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Visualisation of  
manufacturing data of  
segmental production sites

09.-10. März 2017, Europapark Rust



- 1. SDS | The Story behind**  
philosophy and benefits
- 2. Practical Challenges**  
SDS in use at Boßler and Koralmtunnel
- 3. Visualisation in the Future**  
presentational views and KPIs to steer the production
- 4. Summary**  
digitalisation in segmental production sites



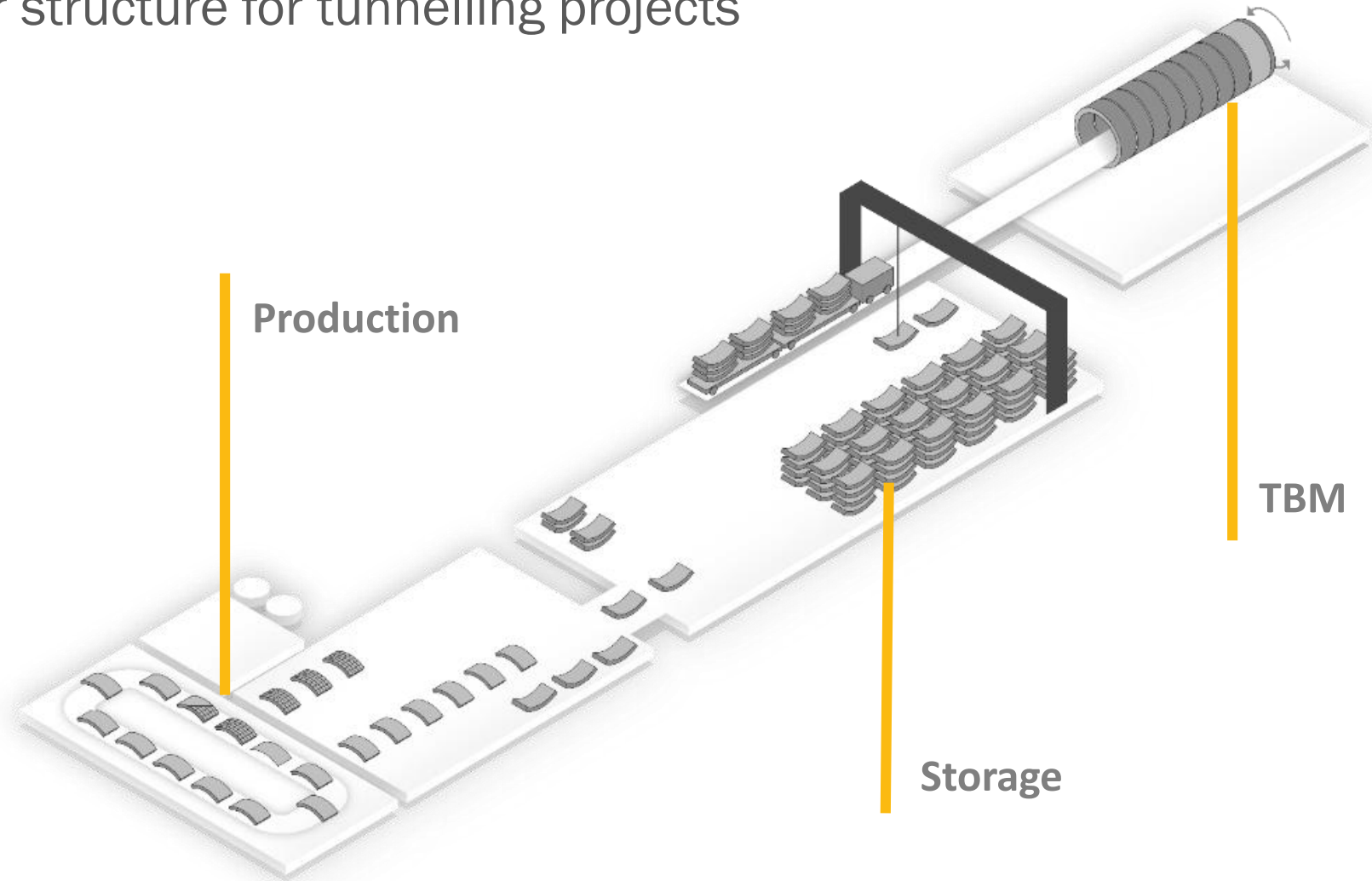
1. SDS | The Story behind
2. Practical Challenges
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4. Summary





## Production and Logistics Management System | SDS

Modular structure for tunnelling projects





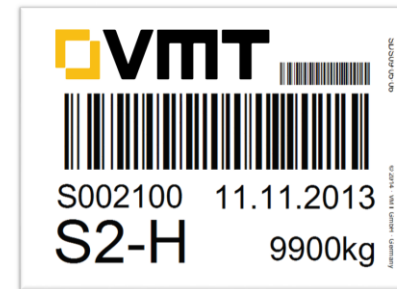
# Philosophy and Components

## How SDS works

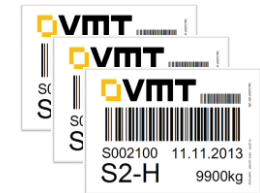
### System Structure



### Identification Aid



*segment barcodes*



*production instrument & logistic barcodes*



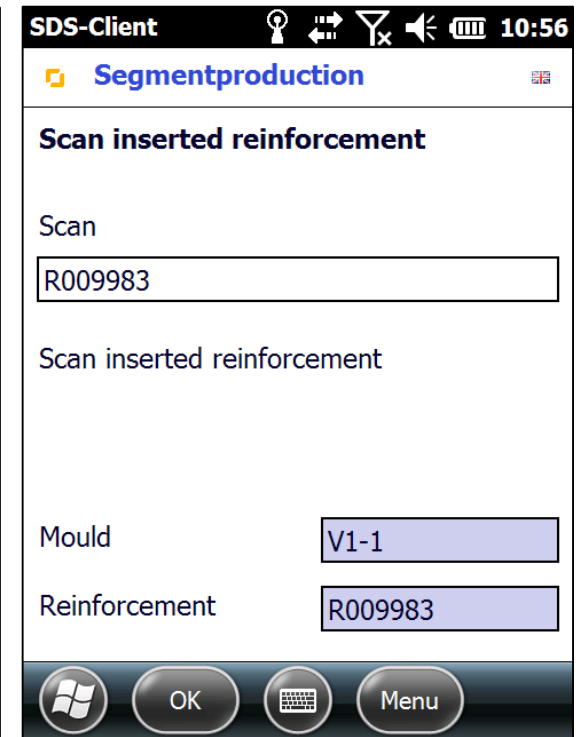
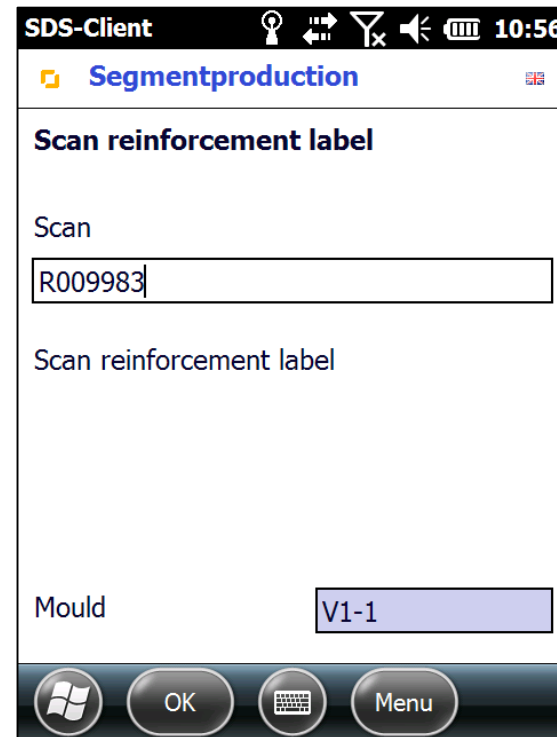
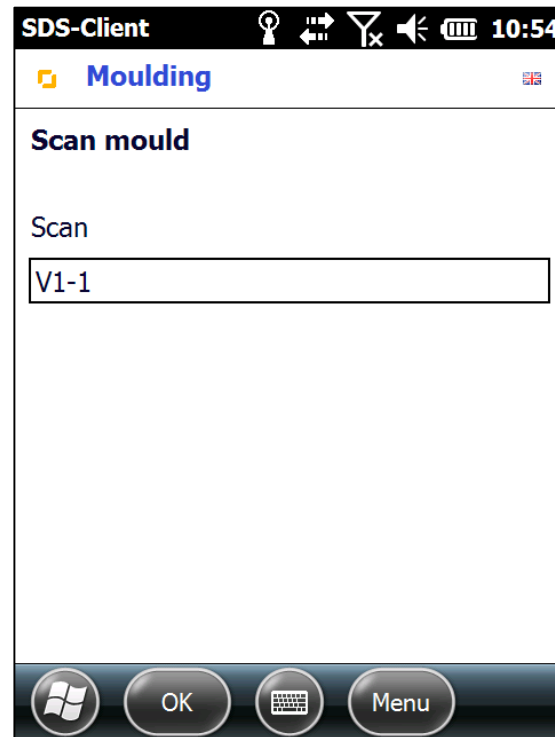
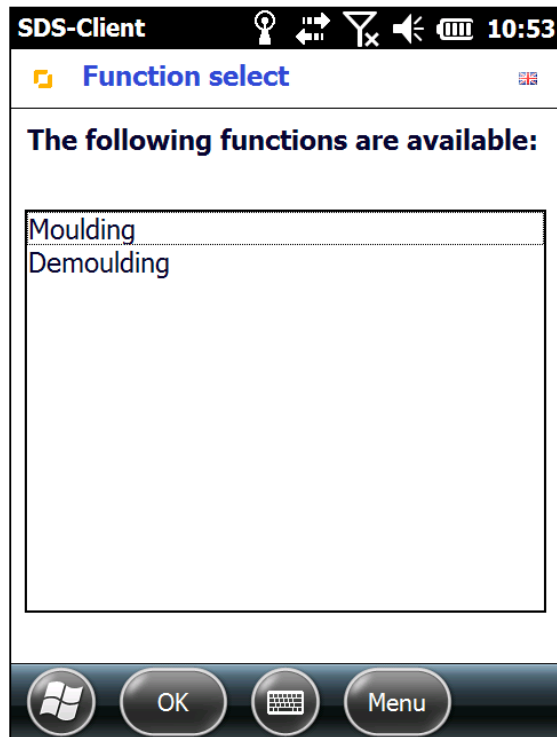
*reinforcement barcodes*



*RFID tags*



# Example mobile Barcode Scanner Handling during moulding





## SDS is more than a simple Barcode System documentation | quality assurance | optimisation

- VMT digitally maps every segmental production site
- all processes will be customised
- extensive warehouse management up to part-automatisation
- commissioning, training and production launch attendance on site
- one Face to the customer - 24/7





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## High Requirements – tight Schedule

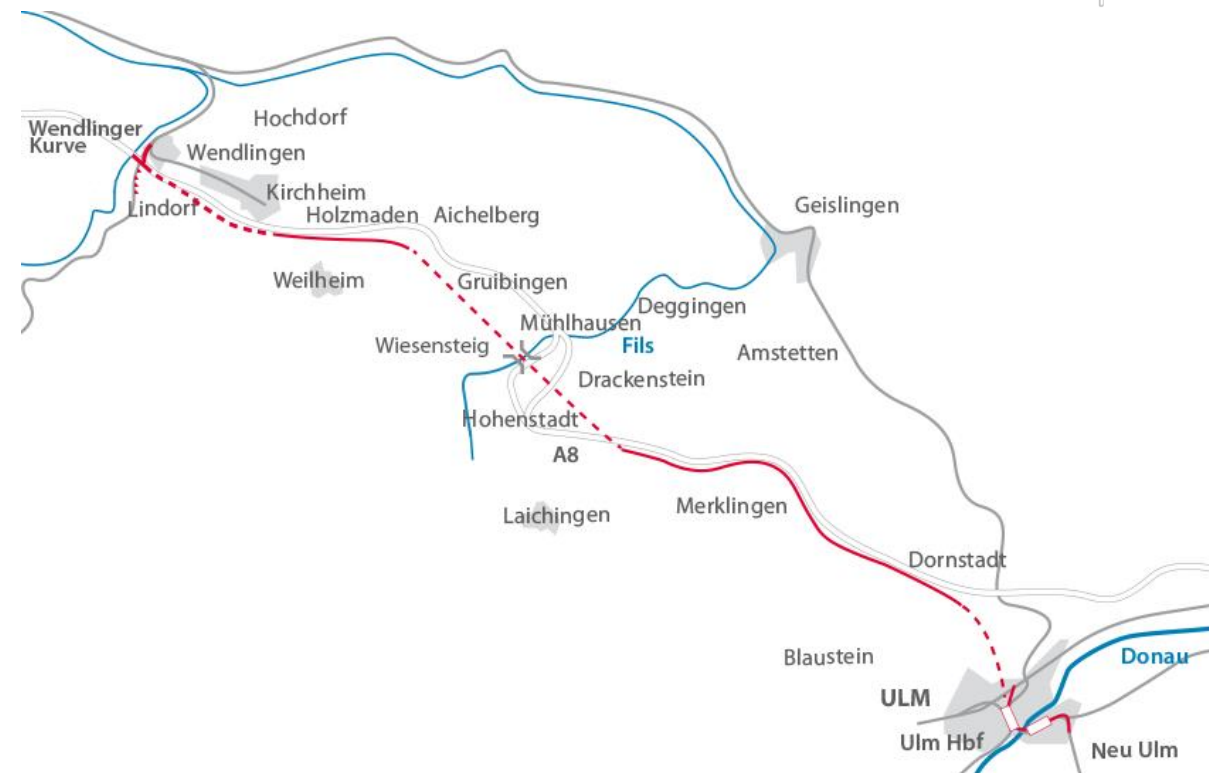
### NBS Ulm Wendlingen | Boßler Tunnel

#### Project facts

- start Q3 2014
- 2x 8 km tunnel length

#### Segmental production

- factory in surrounding of job-site
- carousel production with 56 moulds
- up to 60 segments per shift
- interface to batching plant
- part-automisation of warehouse
- ring ordering from TBM
- documentation of segment installation





## Key Moments

### NBS Ulm Wendlingen | Boßler Tunnel

communication with the customer to fulfill all requirements

- ▶ intensive communication beforehand is the key

part-automatisation of the warehouse

- ▶ optimisation of workflow

ordering of segments directly through SAP interface

- ▶ production planning and commercial handling





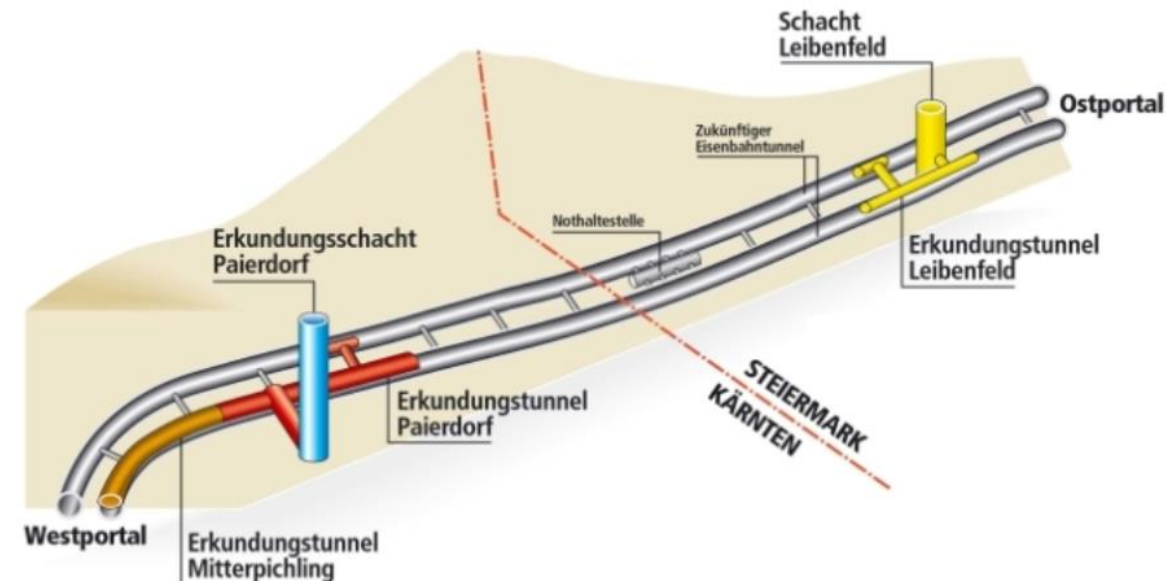
## Sophisticated logistics Concept Koralmtunnel KAT 2 | Graz

### Project facts

- start Q3 2012
- 15 km + 17 km

### Segmental production

- factory in surrounding of job-site
- 2 carousel productions with 112 moulds
- up to 110 segments per shift
- interface to batching plant
- part-automisation of warehouse
- ring ordering and pre-stacking
- documentation of segment installation





## Key Moments

### Koralmtunnel KAT 2 | Graz

extensive communication beforehand

- ▶ smooth commissioning

polish scanner language version

- ▶ increase of compliance and less manual errors

continuous improvement

- ▶ in terms of project and product

graphical overview of production and storage

- ▶ first steps of visualisation



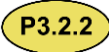




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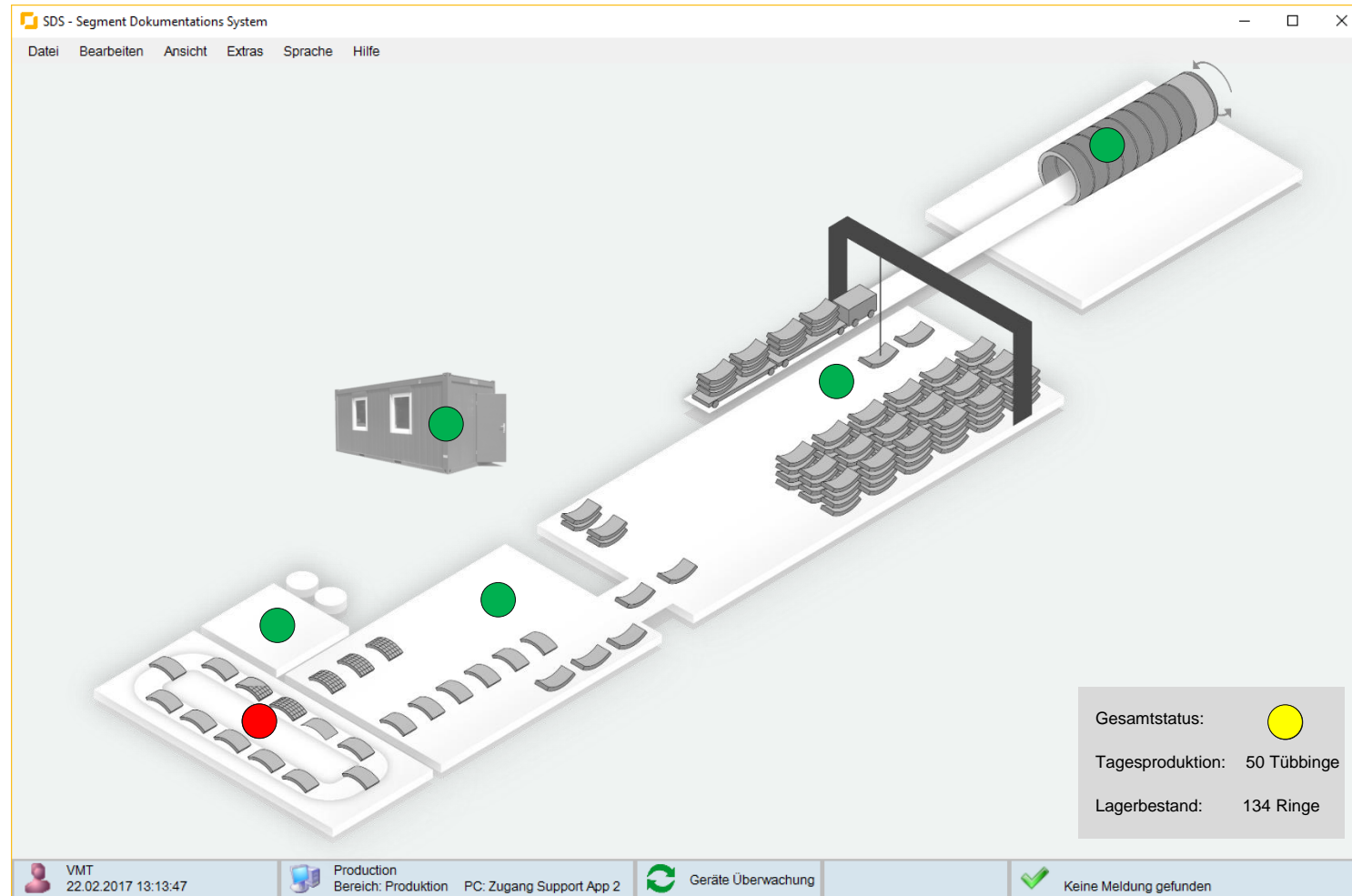
## From Configuration to Visualisation definition of processes

- Where will single processes be done? 
  - What is the positioning of hardware? 
  - Where are the sensors located? 
- **Result:** necessary infrastructure  
e.g. positioning of WiFi access points 





## From Configuration to Visualisation global view



- no incident
- warning
- incident



# Visualisation Example in SDS

## detailed view of carousel production



SDS - Segment Dokumentations System

Datei Bearbeiten Ansicht Extras Sprache Hilfe

### Carousel 1

cycle times and work step progress

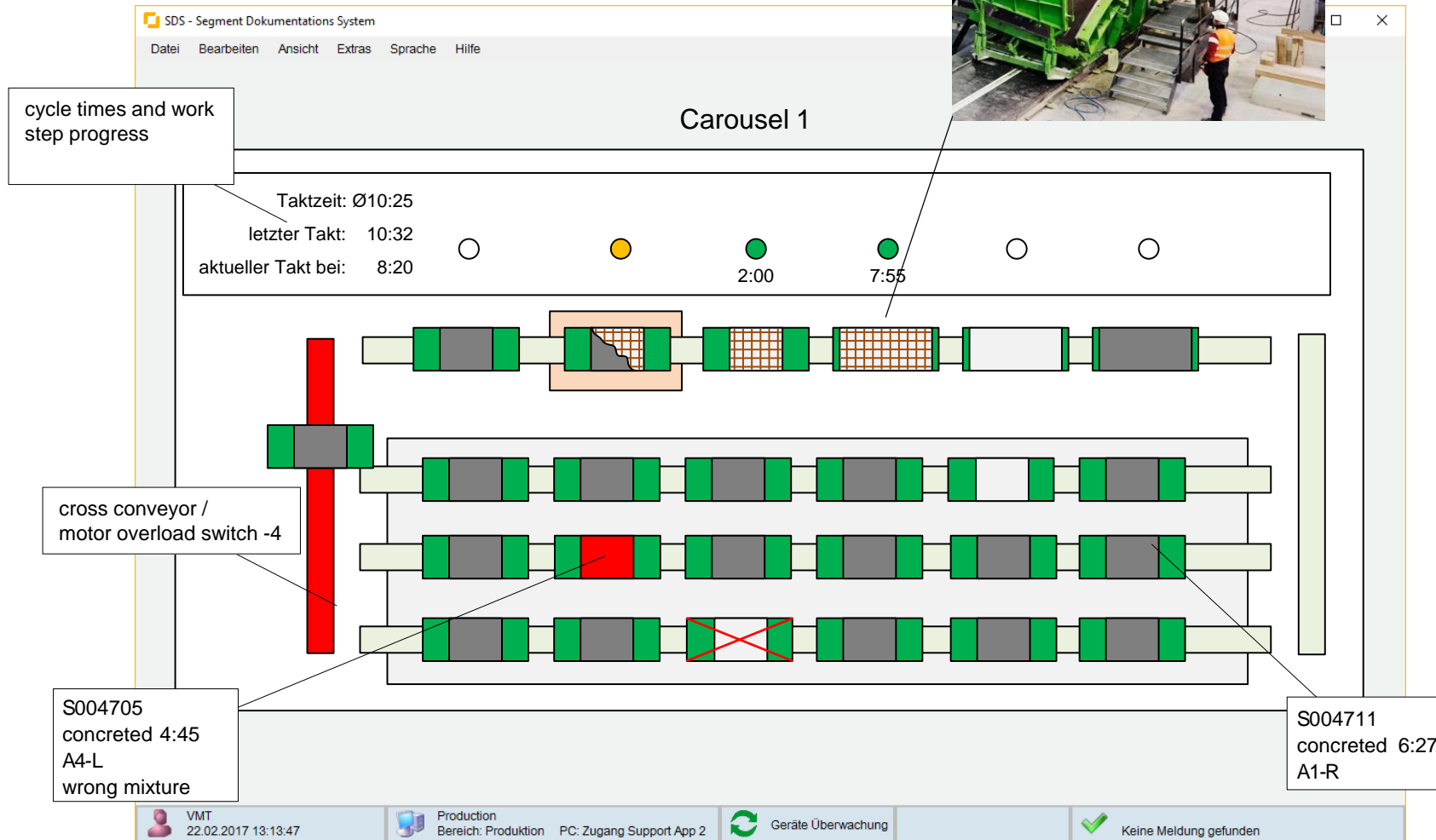
Taktzeit: Ø10:25  
letzter Takt: 10:32  
aktueller Takt bei: 8:20

2:00 7:55

cross conveyor / motor overload switch -4

S004705  
concreted 4:45  
A4-L  
wrong mixture

S004711  
concreted 6:27  
A1-R







# Visualisation Example in SDS

## evaluation of data | cycle times – shift A

SDS - Umlaufanlage

File Edit View Extras Language Help

Aktualisieren Explorer

VMT

### Evaluation Carousel 1

#### Shift A

		Glätten	Betonieren	Prüfen	Einschalen	Reinigen	Ausschalen
1	14:02	00:30	14:02	04:01	12:39	11:01	10:23
2	12:30	12:30	12:23	0		10:45	09:20
3	09:45	08:30	09:45	0		09:37	06:00
4	08:39	07:56	08:35	0		08:39	06:39
5	09:47	07:23	09:47	09:37	09:31	07:56	06:23
6	10:27	07:05	10:27	01:59	09:12	07:45	06:10
7	08:54	07:20	08:54	02:28	08:52	07:50	06:50
8	09:25	06:54	09:25	02:41	08:56	07:19	07:10
9	10:32	07:12	09:54	02:13	10:32	06:59	06:47
10	09:30	07:09	09:30	02:00	07:55	07:10	07:07
Duchschnitt	10:21	07:14	10:16	03:19	09:18	08:30	07:16

Confirmation button not pushed

Bottle neck process concreting

Planned cycle times of 10 min almost reached

VMT 22.02.2017 13:13:47

Production Bereich: Produktion PC: Zugang Support App 2

Geräte Überwachung

Keine Meldung gefunden



# Visualisation Example in SDS

## evaluation of data | cycle times – shift B

SDS - Umlaufanlage

File Edit View Extras Language Help

Aktualisieren Explorer

**VMT**

### Evaluation Carousel 1

Shift B

Takt	Gesamt	Glätten	Betonieren	Prüfen	Einschalen	Reinigen	Ausschalen
1	09:31	05:00	09:31	00:47	07:55	09:04	08:58
2	10:35	06:16	09:26	04:27	06:47	10:35	08:21
3	09:38	05:04	09:36	04:43	07:17	09:38	07:11
4	11:50	05:14	08:47	01:16	08:06	11:50	06:16
5	10:37	05:28	09:15	03:25	08:21	10:37	06:41
6	09:56	05:25	08:52	06:26	08:03	09:56	07:29
7			08:55			09:11	05:28
8			09:35			11:39	23:47
9	10:51	05:08	10:10			10:51	06:10
10	15:39	05:05	15:39	06:34	08:21	10:30	08:28
Duchschnitt	12:09	05:33	09:59	04:01	07:37	10:23	08:53

mould cleaning with problems

incident at process demoulding

incident at the concr. chamber ?

concreting chamber nearly reaches 10 min cycle time

10 min cycle time not maintained

VMT 22.02.2017 13:13:47

Production Bereich: Produktion PC: Zugang Support App 2

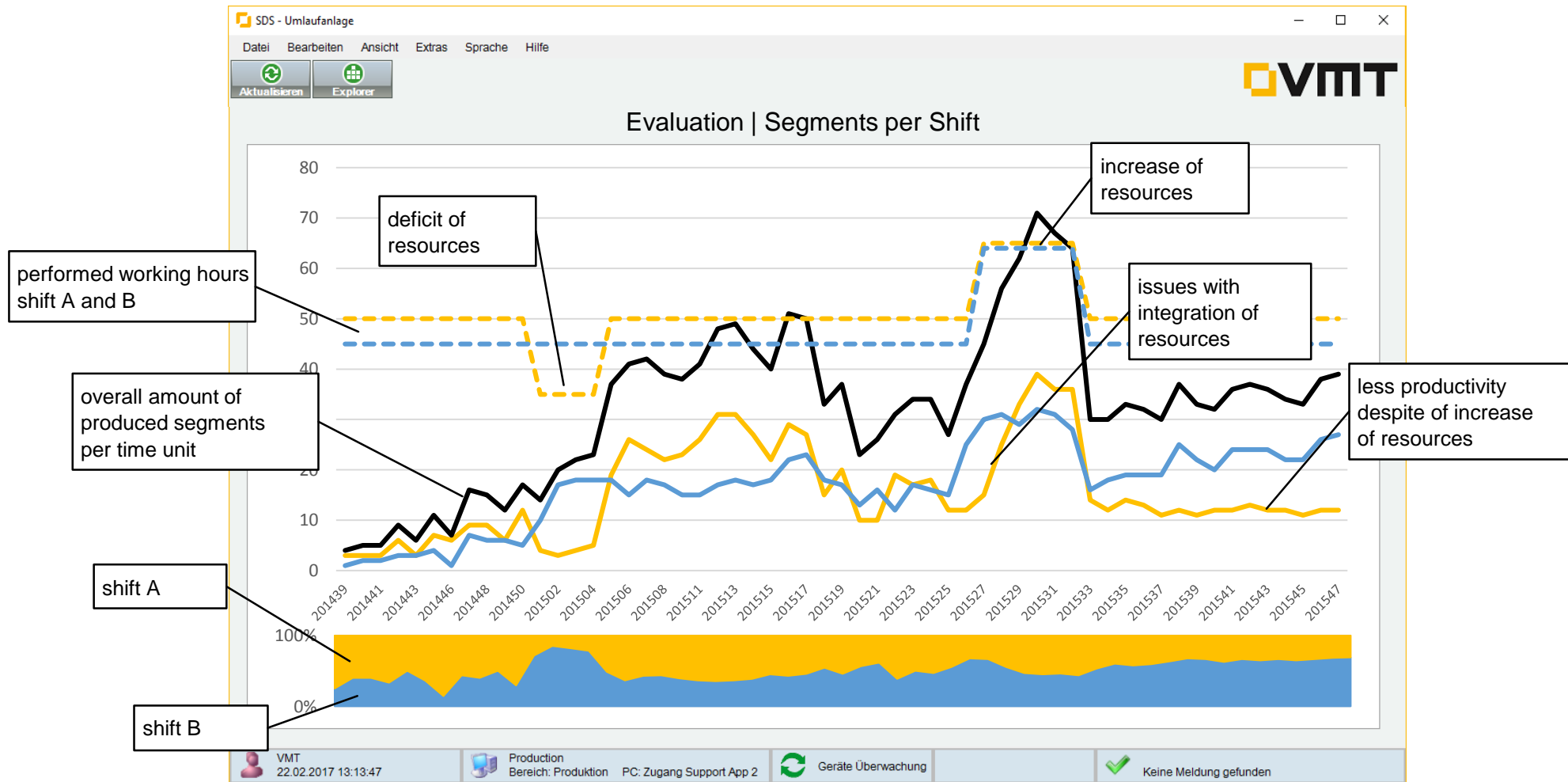
Geräte Überwachung

Keine Meldung gefunden



# Visualisation Example in SDS

## evaluation of data | shift comparison





## Visualisation Example in SDS

detailed view of warehousing | store-in per ring

SDS - Segment Dokumentations System

File Edit View Extras Language Help

**VMT**

Übersicht Filter Auswahl

Name	Typ	Gasse	Ort	Füllstand [%]	Gesperrt	Reserviert	Platz gesperrt	Platz reserviert	Kapazität	Dt
L-T-62	Tübbing	62	20	66	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-U-62	Tübbing	62	21	33	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-C-63	Tübbing	63	3	0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-D-63	Tübbing	63	4	0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-E-63	Tübbing	63	5	33	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-F-63	Tübbing	63	6	66	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-G-63	Tübbing	63	7	16	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-H-63	Tübbing	63	8	33	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	6	Ba
L-I-63	Tübbing	63	9	66	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba
L-J-63	Tübbing	63	10	66	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6	Ba

1078 Datensätze

Tübbing Ereignisse

Platz	Platzsperre	Platz reserviert	Position	Tübbing	Typ	Etiketten Datum	Alter [Tage]	Reserviert	Freigabe	Ti
4	<input type="checkbox"/>	<input type="checkbox"/>	2	S029749	A1-R75-N1	20.07.2016	230	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4	<input type="checkbox"/>	<input type="checkbox"/>	1	S029648	C-R35-N1	12.07.2016	238	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
3	<input type="checkbox"/>	<input type="checkbox"/>	2	S029700	A1-R75-N1	19.07.2016	230	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
3	<input type="checkbox"/>	<input type="checkbox"/>	1	S029705	C-R83-N1	19.07.2016	230	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2	<input type="checkbox"/>	<input type="checkbox"/>	2	S029686	A1-R21-N1	19.07.2016	230	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2	<input type="checkbox"/>	<input type="checkbox"/>	1	S029691	C-R41-N1	19.07.2016	230	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
1	<input type="checkbox"/>	<input type="checkbox"/>	2	S029651	A1-R75-N1	19.07.2016	231	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
1	<input type="checkbox"/>	<input type="checkbox"/>	1	S029656	C-R83-N1	19.07.2016	231	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

10 Datensätze

VMT 22.02.2017 13:13:47
Production Bereich: Produktion PC: Zugang Support App 2
Geräte Überwachung
Keine Meldung gefunden



# Visualisation Example in SDS

## detailed view of warehousing | store-in per ring

SDS - Segment Dokumentations System

Indication of ring type

Classification of storage Places through colours e.g. blocked storage places

Deliverable ring: Delivery confirmation Age > 28 days

incomplete ring

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
H											R-Q	R-N	L-S							
G											L-Q	R-N	L-S	L-S	R-Q	R-N				
F											R-S	R-N	L-S	L-S	L-Q	R-N	L-S	L-N	R-S	R-S
E											R-S	L-S	L-S	L-S	R-S	R-N	L-S	L-N	R-S	R-S
D											R-S	L-N	L-N	L-N	R-S	R-N	L-S	L-N	R-S	R-S
C												L-N	L-N	L-N	R-N	R-N	L-S	L-N	R-S	R-S
B												L-N	L-N	L-N	R-N	R-N	L-S	L-N	R-S	R-S
A												R-L	R-L	R-L	R-N	R-Q	L-Q	L-N	R-S	R-S

R-Q ring  
No confirmation  
Age > 28 days

L-N ring  
Age < 28 days

Lagerbereich Bruchsal

Aktualisieren

Schließen

Alter [Tage] 0

Erreichbarkeit

EIN zurücksetzen

1 1 S029656 231

10 Datensätze

VMT 22.02.2017 13:13:47

Production Bereich: Produktion PC: Zugang Support App 2

Geräte Überwachung

Keine Meldung gefunden



# Visualisation Example in SDS

detailed view of warehousing | store-in per ring

The screenshot displays the 'Lager Explorer' window within the 'SDS - Segment Dokumentations System'. The main visualization shows a 3D arrangement of storage rings in various colors (green, red, yellow, grey) labeled with codes such as R-N, L-S, L-N, L-Q, and R-S. A callout box points to a specific area with the text: "no direct access to remove blocked segment".

On the left, a table titled 'Lager Explorer' shows a grid with columns 1 and 2, and rows A through H. Below the table is an 'Aktualisieren' button.

On the right, another table shows columns 19 and 20, with rows containing 'R-S' labels. Below it is a 'Schließen' button.

At the bottom right, a summary box contains the following information:

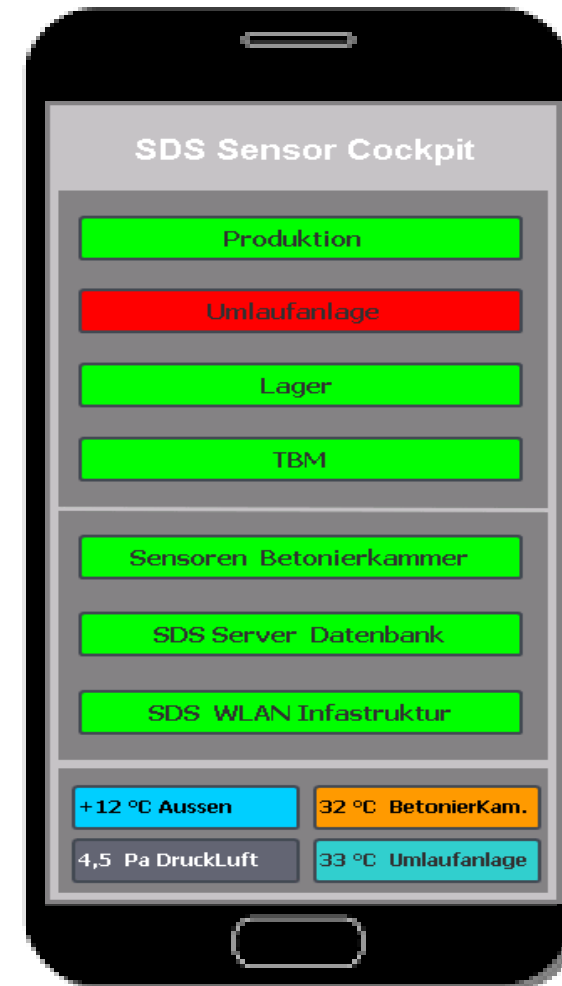
- 45 Ringe auslieferbar
- 73 Lagerort frei
- 89 Ringe < 28 Tage

The main window title bar includes 'Lager Explorer' and 'Storage location Witten-1'. A 'Schließen' button is located at the bottom right of the window.



## SDS Sensor Cockpit mobile visualisation

- condensed display of all relevant KPIs on smartphone
- data access any time everywhere
- alarming function





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## Visualisation of Production Data

which are the main benefits?

- ▶ **increase of performance:** quick decision making process through production performance indicators
- ▶ **early warning system:** identification of incidents to avoid production shutdown
- ▶ **quality assurance:** evaluation of incident sources to act immediately
- ▶ **Real-time controlling:** all production processes can be monitored at any time from everywhere



**„Big data is not about the data.“**

*[Gary King, 2016, Harvard University]*

