

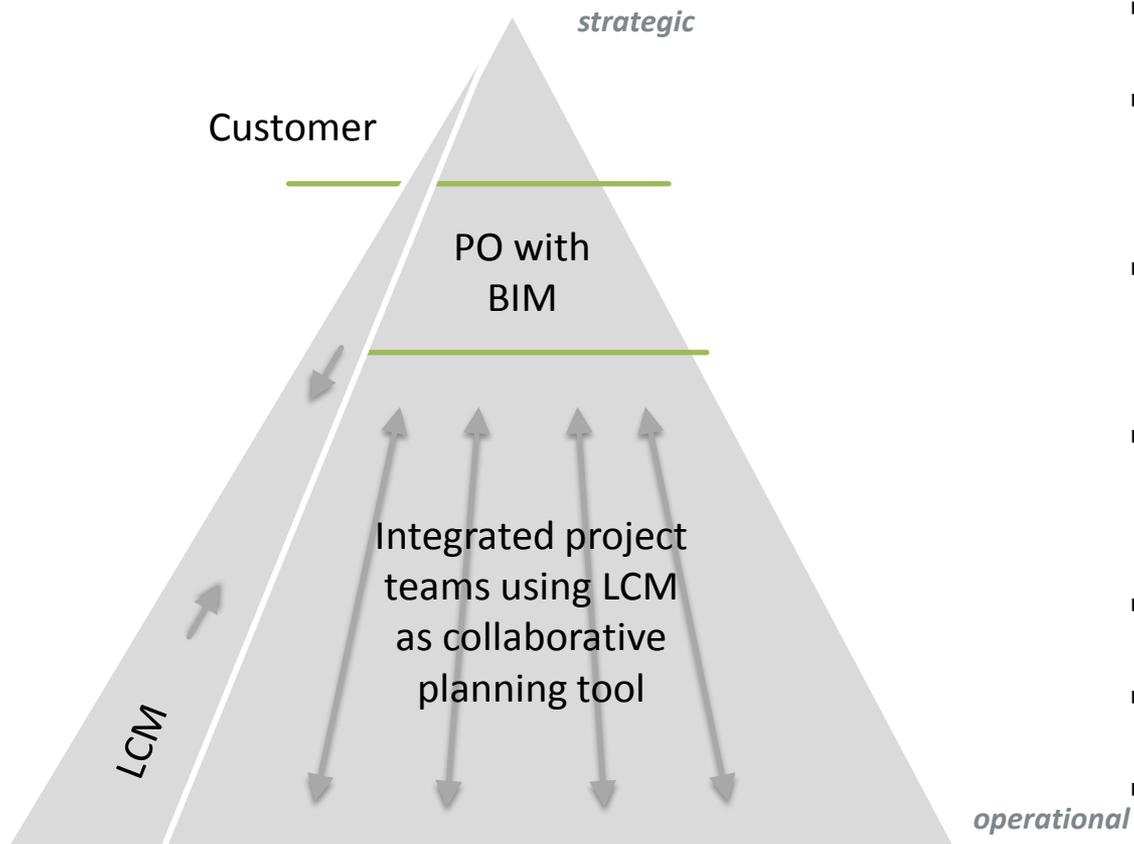


Lean Construction Management & BIM
*Implementation of LCM to bridge the gap between
BIM and the construction site*

Patrick Theis, 29.10.2013

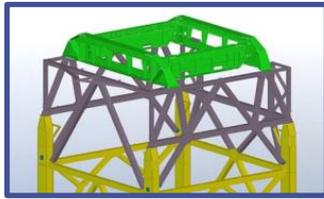
Projectorganisation and BIM with Lean Construction Management

Bridging the strategic and operational level

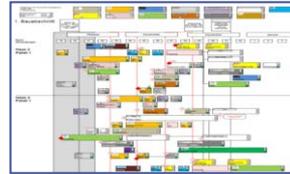


- Top down *and* bottom up
- Production system to speed up the planning and execution
- Highly flexible and dynamic regarding changes
- Control by common commitments and involvement
- Complete system integration
- Continuous and real time
- Real + virtual world

Integration of BIM and a LCM production system



BIM / 5D

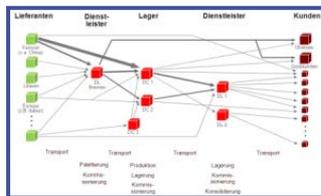


Process Planning



Process Analysis

Work packages & material list



Supply Chain & material Tracking



© Archiv Drees & Sommer
Logistic hub

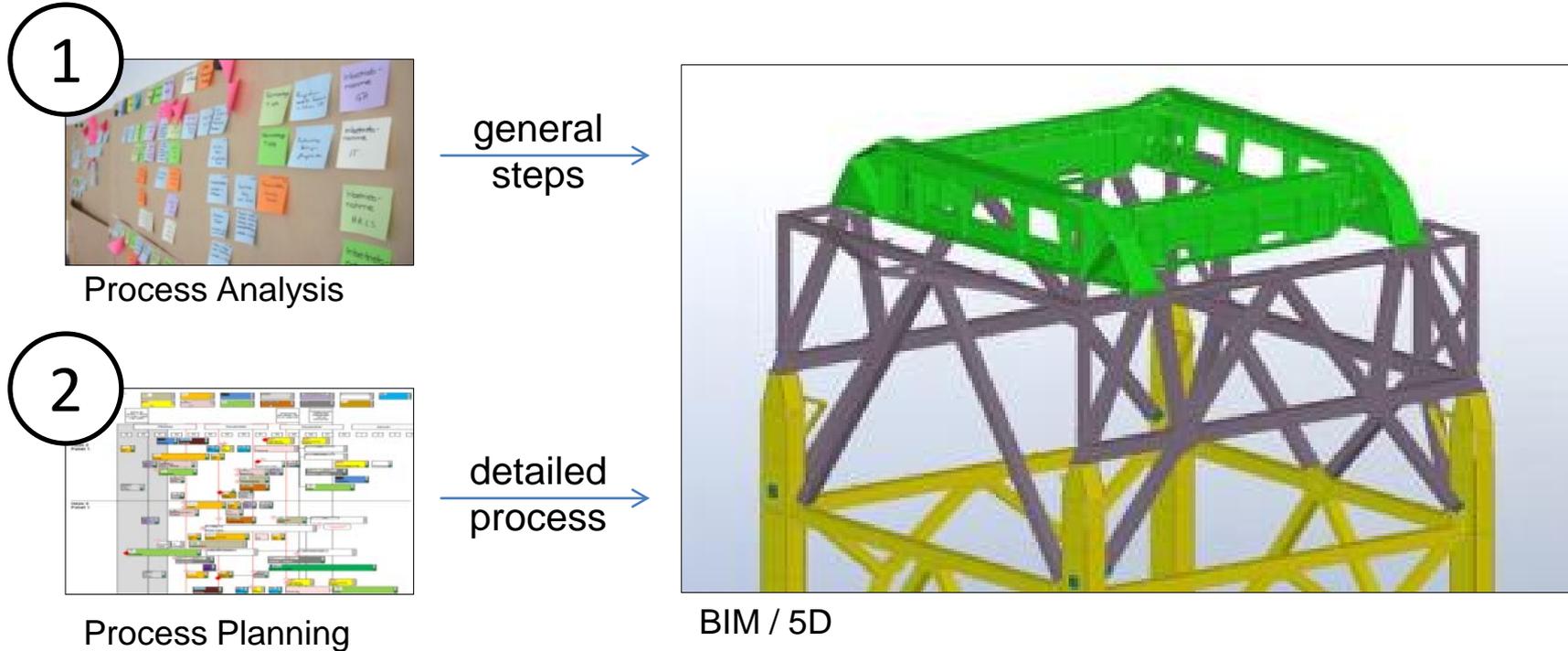
Production Planning



Production Control

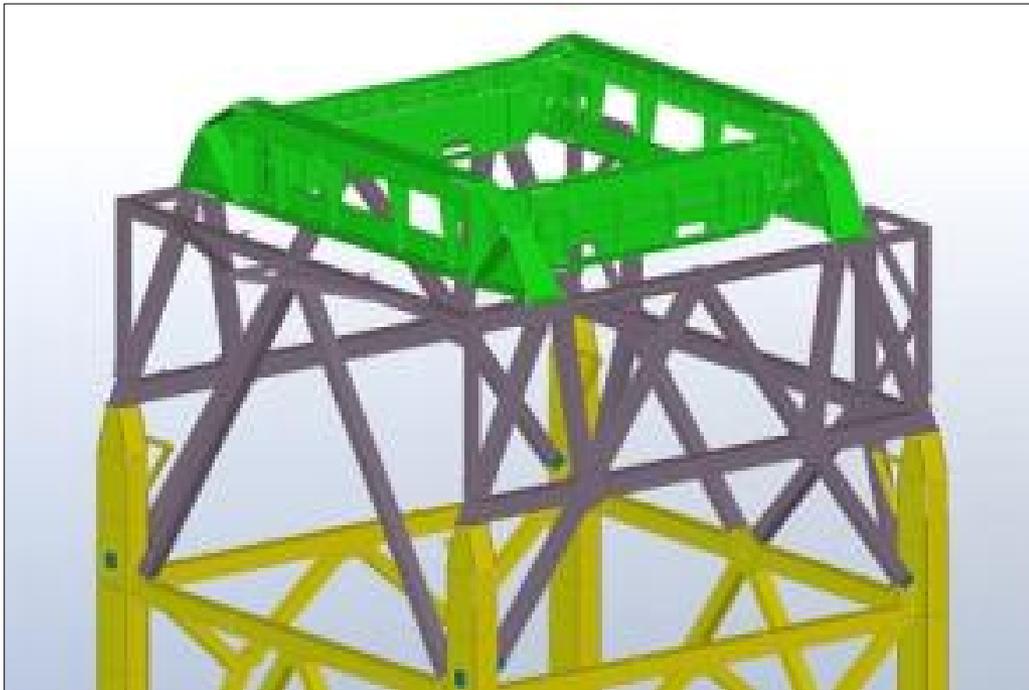
LCM and BIM interaction

Working sequence feed for 5D Model out of LCM



LCM and BIM interaction

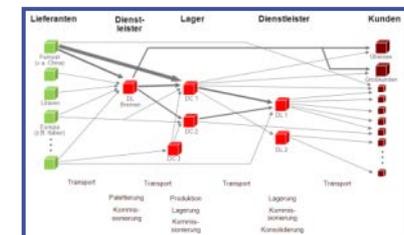
Information out of 5D Model



BIM / 5D



Work packages & material list



Supply Chain & material Tracking

LCM and BIM interaction

Information out of BIM and LCM tools for planning the execution / production



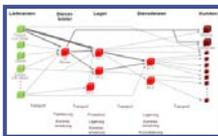
Process Analysis



Process Planning



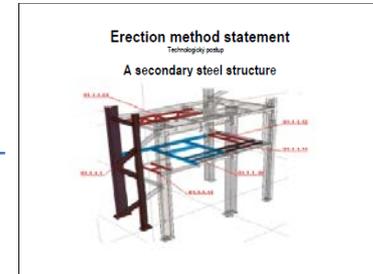
Work packages & material list



Supply Chain & material Tracking

Production Planning

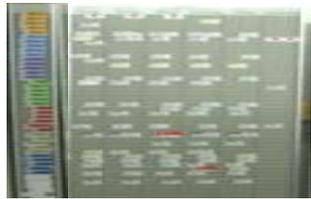
Production Control



Method statement

LCM and BIM interaction

Control of construction site with LCM and BIM tool



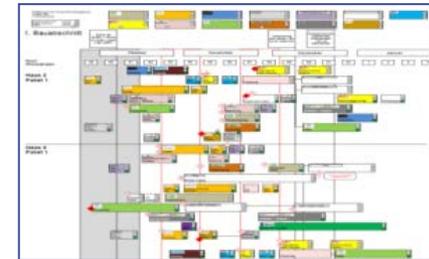
Planning Board



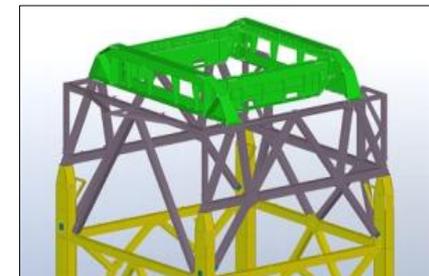
Construction site



Planning Board



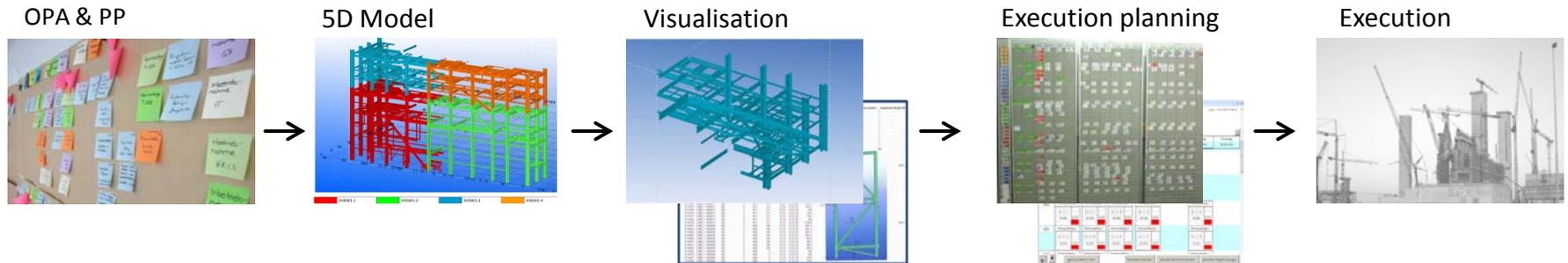
Process Planning



Tecla Model

LCM and BIM interaction

Overview of LCM & BIM shares at the different phases



LCM:

Using LCM for planning the possible working sequences

LCM:

breaking down the Model into working packages (Areas, lifting units, ...)

LCM:

Planning of the execution with planning boards, planning cards, action lists

LCM:

Execution on construction site with help of LCM and BIM tools

BIM:

Using LCM for planning the possible working sequences

BIM:

using the Information of LCM and 3D Model to prepare the 5D Model, checking the practicability

BIM:

visualisation of the working areas, lifting and construction units, material lists, simulation and status tracking

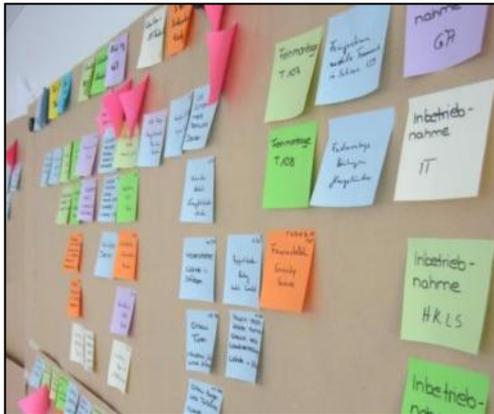
BIM:

supply chain management, material tracking

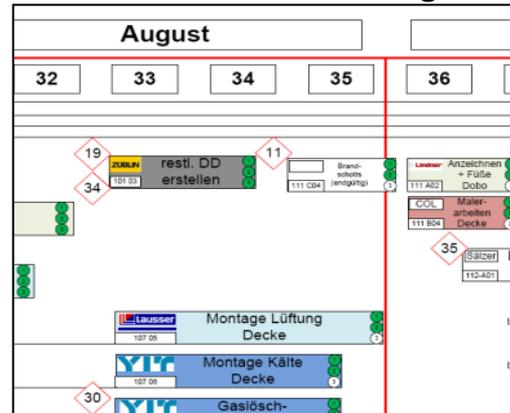
Production management on site

Reliable processes to speed up projects

Process Analysis



Process Planning



Detailed Planning



- Develop construction process
 - Detection of open issues
 - 4 Month lookahead for engineering, procurement and construction
 - Stable, reliable and leveled construction processes
 - Detailed 4 weeks lookahead on a daily basis
 - Production plan on site including logistics
 - Remove obstacles
- ➔ higher flexibility, faster process, less claims

Overall process analysis for the whole project

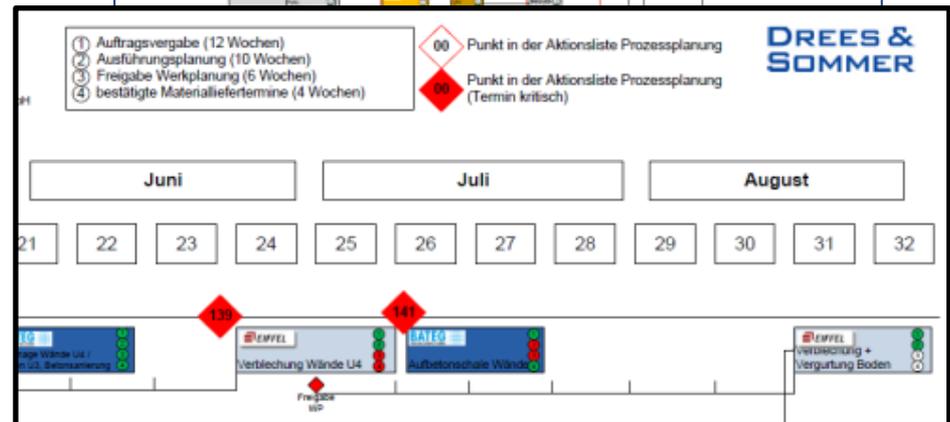
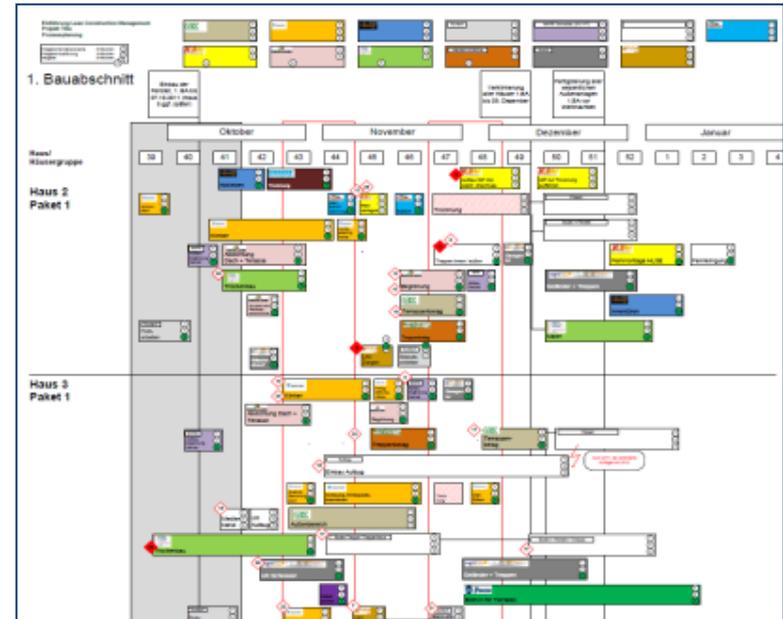
- With a **transparent process view** development and simulation of the whole process sequences
- **Reverse planning**: start of process development from the end to the beginning of the whole project
- **Early identification** and solving of conflicts already in planning phase
- **Optimization of processes** for a part of the processes and for the whole construction
- **Takt timing** and **Sequencing** on basis of the process analysis
- **Interconnection of process and logistic** (JIT) for optimal usage and bottleneck



4-8 Month look ahead process planning

Obstacle free from engineering to the construction site

- **Linking** of design and construction
- On basis of the master time schedule a process planning is created **with all relevant participants** on site
- The focus is on obstacles and **bottleneck resources**
- Defined „**Quality Gates**“ and Milestones are used to identify the stability of the flow between planning and the construction site
- The goal is to **solve all constrains** – before the construction process could be influenced
- Link of detail design, erection concepts and construction



Detailed planning / Planning board

Visual work preparation for construction on a daily basis

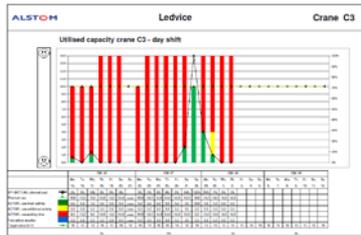
- **Visual tool** for a daily scheduling of the construction and pre-assembly works
- **Takt time** on a daily basis
- **Process optimization**
- **Capacity utilization** of bottleneck resources
- “The **pulling** construction site”
- **Information flow**
- **Stabilization**
- **Stable KPI forecast**



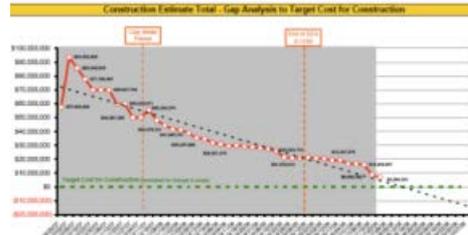
Alstom Construction System



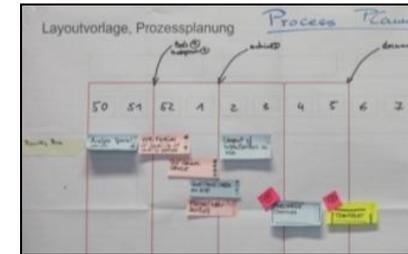
Example - Lean Design in plant construction



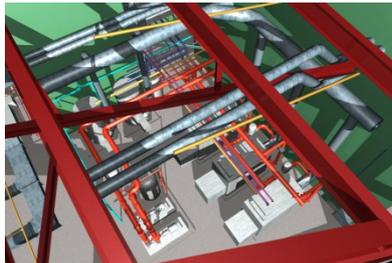
Process KPI



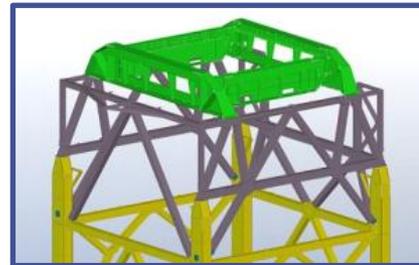
Target Costing



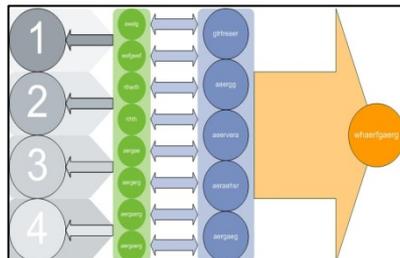
Integretet EPC Planning



5D processes and tools



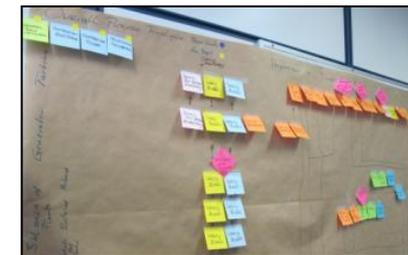
Interface management



Virtual organisation



Planning in teams

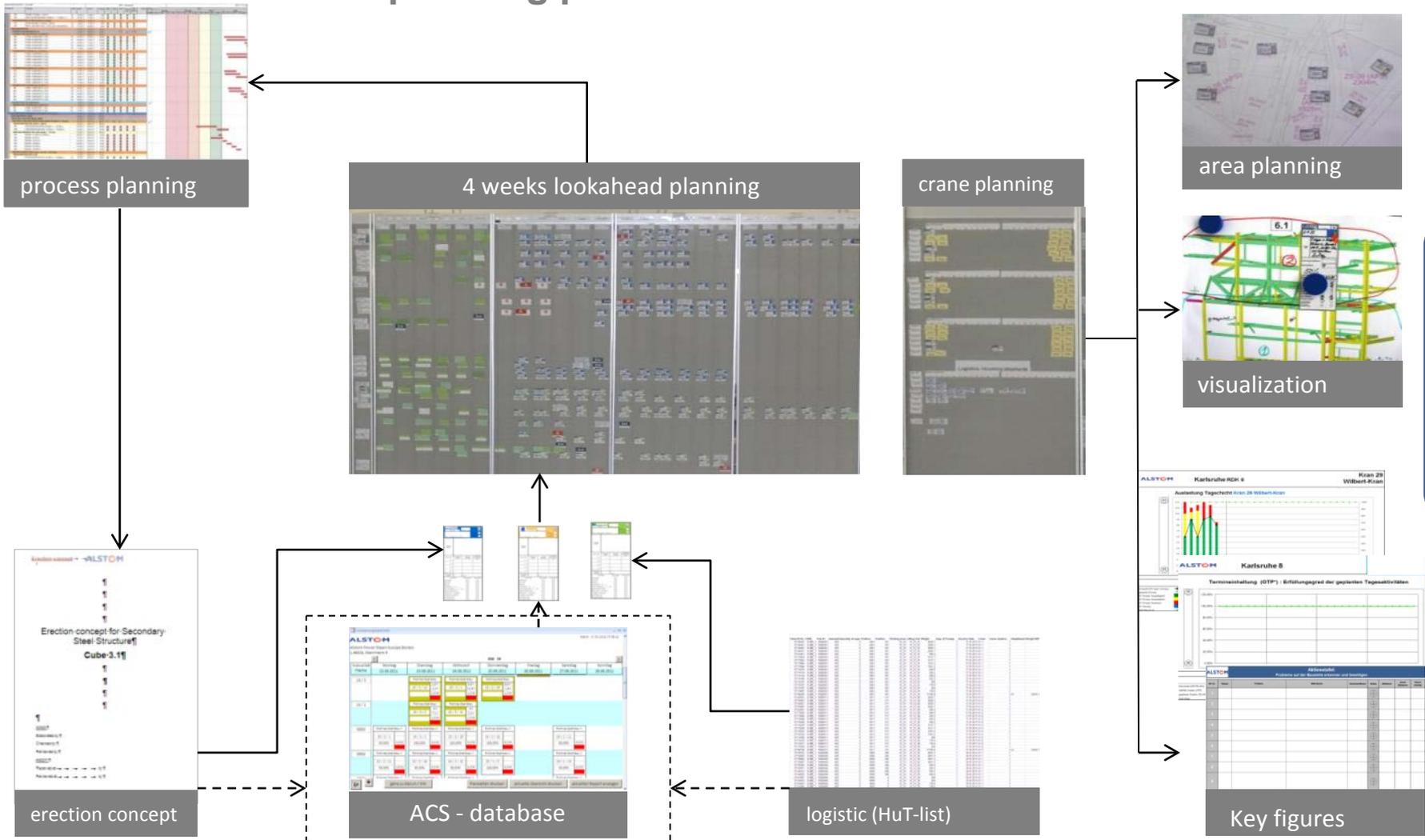


Process Design

Example

Alstom Construction System

The elements of the planning process



Example

List of documents ACS

1.48210 EEMSHAVEN Block A											
1	Montagevorbereitung und -ausführung pre Kubus		SSS Cube	330				Start of preassembly erection: BASED on Lifting 1st Column on 28.03.2011		06.04.2012	
2	Overview Documents for preparation and execution of assembly work										
4											
5				30.12.2011	13.01.2012	27.01.2012	10.02.2012	24.02.2012	09.03.2012	23.03.2012	06.04.2012
6	Document Type "german"	handover from Master	earlier than t - 1w	t - 14w	t - 12w	t - 10w	t - 8w	t - 6w	t - 4w	t - 2w	Erection Start t = 0
7	BE-Übersicht		rel-eng								
8	Tekis BE model		rel-eng								
9	Verstärkzeichnungen			pre-eng			rel-eng			rel-char	
10	Stücklisten pro Verstärkzeichnungen			pre-eng			rel-eng				
11	Montageübersichtsliste			pre-eng			rel-eng			rel-char	
24	Punkt- und Pol-Liste			pre-eng			rel-eng				
25	Dokumentenverzeichnis			pre-eng			rel-eng				
26	Schraube Liste pro Kubus (steigt in Gesamt Kubusliste)								rel-eng		
27	Hilfsbohrliste			pre-eng			rel-eng				
28	Bestätigung Ankererfolge und Termin						pre-scm		rel-scm		
29	Liste aller Änderungen						pre-eng		rel-eng		
30	Montagekonzept				issue-sc						
31	Detaillierte Montagebeschreibung							issue-sc	rel-cc rel- char		

Seite 1

Example

Ducts tracking ACS

1.46210 EEMSHAVEN PROJECT

Montagevorbereitung und -ausführung
pro Kubus
Overview Documents for preparation
and execution of assembly work

Duct System **RGK bis LUV0**

Start of preassembly /
erection: **01.09.2011**

Document Type "gmsac"	last owner from: Walter	earlier than t - 14w	28.06.2011 t - 14w	06.06.2011 t - 12w	23.09.2011 t - 10w	07.07.2011 t - 8w	21.07.2011 t - 6w	04.08.2011 t - 4w	18.08.2011 t - 2w	01.09.2011 Erection start t = 0
BE-Übersichten		rel-eng								
Verbindzeichnungen			pre-eng			rel-eng				
Stücklisten pro Verbindzeichnungen			pre-eng			rel-eng				
Übersichts- / Zusammenbauzeichnungen			pre-eng			rel-eng				
Verbindskizzen			pre-eng			rel-eng				
Dokumentationszeichnis			pre-eng			rel-eng				
Anschlusskürze			pre-eng			rel-eng				
Hilfskürze			pre-eng			rel-eng				
Messskizzen			pre-eng			rel-eng				
Endverbauskürze			pre-eng			rel-eng				
Lagerplanfunktion			pre-eng			rel-eng				
Subtrahenzkürze			pre-eng			rel-eng				
Bestätigung Anlieferungsliste und Termin						pre-com		rel-com		
Liste aller Änderungen						pre-eng		rel-eng		
Montagezeichnungen (soweit von dem Fachbereich / Lieferanten zu erstellen)		rel-eng								
Montagekonzept				issue-co						
Detaillierte Montagebeschreibung							issue-co	rel-co		

Example

PP tracking ACS

1.48210 EEMSHAVEN A+B PROJECT

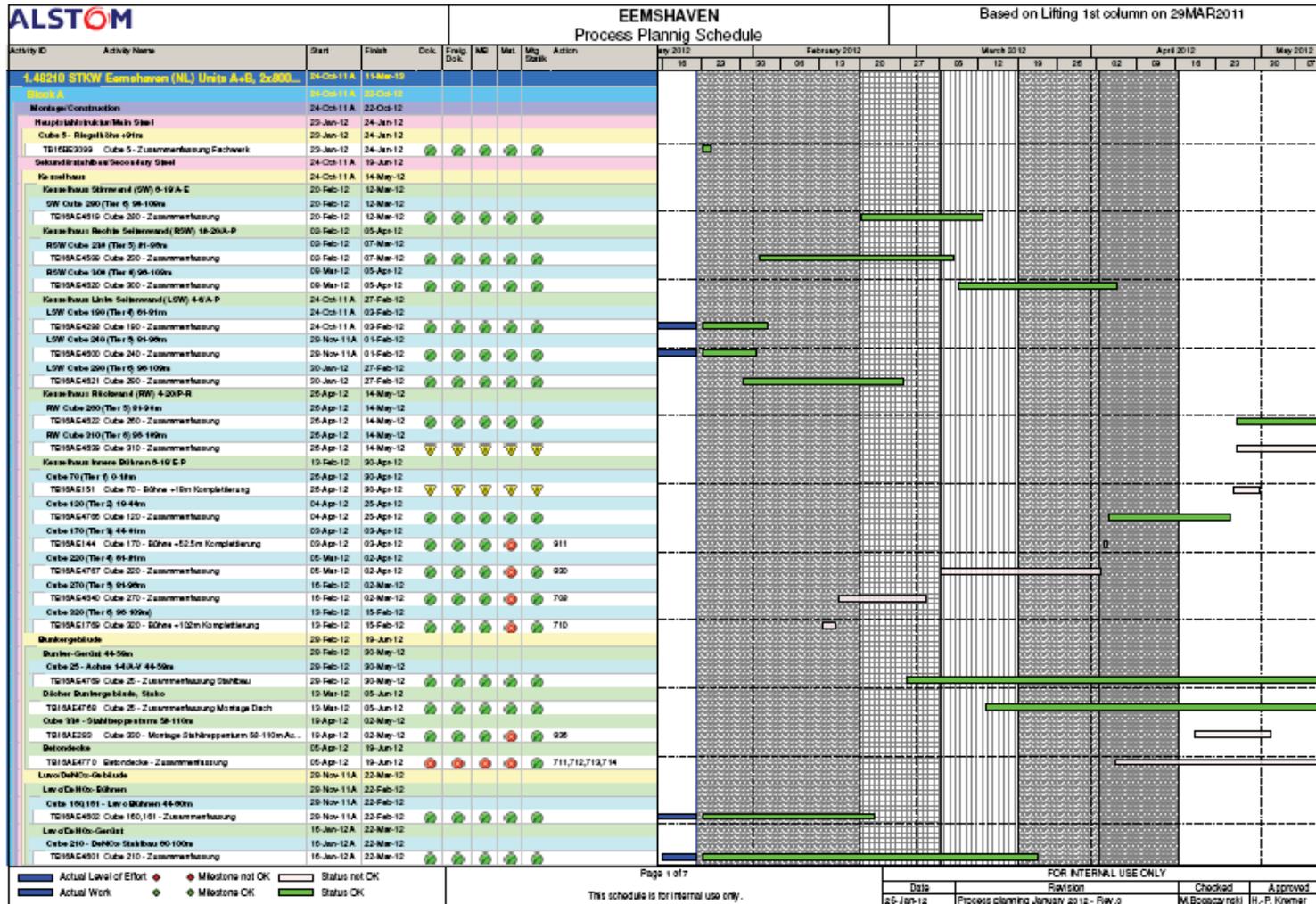
Montagevorbereitung und -ausführung
pro Kubus
Overview Documents for preparation
and execution of assembly work

vertical walls	vertical walls incl. Buckstays haeder external hanging tubes	Start of preassembly / erection:	28.06.2011
----------------	---	-------------------------------------	------------

Document Type "german"	handover from Maritime	earlier than t - 14w	22.03.2011	06.04.2011	18.04.2011	03.05.2011	17.06.2011	31.06.2011	14.08.2011	28.08.2011
		t - 14w	t - 12w	t - 10w	t - 8w	t - 6w	t - 4w	t - 2w	Erection Start t = 0	
Übersichtszeichnungen		pre-eng								
Montagezeichnungen		pre-eng				rel-eng				
Versandstücklisten		pre-eng				rel-eng				
Dokumentenverzeichnis		pre-eng				rel-eng				
erections records		pre-eng				rel-eng				
Lagenspezifikation		pre-eng				rel-eng				
Bestätigung Anlieferungsfolge und Termin						pre-scm		rel-scm		
Montageanweisungen (soweit von dem Fachbereich / Lieferanten zu erstellen)		rel-eng								
Montagekonzept				issue-sc						
Montageschweißpläne in BIMAS						rel-eng				
WPS -							issue-sc	rel-SiteQM		
Detaillierte Montagebeschreibung							issue-sc	rel-cc		
Liste aller Änderungen						pre-eng		rel-eng		

Example

Process planning – today (ACS)



Example

Actionlist of PP ACS

ALSTOM		Interne Aktionsliste (Prozessplanung) Probleme auf der Baustelle erkennen und beseitigen					Stand: 26.01.12			
lfd. Nr.	Datum	Problem	Maßnahme	Verantwortlicher Baustelle	Verantwortlicher	Status	Zieldatum	neues Zieldatum	Datum erledigt	
976	24.01.12	Block B - Vormontage PL Ansaugung: Material nicht vollständig auf der Baustelle	Material auf Vollständigkeit überprüfen, Liefertermine abklären und Wareneingang bestätigen	Böske		☐	30.01.12	06.02.12		
977	24.01.12	Block B - Einheben PL Ansaugung: Montagebeschreibung noch nicht übergeben	Montagebeschreibung / Lifting plan an Alstom übergeben	Böske		☐	30.01.12	06.02.12		
978	24.01.12	Block B - Einheben PL Ansaugung: Material nicht vollständig auf der Baustelle	Material auf Vollständigkeit überprüfen, Liefertermine abklären und Wareneingang bestätigen	Böske		☐	30.01.12	06.02.12		
979	24.01.12	Block B - PL Ansaugung: Montagestatik ggf. nicht vorhanden	Prüfen, ob Statik erforderlich	Böske		☐	30.01.12	06.02.12		
984	26.01.12	Auftragsvergabe für das Ölsystem ist noch nicht erfolgt	Anfrage erfolgt nach Übergabe der techn. Dokumentation durch die Fachabteilung	Lugschi	Summermatter	☐	15.02.12			
985	26.01.12	Dokumente für Heißlagertank noch nicht freigegeben	Die Dokumente für den Heißlagertank müssen noch freigegeben werden	Steinbach	Summermatter	☐	01.02.12			
986	26.01.12	Montage Kondensatleitungen: Dokumente gem. Liste "Review documents for assembly preparation and execution per cube" ggf. nicht vollständig	Dokumente auf Vollständigkeit überprüfen	Steinbach		☐	31.01.12			
987	26.01.12	Aufbau K12: Dokumente gem. Liste "Review documents for assembly preparation and execution per cube" ggf. nicht vollständig	Dokumente auf Vollständigkeit überprüfen	Windisch		☐	31.01.12			
988	26.01.12	Aufbau K12: Freigaben von Prüfstatiker ggf. nicht vorhanden	Prüfen, ob Freigaben vollständig vorhanden sind	Windisch		☐	31.01.12			
989	26.01.12	Aufbau K12: Montagestatik ggf. nicht vorhanden	Prüfen, ob Statik erforderlich	Windisch		☐	14.02.12			

Example

Detailed production planning

Resources, logistics and equipment capacities

Material Database
Material Part List / Material Handling (e.g. RFID)

LCM Database / Planning Tool

Kubus/AB Fläche	Montag 22.08.2011	Dienstag 23.08.2011	Mittwoch 24.08.2011	Donnerstag 25.08.2011	Freitag 26.08.2011	Samstag 27.08.2011	Sonntag 28.08.2011
13 / 2		Polimex Stahlbau 13 / 2 / 12 2,5h 1,4t 1,0M	Polimex Stahlbau 13 / 2 / 1 5,5h 11,6t 1,0M	Polimex Stahlbau 13 / 2 / 10 8,5h 1,6t 1,0M			
13 / 2		Polimex Stahlbau 13 / 2 / 2 6h 7,2t 1,0M	Polimex Stahlbau 13 / 2 / 11 3h 2,3t 1,0M				
DE02	Polimex Stahlbau V 13 / 2 / 1 50,00% 4,0M	Polimex Stahlbau V 13 / 2 / 1 100,00% 4,0M	Polimex Stahlbau V 13 / 2 / 10 100,00% 4,0M	Polimex Stahlbau V 13 / 1 / 12 100,00% 4,0M		Polimex Stahlbau V 13 / 1 / 11 50,00% 4,0M	
DE02	Polimex Stahlbau V 13 / 2 / 11 50,00% 4,0M	Polimex Stahlbau V 13 / 2 / 10 50,00% 4,0M	Polimex Stahlbau V 13 / 1 / 12 50,00% 4,0M	Polimex Stahlbau V 13 / 1 / 3 100,00% 4,0M		Polimex Stahlbau V 13 / 1 / 13 33,33% 4,0M	



Process planning
4 month lookahead linked to the overall shedule (MTS)

“Working Cards”
incl. logistic information

Example

ACS-Database Overview of Pre-planning

Vorplanungsübersicht Stand: 17.02.2012 17:08:12

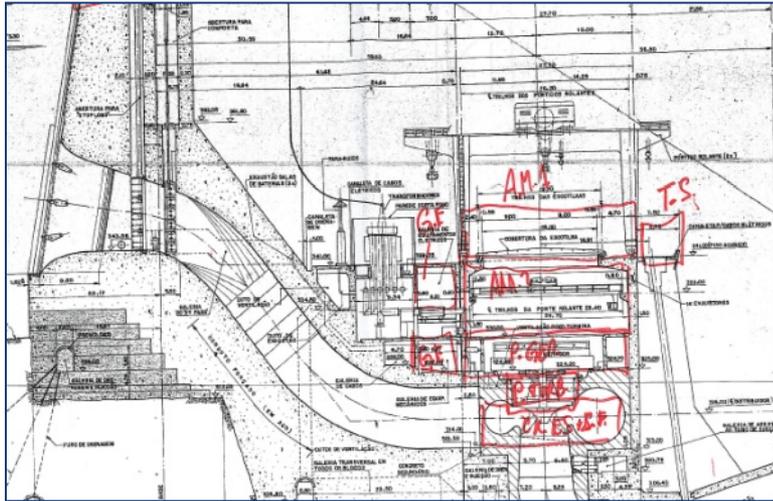
ALSTOM
Alstom Power Steam Europe Boilers
1.48318, Mannheim 9

KW 34

Kubus/AB Fläche	Montag 22.08.2011	Dienstag 23.08.2011	Mittwoch 24.08.2011	Donnerstag 25.08.2011	Freitag 26.08.2011	Samstag 27.08.2011	Sonntag 28.08.2011
13 / 2		Polimex Stahlbau 13 / 2 / 12 2,5 h 1,4 t 1,0 M -	Polimex Stahlbau 13 / 2 / 1 5,5 h 11,6 t 1,0 M -	Polimex Stahlbau 13 / 2 / 10 8,5 h 1,6 t 1,0 M -			
13 / 2		Polimex Stahlbau 13 / 2 / 2 6 h 7,2 t 1,0 M -	Polimex Stahlbau 13 / 2 / 11 3 h 2,3 t 1,0 M -				
DE02	Polimex Stahlbau V 13 / 2 / 1 50,00% 4,0 M -	Polimex Stahlbau V 13 / 2 / 1 100,00% 4,0 M -	Polimex Stahlbau V 13 / 2 / 10 100,00% 4,0 M -	Polimex Stahlbau V 13 / 1 / 12 100,00% 4,0 M -		Polimex Stahlbau V 13 / 1 / 11 50,00% 4,0 M -	
DE02	Polimex Stahlbau V 13 / 2 / 11 50,00% 4,0 M -	Polimex Stahlbau V 13 / 2 / 10 50,00% 4,0 M -	Polimex Stahlbau V 13 / 1 / 12 50,00% 4,0 M -	Polimex Stahlbau V 13 / 1 / 3 100,00% 4,0 M -		Polimex Stahlbau V 13 / 1 / 13 33,33% 4,0 M -	
DE02	Polimex Stahlbau V -	Polimex Stahlbau V -	Polimex Stahlbau V -	Polimex Stahlbau V -		Polimex Stahlbau V -	

Example

Adaptation of LCM elements to Alstom Planning cards, OTP's, meeting structure



ALSTOM Modernization Hydro Power Plant, Brasil, Agua Vermelha
ean Construction Management
 weekly report CW .. (.....2013.....2013)

Logistic

Gewerk	Firma	KW45	KW46	KW47	Gesamt
		40%	0%	0%	40%
					0%
					0%
					0%
Gesamt:		10%	0%	0%	10%

Quality

Vantwortlicher	offene Punkte	gelöste Punkte	KW45	KW46	KW47	Gesamt
CRP	9	5	20%	9%	50%	
BAL	6	6	50%	0%	100%	
HGM	6	2	0%	0%	0%	
D&S			0%	0%		

Progress

Remarks / Special

- Terminzusage für den Folgetag werden zu 100% eingehalten. Ab KW 43 führt BAL keine Statistik mehr zur Terminhaltung der Firmen (Kennzahl geht auf 0). Ab KW47 wird die Terminhaltung der Aufgaben der ausführenden Firmen docuaddiert.
- Die Übernahme der Aktivitäten aus der Prozessplanung auf die Detailplanung lag bei der letzten Prozessplanung, 23.11.2012 (KW47) bei 59,5%. Dieser Wert spiegelt zwar eine kontinuierliche Steigerung des Wertes wieder, allerdings wurden auch auch weniger Prozesse in der Prozessplanung geplant.
- Die offenen Punkten aus den Aktionslisten wurden nur zum Teil zum Zielttermin erfüllt.
- Eine Aufnahme der Kennzahl und des täglichen LCM Meetings ist derzeit nicht möglich, da kein Zugang zum LCM-Container besteht. (Fehlende Treppe). Aus diesem Grund bestehen die Kennzahlen allein aus den Werten aus der Aktionsliste.

action board

Volth Hydro Power - Brasil
 Agua Vermelha

overall process analysis

no.	date	description	problem	measures	responsible	status	closed date	open again	reopen date
1	11.12.2012	general	interface with customer safety blocks	clarify the interface / items e.g. small items	LOTH	LOTH			
2	11.12.2012	system	customer decision of additional services	meeting with customer	LOTH	LOTH			30.07.2013
3	11.12.2012	system	check to install the machine, please not close	what is the best and cheapest solution	LOTH	LOTH			01.11.2013
4	11.12.2012	transport	transport documentation	check and create transport documentation	LOTH	Customer			
5	11.12.2012	system	check of order for road cover	what is the best and cheapest solution	LOTH	LOTH			
6	11.12.2012	release of parts	check out	confirm procedure and authorization	LOTH	LOTH			
7	11.12.2012	release of parts	check out	check out	LOTH	LOTH			
8	11.12.2012	release of parts	check out	check out	LOTH	LOTH			
9	11.12.2012	general	interface with customer	define procedure	LOTH	LOTH			
10	11.12.2012	release of parts	check out	check out	LOTH	LOTH			

defined, in process, implemented, completed

Example

Detail Planning Board

Planning on a daily basis



Visualization of activities on planning cards

Transparency of workload per day

Montage Plankarte Vorderseite

T
N

K7.1

11 / 1 / 1

Code / Arbeitsbereich / Hubenheit

Vor-
montage

Vorarbeit

Arbeitspaket

Kran-Typ	Gesamtanz. Hube	Gesamt Tonnage	Gesamte Einsatzdauer (h)
K7.1 <input checked="" type="checkbox"/>	1	15,6	10
<input type="checkbox"/>			
<input type="checkbox"/>			
<input type="checkbox"/>			

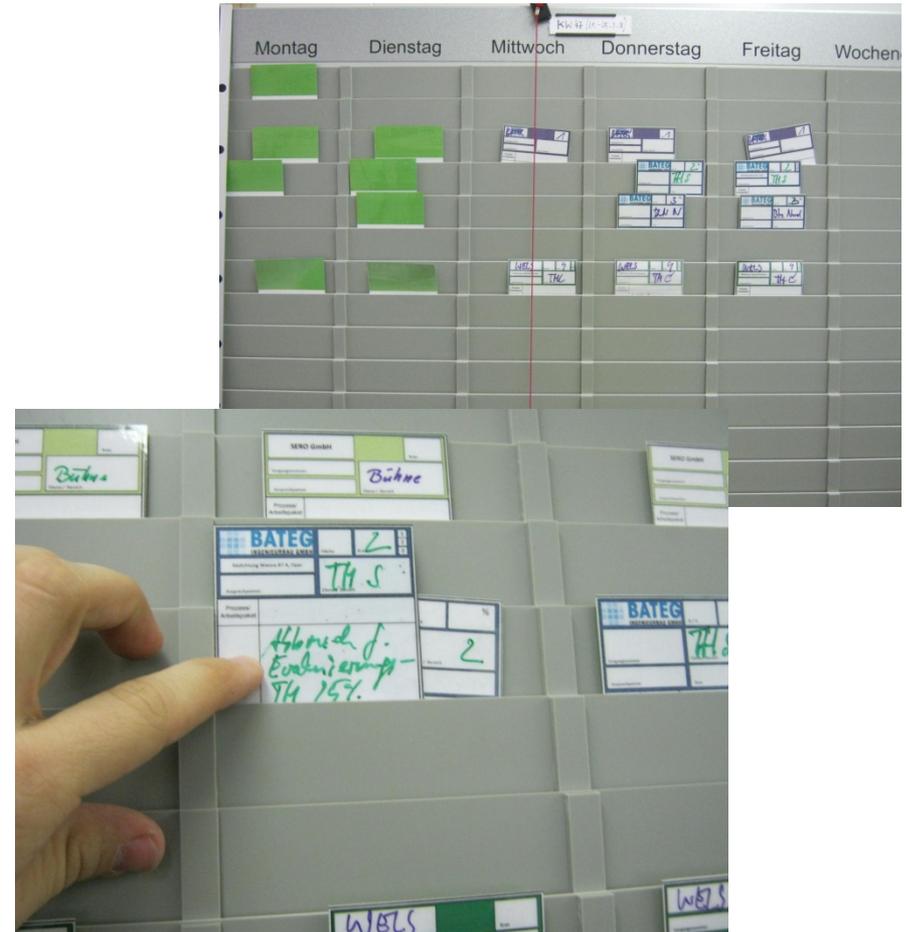
Personalstärke	6	12.01.2011
----------------	---	------------

Vorarbeit: notwendig? vorhanden?

- Unterlagen
- Personal
- Material
- Lagerfläche Nr. _____
- Vormontageplatz _____ qm
- Zeichnungsprüfung
- Hilfskonstr. + Prüfstatik
- Freigabe Prüfstatiker
- Arbeitsgerüste
- Transportmittel

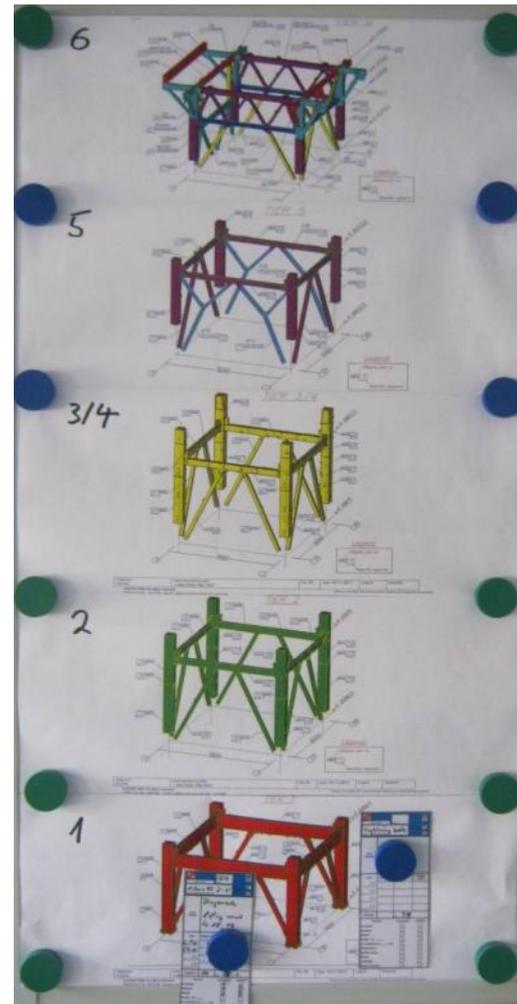
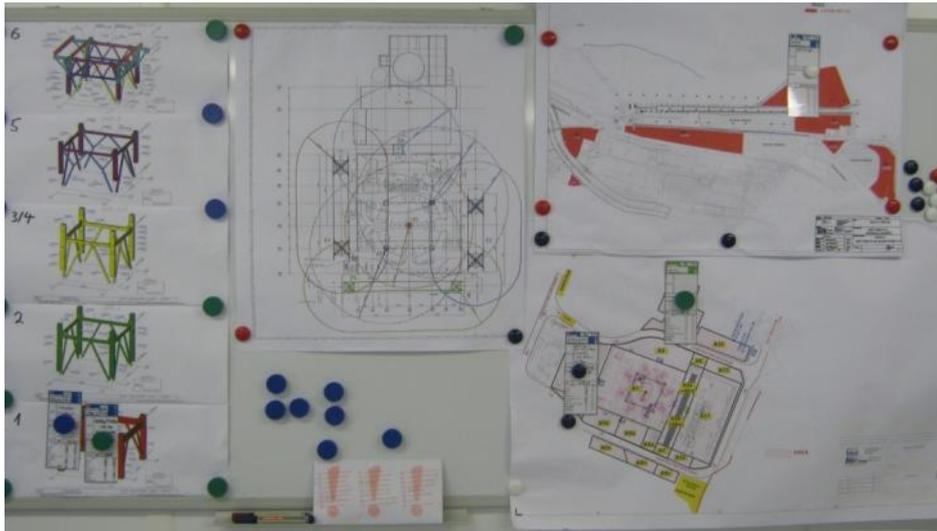
Montage Plankarte Rückseite

ID - Nr.	Positionskategorie	Code OS	Bauzeitstatus	Planstatus	Pos.-Nr.	BG
166523K11-C3	1-Hauptposition	1-01	05	55	1003	110
166523K11-C3	2-Lostelle Anschluss	1-01	05	55	1003	110
166523K11-C7	1-Hauptposition	1-01	05	55	1004	110
166523K11-LPR6	1-Hauptposition	1-01	40	55	2001	110
166523K11-LPR10	1-Hauptposition	1-01	05	55	2020	110
166523K11-LPR16	1-Hauptposition	1-01	05	55	2032	110
166523K11-LPR21	1-Hauptposition	1-01	05	55	2054	110
166523K11-LPR28	1-Hauptposition	1-01	05	55	2060	110
166523K11-LPR33	1-Hauptposition	1-01	05	55	2070	110

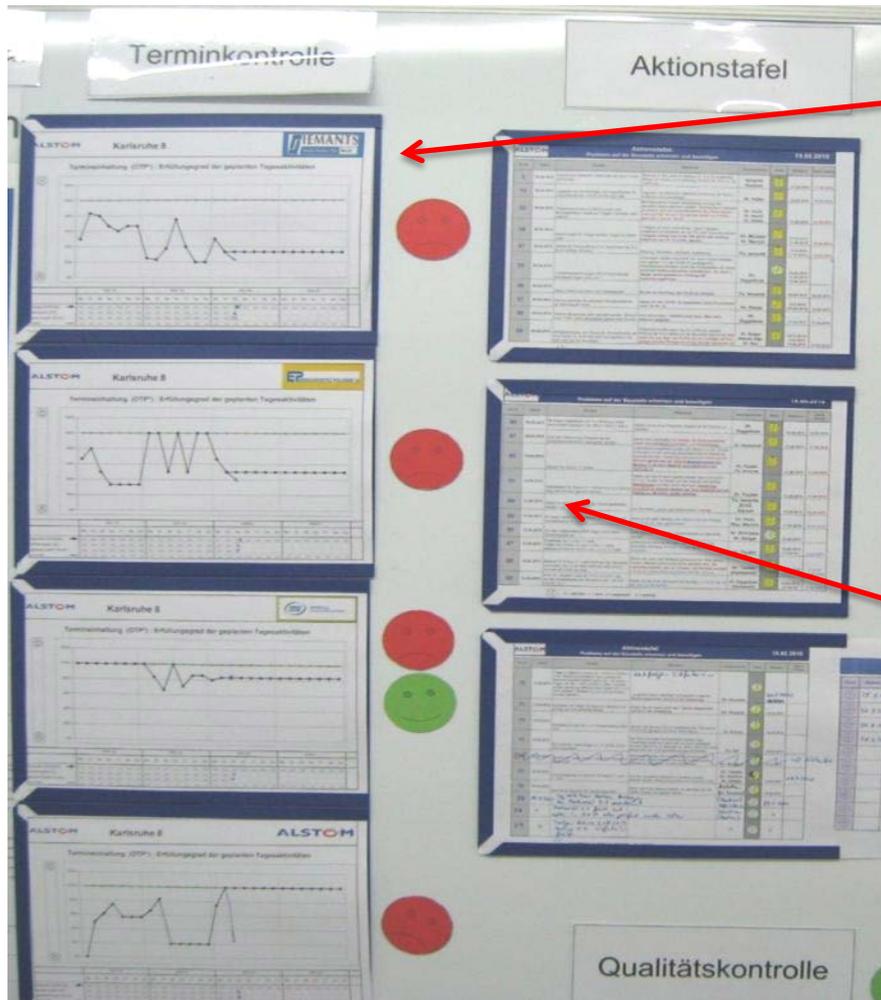


Assignment of planning card

Working areas

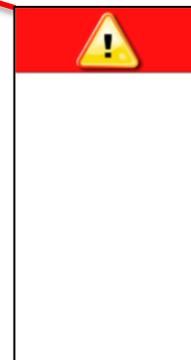


KPI's and Action board ACS



Reasons for bad OTP are placed behind the KPI-sheets and available for everyone

Basis Claim Management



Example

ACS Implement at Alstom sites

Implementation throughout Europe



Sostanj Boiler (Slovenja)



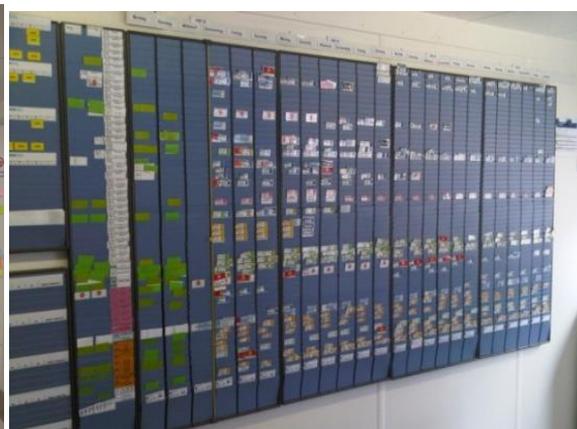
Eemshaven (Netherlands)



Belchatow (Poland)



Sostanj Plants (Slovenja)



Karlsruhe (Germany)



Ledvice (Czech Republic)

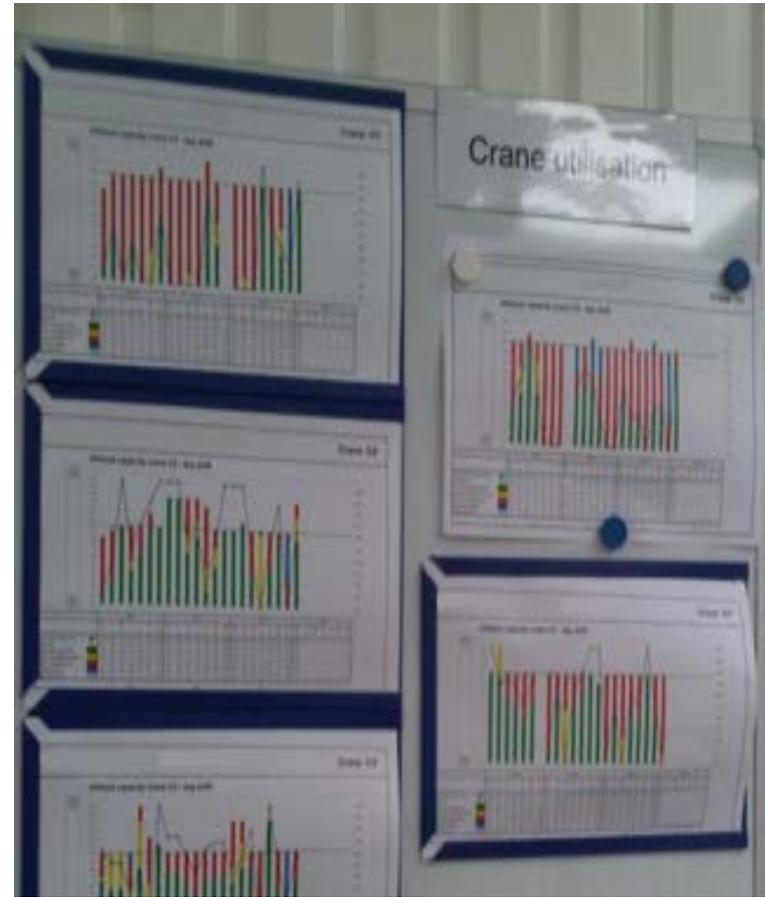
Example

Area-space management ACS



Example

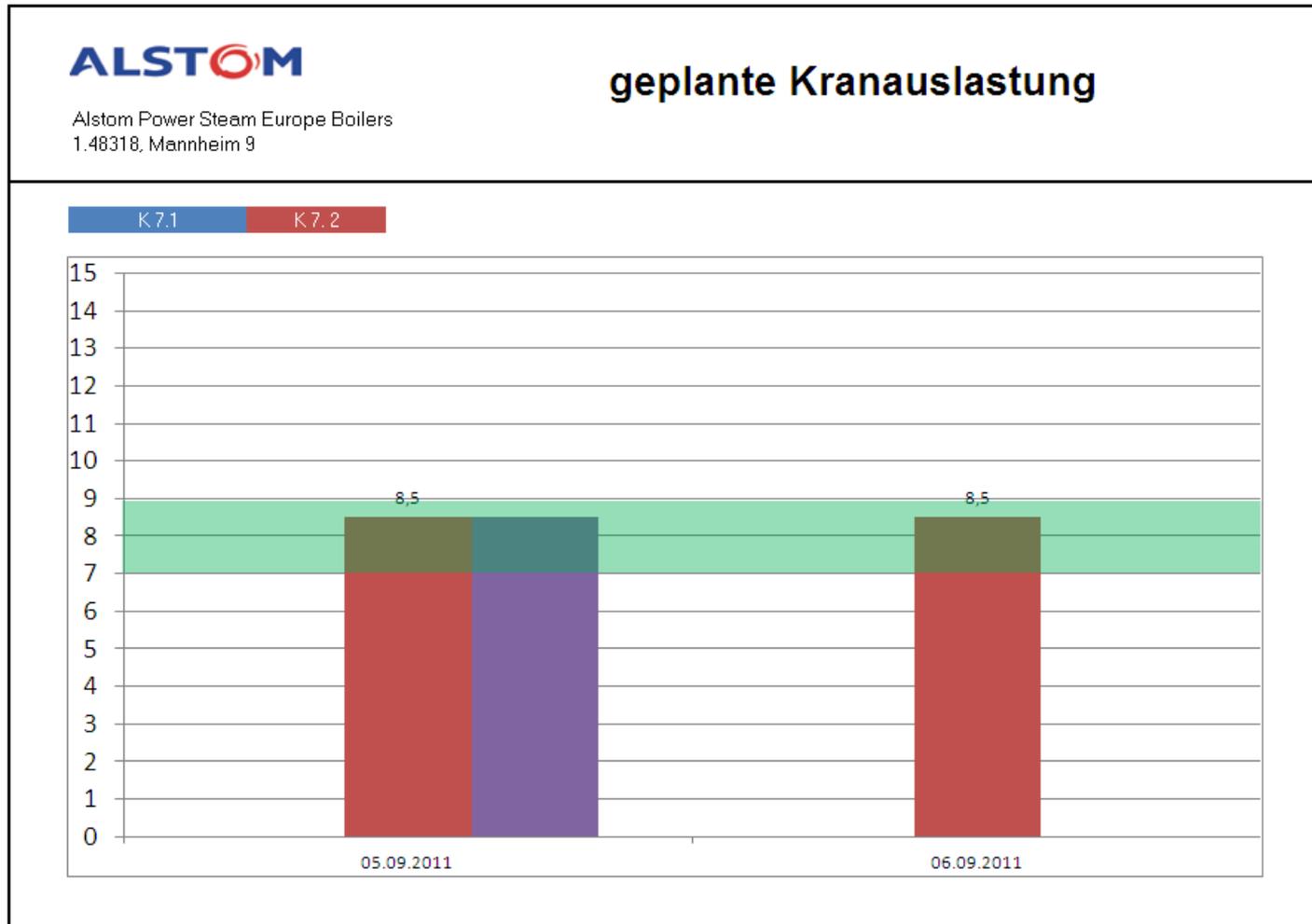
Detail Crane-planning and controlling of crane workload



Example

ACS Database

planned use of resources (crane)

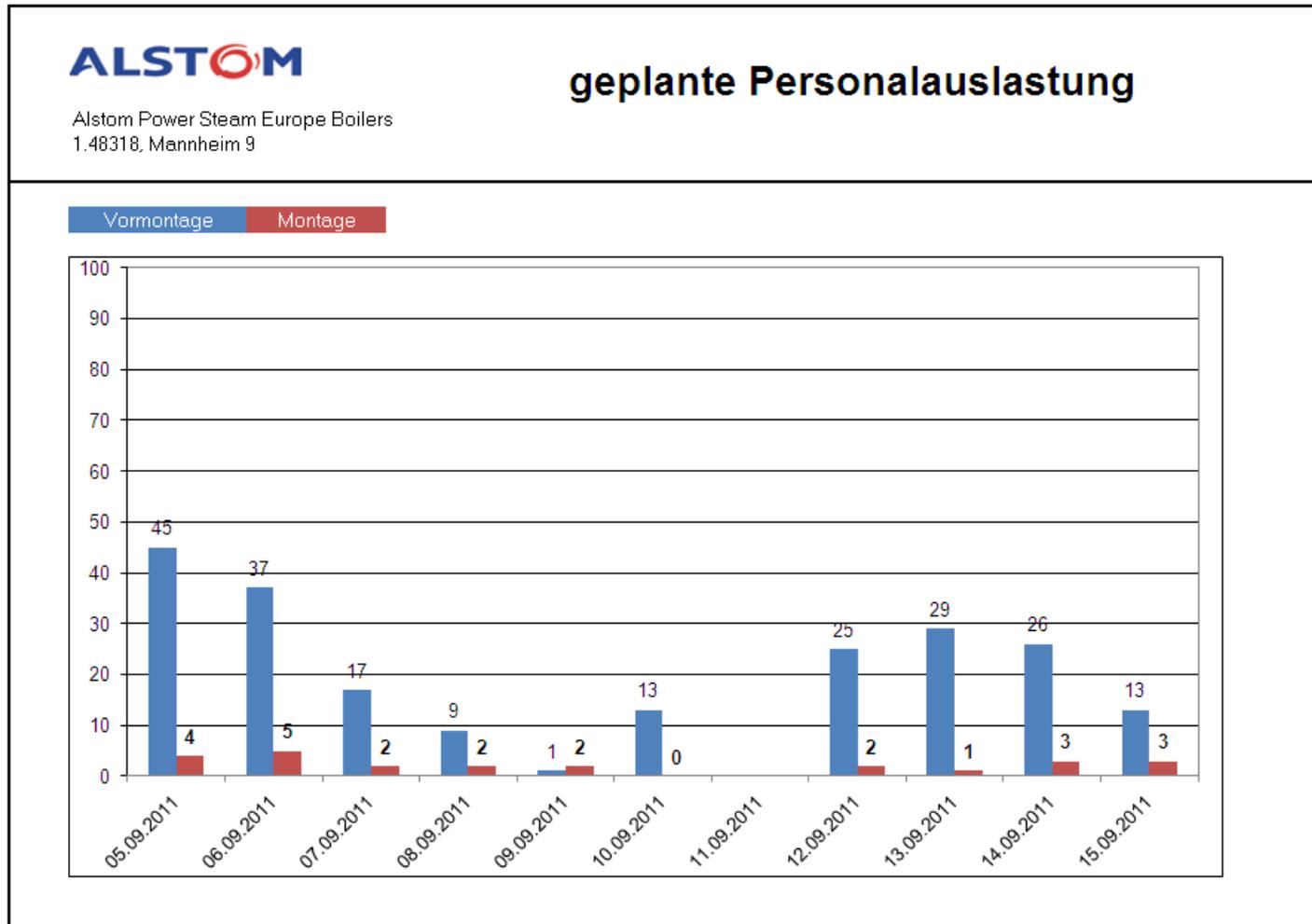


Example

Info out of 4 weeks
lookahead

ACS Database

Planned use of resources (workload of staff)

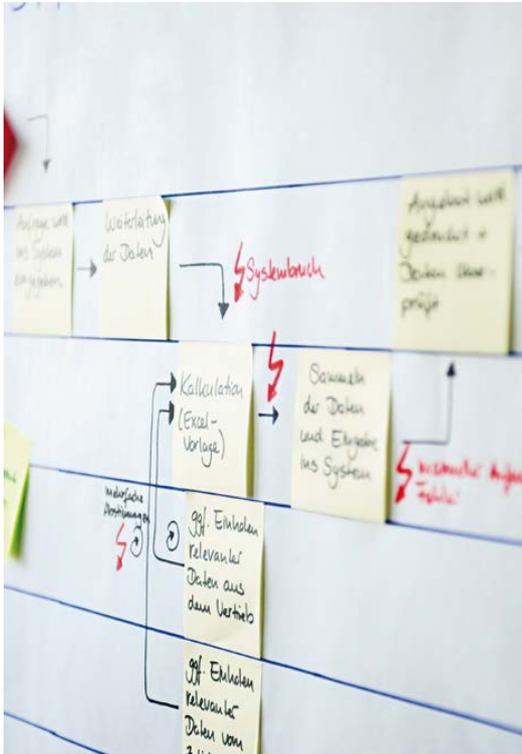


Example

Info out of 4 weeks
lookahead

Effects by Lean Construction Management

Reliability of processes



- **Combination of advantages** of both tools (BIM + LCM)
- **Reduction of costs** due to more efficient processes and prevention of interferences
- **Testing the practicability** of the planned execution
- **High stability** for personnel planning, logistics and other capacity utilization, bottlenecks
- **Transparent and planned processes** for all trades with the aim to eliminate problems as early as possible
- **High flexibility** for changes
- **Realistic view of total costs**
- **On budget and on time completion** of projects

Win-Win situation for all involved parties

Your contact

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