

PROMOTING COLLABORATIVE CONSTRUCTION PROCESS MANAGEMENT BY MEANS OF A NORMALIZED WORKLOAD APPROACH

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Context

Focus on S

- ▶ Limited mo
- ▶ Limited res
- ▶ Limited knowledge
management theory and practice

**Lean
Construction**

...as a consequence

~ coarse planning and management

adding tasks

identified too late

very actions



Lean Approaches

- ▶ Last Planner System (LPS)
- ▶ Takt Planning & Last Planner System
- ▶ Location Based Management System

Last Planner System

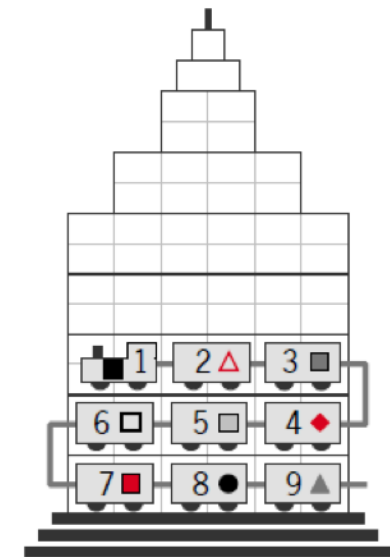
Based on several principles:

- ▶ Planning at **different levels of detail**
- ▶ Create **commitments**: Collaborative Planning
- ▶ Measure **schedule reliability**: Percent Plan Complete (PPC)
- ▶ **Continuous improvement**: Feedback mechanism
- ▶ *Limited* support for **quantitative** construction progress measurement



Takt Planning & LPS

- ▶ **Takt Planning** can be used as a support of LPS to:
 - ▶ Standardize batches, striving for continuous workflow
 - ▶ Aim at disruption-free handovers between trades
- ▶ Mainly applicable to **repetitive** construction work
- ▶ Often difficult to define **takt area** w.r.t chosen **takt time**



Legende

■ Dry walls	■ Mains supply (Elt)	■ Painter	■ Electrical installation	△ Plumber (HLS)
▲ Fitter	□ Paver	◆ Carpet layer	● Carpenter	

Location Based Management System (LBMS)

Location Based Management System (LBMS):

- ▶ Focuses on tasks that repeat in different **locations**
- ▶ Aims at reducing movement of resources in space
- ▶ Limited focus on:
 - ▶ **social** aspects in a production planning system
 - ▶ **learning** from process feedback



Desiderata

- ▶ Commitment network (LPS)
- ▶ Schedule reliability (LPS)
- ▶ Learning from feedback (LPS)
- ▶ Location-Based perspective (LBMS)

Additionally:

- ▶ Introduce a **quantitative construction progress measurement**...
- ▶ ...which serves both **repetitive** and **non-repetitive** projects



The Normalized Workload Approach

1. For each **task** and **location** estimate:

- ▶ The production rates;
- ▶ Required number of workers;
- ▶ Work sequencing.

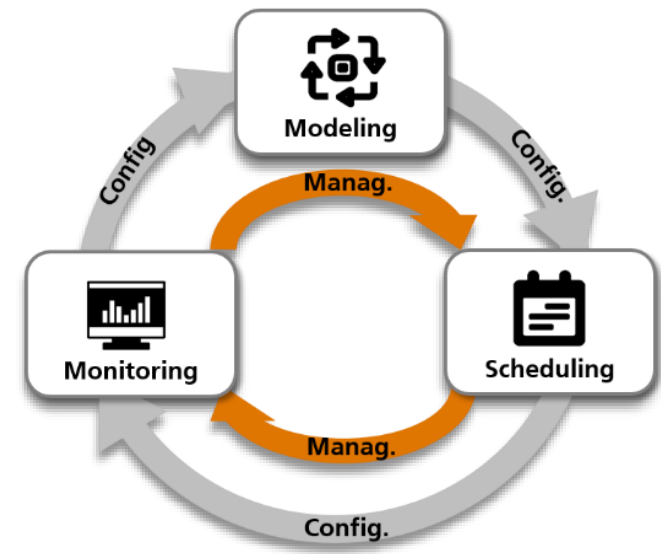
$$Pitch_{\text{parquet_laying,Floor_1,2}} = \frac{20 \text{ m}^2}{1 \text{ working_day}}$$

2. Normalize to a time interval

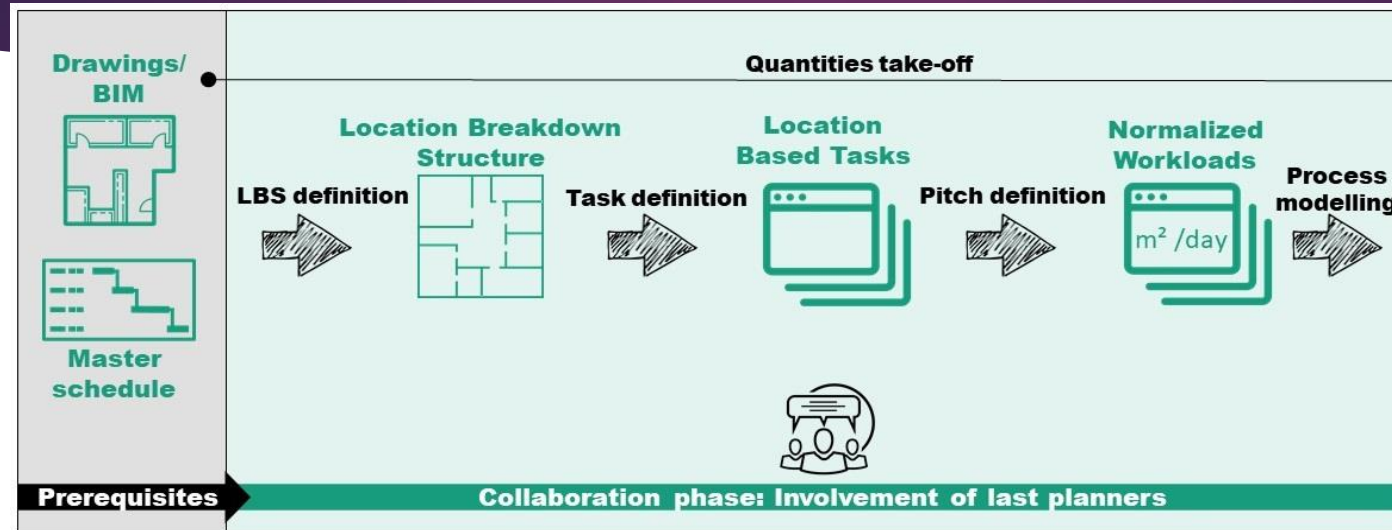
$$Pitch_{\text{Task}_i, \text{Loc}_j, \text{Crewsize}_k} = \frac{\text{Quantity}_{ij}}{\text{time interval}}$$

How is the Pitch Applied?

1. Collaborative process **modeling**
2. Rolling short-term **scheduling** based on modeling
3. Real-time progress **monitoring** with feedback loops

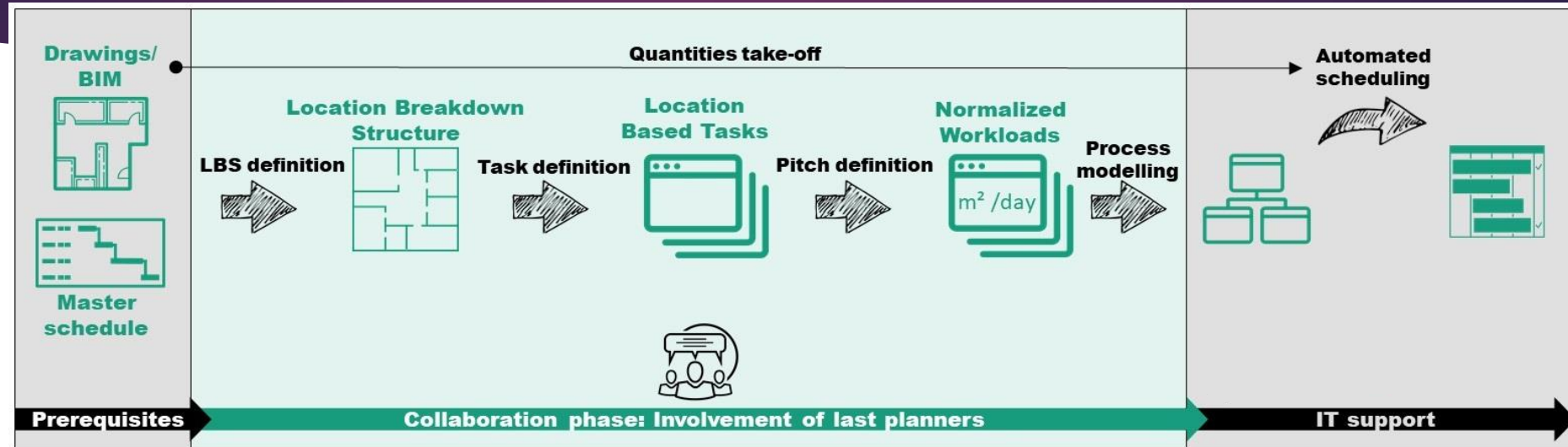


1. Collaborative Process Modeling



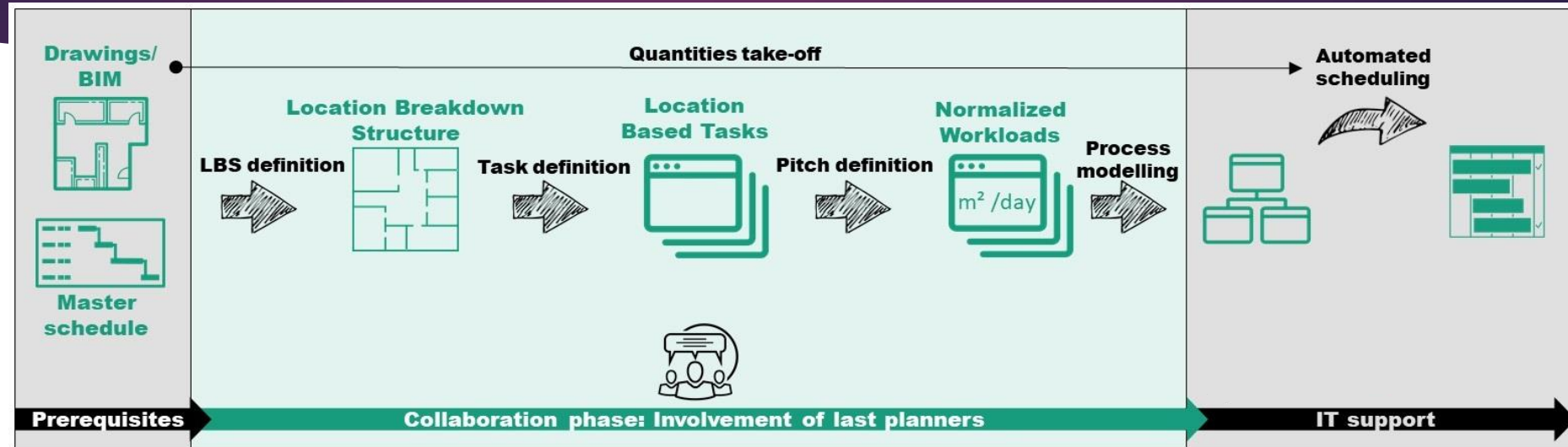
- ▶ Collaborative definition of the requirements on the execution process:
 - ▶ Locations, tasks, **pitch**, resources, dependencies
- ▶ The pitch is thus part of the commitments

2. Rolling Short-Term Schedule



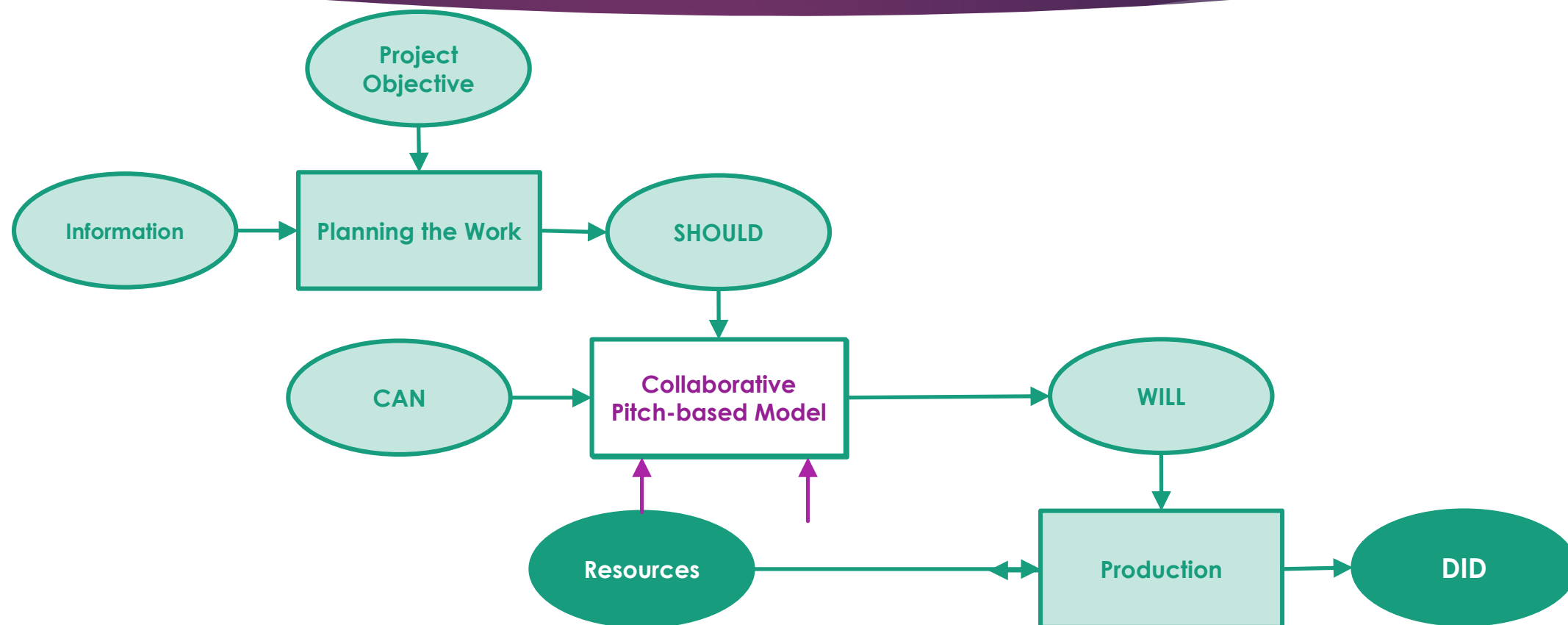
- ▶ Define a **schedule** for short period of time:
 - ▶ Relying on the **pitch**
 - ▶ Based on up-to-date **progress information**
 - ▶ **Automatically** generation

3. Quantitative Real-Time Monitoring

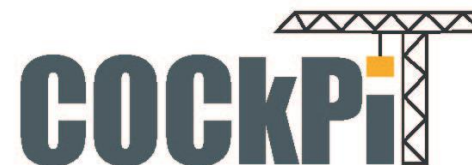


- ▶ **Quantitatively** measure the progress on site
 - ▶ Compare and possibly update the pitches
 - ▶ Compute the updated budget forecasts until project completion
- ▶ **Feedback** loop-based optimization

Turning the Planning-Production Cascade into a Loop



The COCKPiT Project



- ▶ **COCKPiT**: Collaborative Construction Process management
- ▶ Develop **methodologies** and **IT-Tools** to support construction process execution

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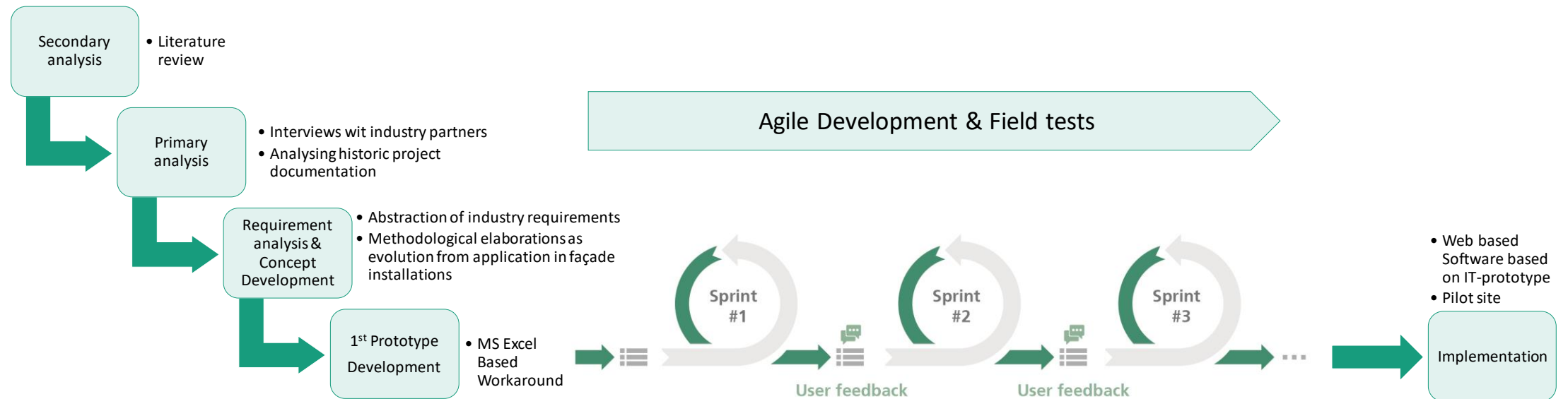


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COCKPiT Research Methodology



COCKPiT Current Development

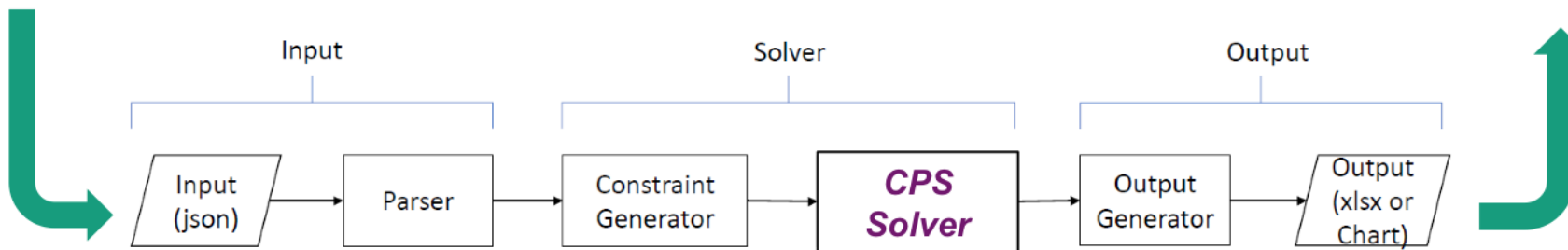
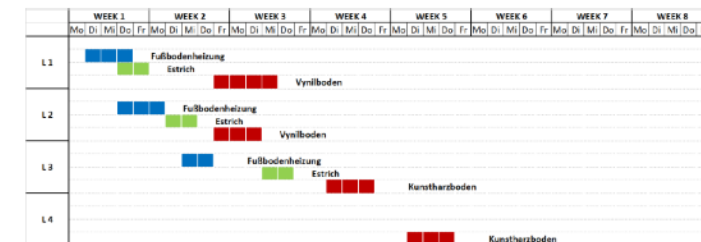
SITE DIARY

Project: Feuerwehrehalle Sterzing Weather: cloudy
 Project No.: XXXX H Temp: 15 °C
 Date: Wildo L Temp: 17 °C
 Site Manager: E. Weissteiner Wind: 3.8 km/h

SAVE DATA

TASK	PITCH	COMPLETION [%]	ABSOLUTE	WORKER
L1 Fußbodenheizung	2 rooms	75	1.5 rooms	Ulrich Klausen
L1 Estrich	25 m²	50	12.5 m²	Peter Roland
L2 Fußbodenheizung	2 rooms	100	2 rooms	Wolfgang Heinz

ID	Task	Trade	BQ-Position	Predecessor	Type/Prod	Daily Productivity	Locations
1	Gipskörbe 100mm	Trockenbauer	04.05.02.02.b		Concrete	Quantity Unit	L1 L2 L3 L4
2	Installationen - HL	Heizungsbauer	000-000-000		FS	2 2 rooms	
3	Installationen - EL	Elektriker	000-000-000		FS	2 1 room	
4	Montage Badmöbeln	Trockenbauer	000-000-000		FS	1 30 m²	
5	Schraubanker	Holzbauer	000-000-000		FS	2 80 m²	
6	Dämmungen	Holzbauer	000-000-000		FS	2 20 m²	
7	Badenheizung	Heizungsbauer	000-000-000		FS	2 25 m²	
8	Industrieböden	Bodenleger	000-000-000		FS	2 25 m²	
9	Estriche	Estrichleger	000-000-000		FS	2 30 m²	
10	Luftheizkörper Estriche	Heizungsbauer	000-000-000		FS	1 6 rooms	
11	Deckenverkleidungen	Trockenbauer	000-000-000		FS	1 12 m²	
12	Baden und Wandverkleidungen	Bodenleger	000-000-000		FS	1 35 m²	
13	Bodenarbeiten	Maler	000-000-000		FS	1 45 m²	
14	Montage Fenster	Fensterbauer	000-000-000		FS	2 8 20%	
15	Verglasungen	Bodenleger	000-000-000		FS	2 25 m²	
16	Kunstharzböden	Bodenleger	000-000-000		FS	2 25 m²	



Thank you for the Attention

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