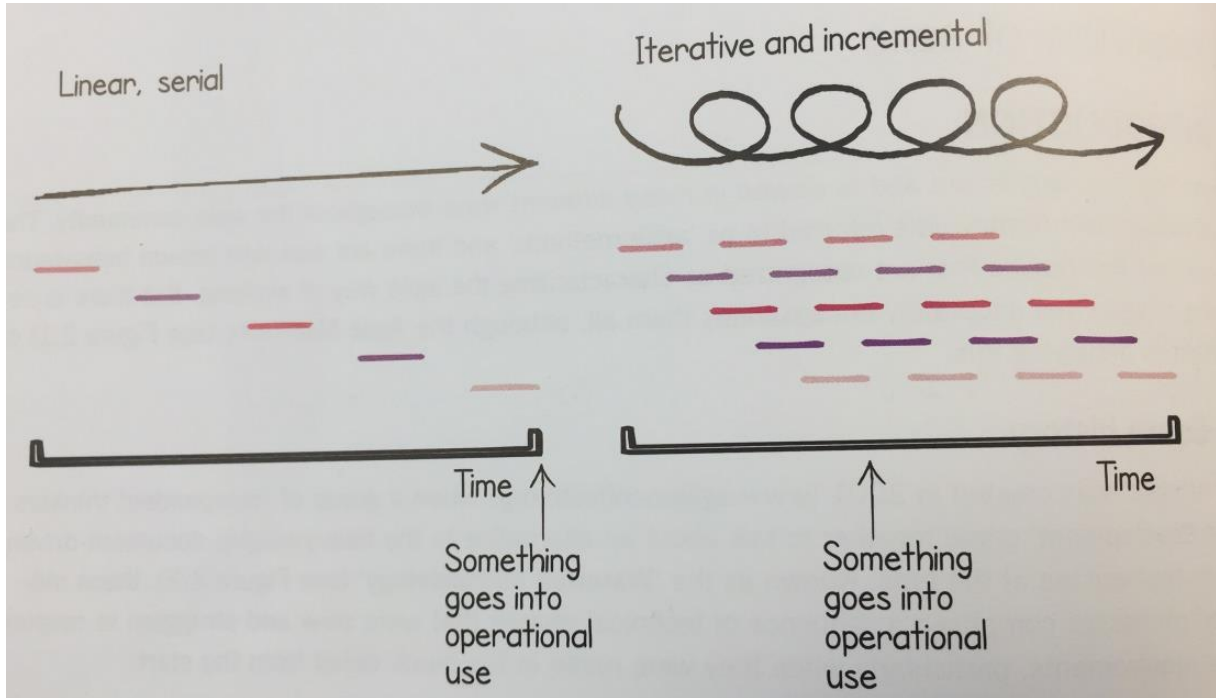
Right first time – V-model



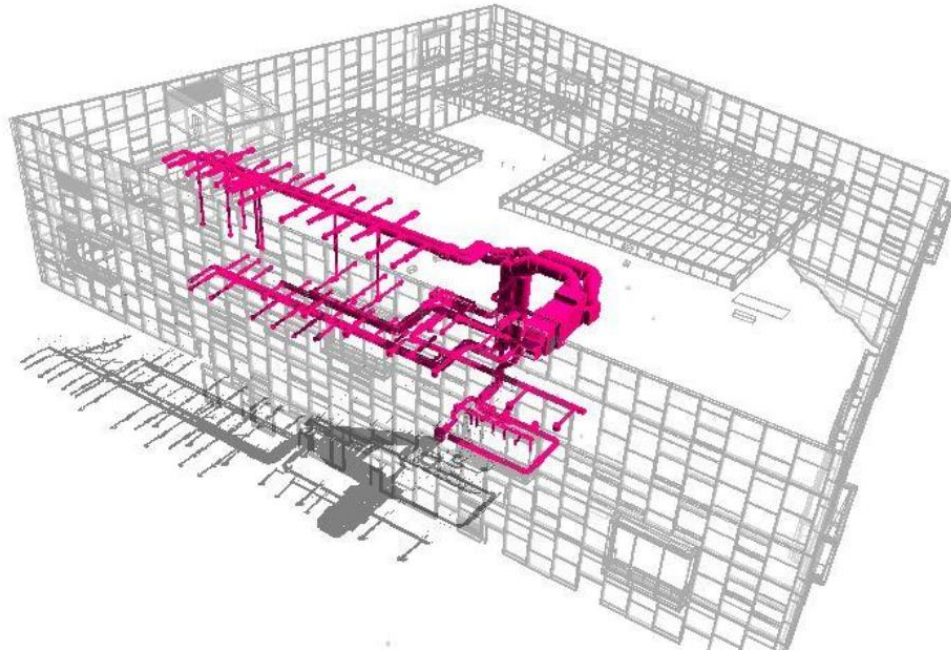
Early testing = Release

End testing

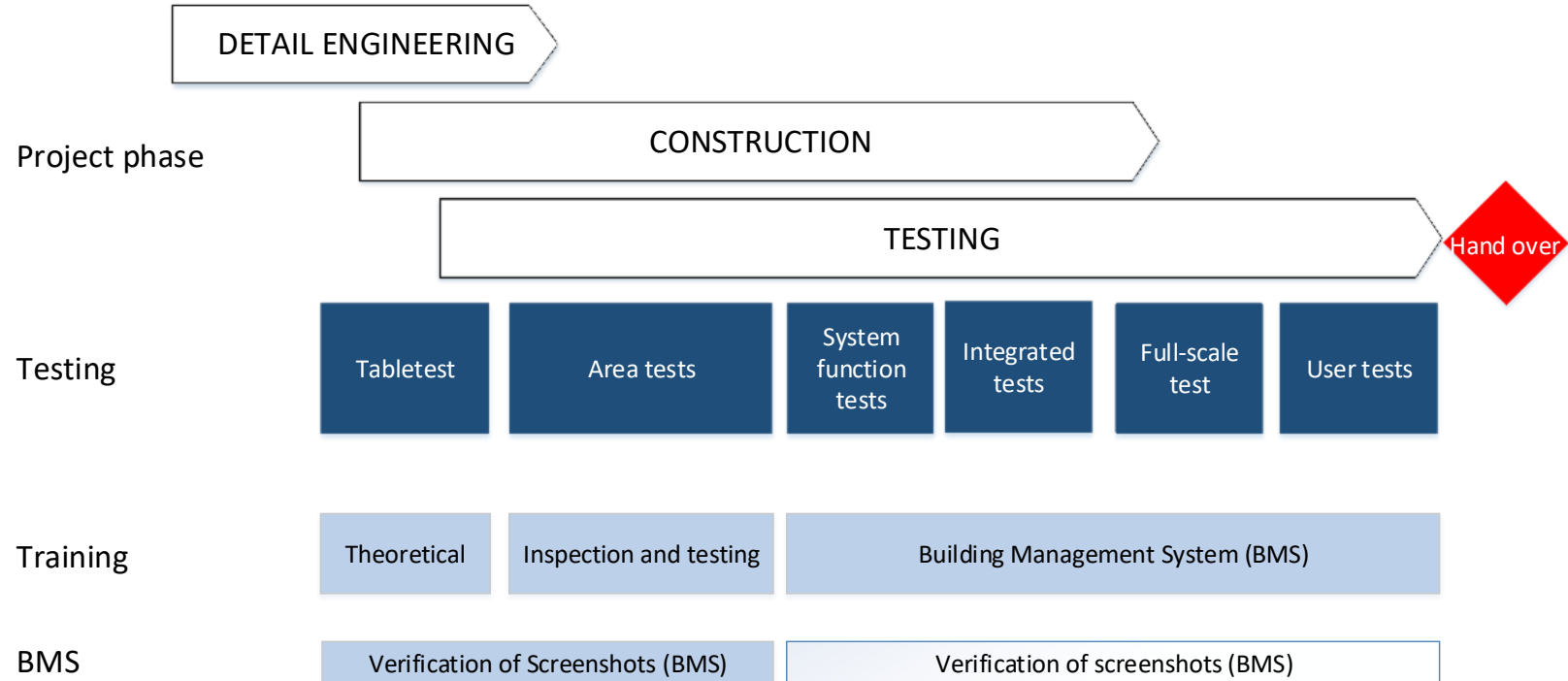
Early testing



Physical installation and technical functionality



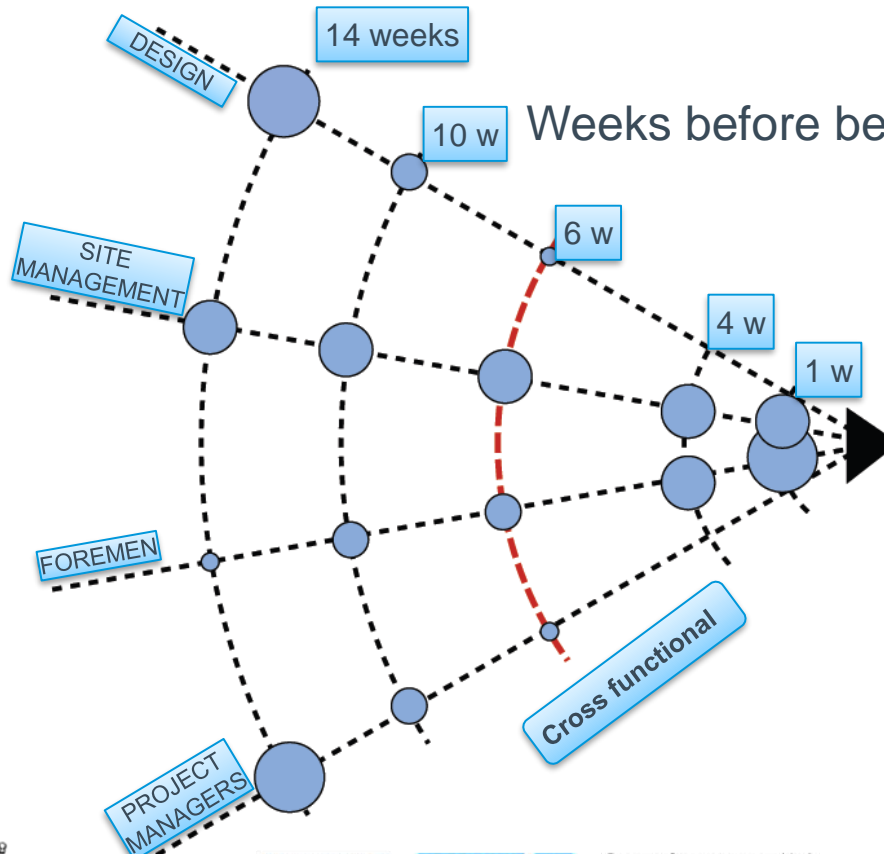
Training and testing



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14-10-6-4-1 preparation meetings



Weeks before beginning / occurrence "on site" in a takt-area



Takt planning

Easy-to-read Plan and
Complete Overview.
“Replacing” > 5.000 lines

DETAILED PROCESS-
DESCRIPTIONS

6 BiM-stations
on site

Ideal for Reverse Planning
and Reducing Constraints

Source: Statsbygg/KHIB

Takt planning

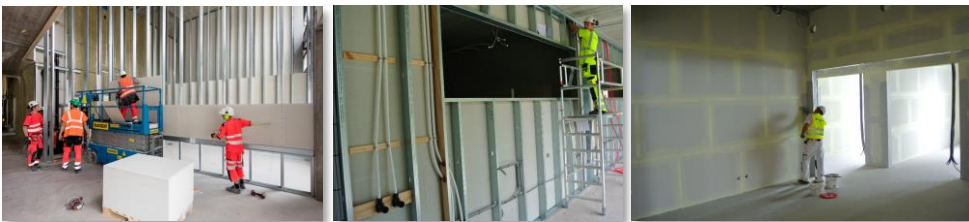
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Plan		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
Innredning																						
4	4.1	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16									
	4.2	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16								
	4.3	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16							
	4.4	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16						
	4.5	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16					
	4.6	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16				
	4.7	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16			
	4.8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16		
3.-4. etg	Videostudio	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16					
1	1.1	FA4/I6	I1	I2a	I2b	I3a	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16		
	1.2	FA4/I6	I1	I2a	I2b	I3a	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16		
	1.3		FA4	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16
	1.4			FA4	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15
	1.5				FA4	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14
	1.6					I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14
3	3.1	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16									
	3.2	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16								
	3.3	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16							
	3.4	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16						
	3.5	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16					
	3.6	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16				
2	2.1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16			
	2.2	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16		
	2.3	FA8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16	
	2.4	FA8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16	
	2.5	FA8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16	
	2.6	FA8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16	
1	1.7																					
	1.8																					

		Innredning																			VOGNEIER	
Entreprise	Fag	Arbeidsoperasjon																	Vogn Tog A	Vogn Tog B	BL	Kode
K206	Påstep	Isolering overkant hullekke inkl. plastfoie																	I1	I1	BLB1	K206
		Armering																				
		Randisolering og fugging																				
		Påstep																				
		Sliping og oljing																				
		Tidekking av betonggulv																				
		Eventuelt slissgjulldage																				
		Brannisolering og brannmaling av stålsøyler og gitterdragere																				
		Stålsønder påføring 70mm mot fasadeelementer og mot																				
		Prosjekthalvvegg																				
		Stålsønder innervegger																				
		Enkling av innvendige vegger, inkl. utsparring																				
		Foring av smyg dører (systemvegger)																				
		Foring av smyg vindutsparinger																				
		Spikreslag for lunge installasjoner vegg																				
K206	Maler	Maling av hullekke, i spesielle rom																				
K204	Bikenslager	Innvendig beslag i kampan																				
K301	Rørlegger	Montering av vannrør for vegghengte toiletter																				
		Reviser fra fordelerskap til utstyr - inkl. koblinger																				
K401	Elektriker	Montering av el-boks og trekkerer for svakstrøm i tak og vegg																				
K302	Ventilasjon	Montering av ventilasjonskanal i vegg																				
K401	Elektriker	Montering av el-boks og trekkerer for svakstrøm i tak og vegg																				
K206	Tømrer	Isolering innvendige vegger inkl. lukking av 70mm påføringsvegger																				
		Sparking og pussing av fibergips-vegger																				
K206	Maler	Grunnforfylling av fibergips-vegger																				
		Maling av fibergips-vegger (2-strøk)																				
		Akustiske plater vegg, inkl.																				
K206	Tømrer	Direktemontert akustisk himling inkl. isolasjon, spikreslag, beslag																				
		Montering av opphengeslag for akustisk himling samt wire for batterskinner																				



Flow!
Weekly, continuous completions!

Source: Statsbygg/KHIB



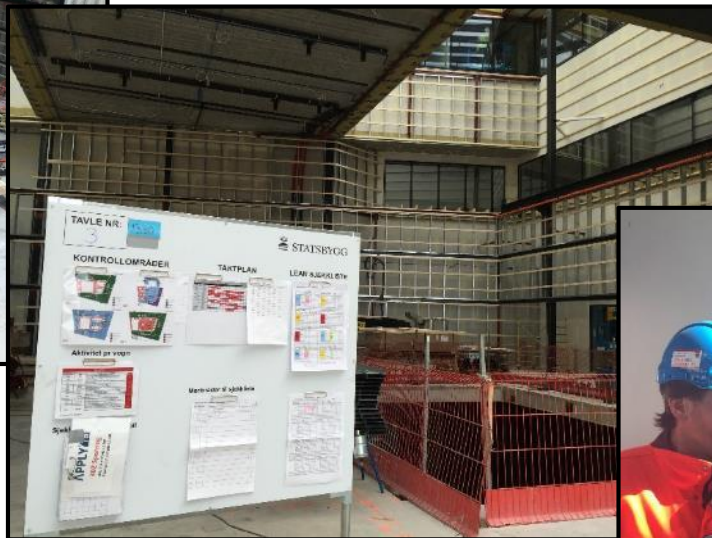
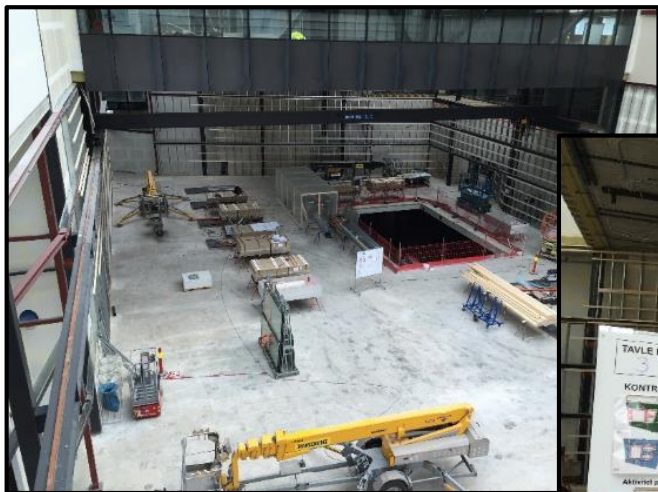
Early testing and takt planning

		01.08	08.08	15.08	22.08	29.08	05.09	12.09	19.09	26.09	03.10	10.10	17.10	24.10	31.10	07.11	14.11	21.11
Plan	Kontroll område	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
4	Innredning																	
	4.1	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16					
	4.2	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16				
	4.3	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16			
	4.4	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16		
	4.5	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14	I15	I16	
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	4.8	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13	I14
3.-4. etg	Videostudio			I1	I2	I2	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12
	1.1	FA4/16	I1	I2a	I2b	I3a	I3b	I4	I5	I6	I7	I8	I9	I10	I11a	I11b	I12	I13

Process and Takt based

Arbeidsoperasjoner				Vogn
Entreprise	System	Beskrivelse		
K401	442.303	Belysning DALI		OT3.1
K401	542.101	Brannalarmanlegg - deteksjon		
K501	360.004	Ventilasjon og romstyring inkl. evt vinduskontakter		
K401/K501	442.303	Integrasjon DALI<->SD-anlegg		
K401/K501	433.303++	Overspenningsvern og energimålere		OT3.2
K401	442.302	Belysning DALI		
K401	542.101	Brannalarmanlegg - deteksjon		
K501	360.001	Ventilasjon og romstyring inkl. evt vinduskontakter		
K501	360.010	Ventilasjon og romstyring inkl. evt vinduskontakter		OT3.3
K501	360.534-360.539	Spesialavtrekk		
K401/K501	442.302	Integrasjon DALI<->SD-anlegg		
K401/K501	433.302	Overspenningsvern og energimålere		
K401	442.301	Belysning DALI		OT3.4
K401	542.101	Brannalarmanlegg - deteksjon		
K501	360.009	Ventilasjon og romstyring inkl. evt vinduskontakter		
K501	360.010	Ventilasjon og romstyring inkl. evt vinduskontakter		
K501	360.530-360.533	Spesialavtrekk		OT2.1
K401/K501	442.301	Integrasjon DALI<->SD-anlegg		
K401/K501	433.303++	Overspenningsvern og energimålere		
		Retest av feil og mangler, test av evt utestående punkter		
K401	442.203	Belysning DALI		OT2.1
K401	542.101	Brannalarmanlegg - deteksjon		
K501	360.004	Ventilasjon og romstyring inkl. evt vinduskontakter		
K401/K501	442.203	Integrasjon DALI<->SD-anlegg		

Stand-up meeting – takt board



BIM-station on site



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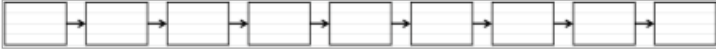
**15 years of experience
or
1 year of experience 15 times?**

**LEAN as (CONSTRUCTION) METHODOLOGY.
EVERYTHING is CONNECTED**

Everything is connected

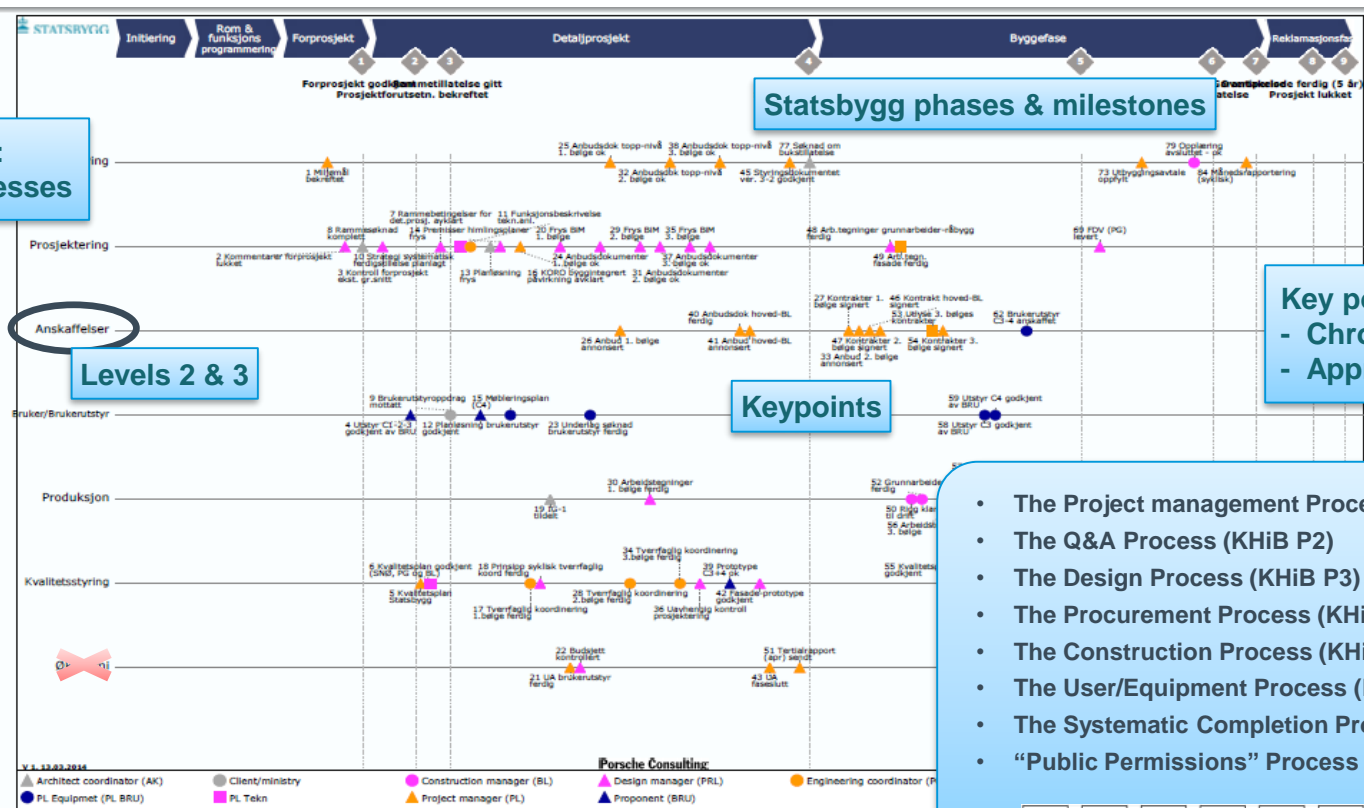
- LEAN STRATEGY
- PROCESS PLANNING
- REVERSE PLANNING
- LEAN DESIGN
- TAKT PLANNING
- FUNCTION and GEOMETRY in TAKT
- SYSTEMATIC COMPLETION
- INVOLVE SUBCONTRACTORS and SUPPLIERS
- BIM and DIGITAL TOOLS

LEAN on KHiB

- Flow 
- Processes 
- Bigger Picture Master Process Plan / Master Takt Plan
- Proactivity Early and detailed planning
- Transparency Visualise as much as possible
- BIM 3D-tools always updated

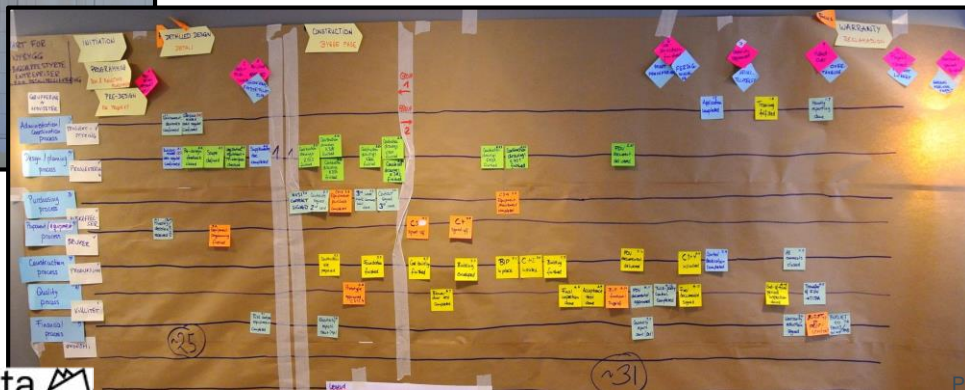
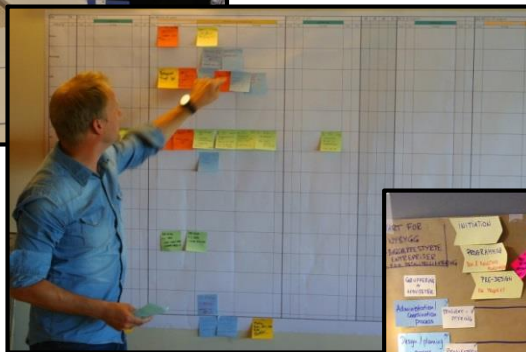
KHiB Process Management

Level 1:
8 Main Processes



Source: Statsbygg / Porsche Consulting

Reverse planning



KHiB successes

- Systematically completed construction.
- Completely handed over to operations on time, May 1.st.2017.
- Landscaping (all outdoor) completed simultaneously with the building.
- Innovations:
Extended use of Lean Management / Lean Process Planning* / Lean Design*.
Extended use of Systematic Completion*. (* New methodologies.)
- Common BIM for all from day 1.
- Delivered on time, on cost, and on quality.

**Nothing Changes
if
Nothing Changes**

3 things to remember

1. Manageable deliveries
2. Transparency and visualisation
3. Involvement and ownership





Thank you for
your attention



Photo: HT Holm





