

Augmented Reality for Plant Service

Applications, Challenges, Future Directions

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Overview

Motivation & Setup

Applications

Solution Method

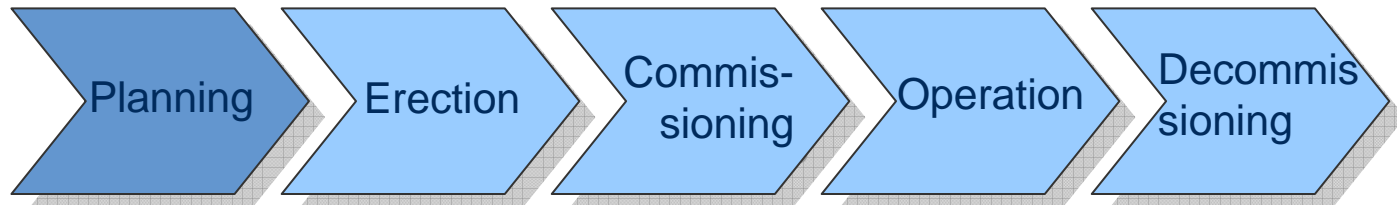
Service Integration Aspects

Conclusion & Lessons Learned



Motivation & Setup 1/2

Utilization of CAD Model and Drawings During the Entire Plant Life Cycle



Abschnitt des Rohrleitungssystems	DN	Stahlart / Erzeugnisform	Abmessung der Flg. mm	Prüfmaßstab / Normung / Ausführung	Druckverlust / Betriebsdruck / Betriebsverhältnis	Auslag. Dimensionen	Bezeichnung
T-Block TH12 bis Druckstempel TH480001	300	Rohre geschw. Bogen	323,9 x 8				
T-Block TH12 bis Armatur TH480002	250	Rohre geschw. Bogen	279 x 8				
T-Block TH12	300 250 250	T-Block	323,9 x 1 279,2 x 1 279,2 x 1				

1) bei bestimmungsgemäßen Betrieb 2) bei vollständiger Eins- und Zweifeldigkeit

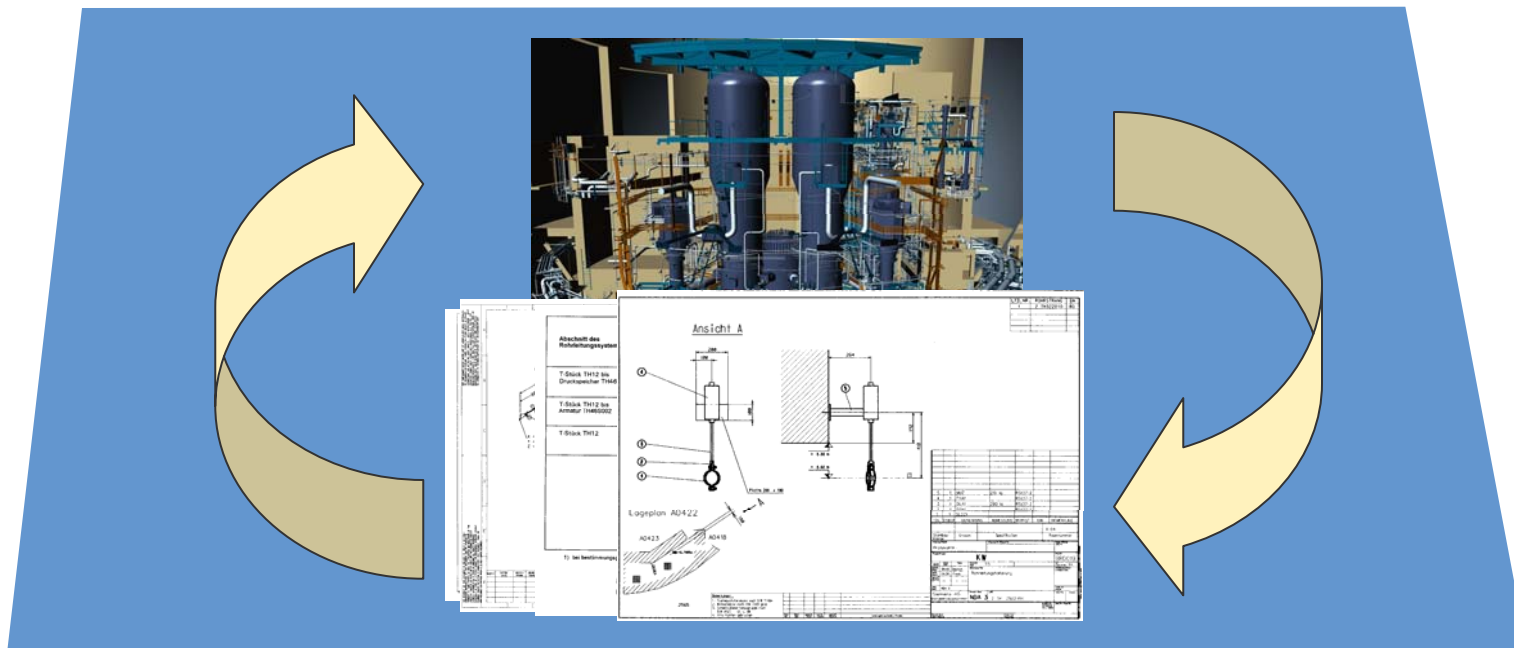
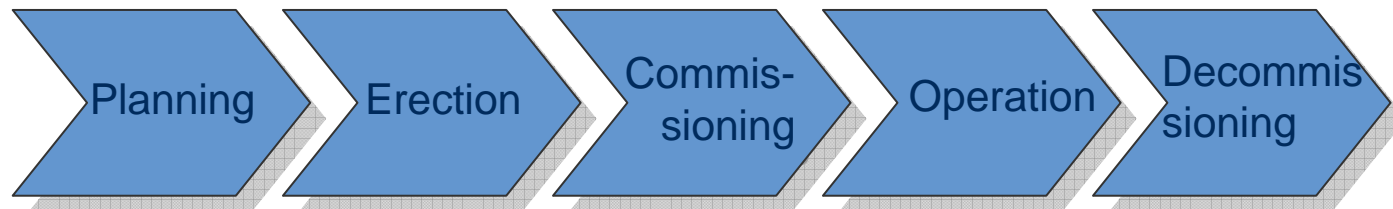
Bild A, TH-System zwischen 1. und 2. Primär Loop: Umfang und Basisdaten für Rohrleitung

Legenplan AD4122



Motivation & Setup 1/2

Utilization of CAD Model and Drawings During the Entire Plant Life Cycle



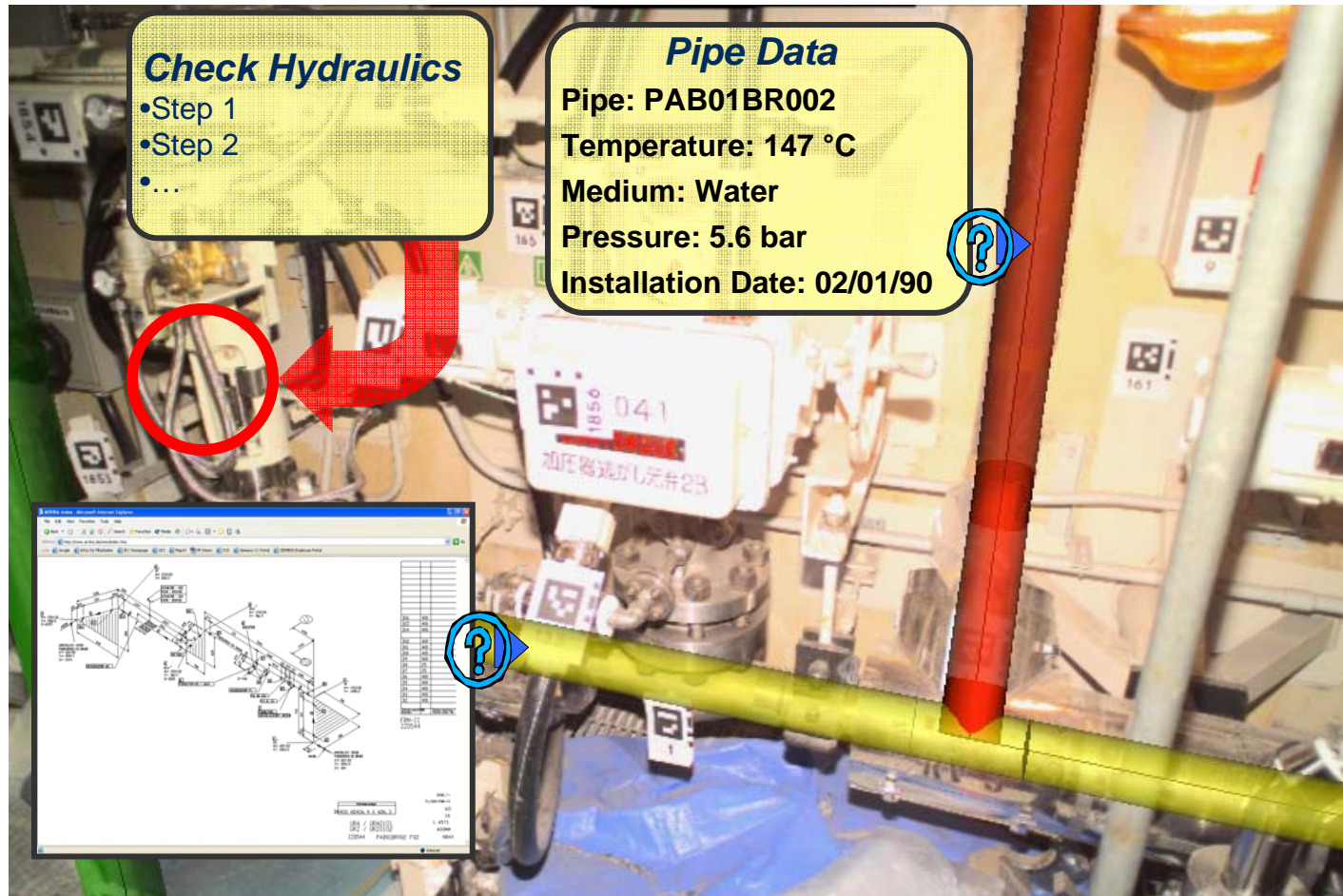
Motivation & Setup 2 / 2

Particular Challenges and Constraints include:

- **Industrial Plants can be Huge**
- **Complex Configurations of Components**
- **Changing Environmental Conditions**
- **Changing Constructional Conditions**
- **Lots of Metal and Concrete**



Applications 1/2: Model Based Information Retrieval

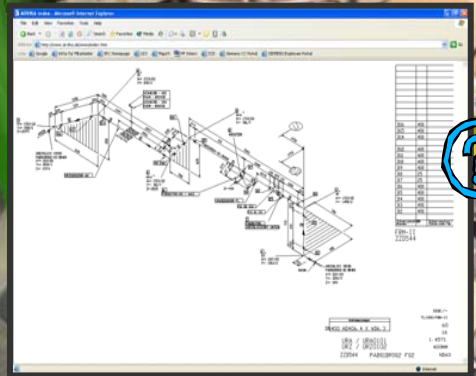


Check Hydraulics

- Step 1
- Step 2
- ...

Pipe Data

Pipe: PAB01BR002
 Temperature: 147 °C
 Medium: Water
 Pressure: 5.6 bar
 Installation Date: 02/01/90

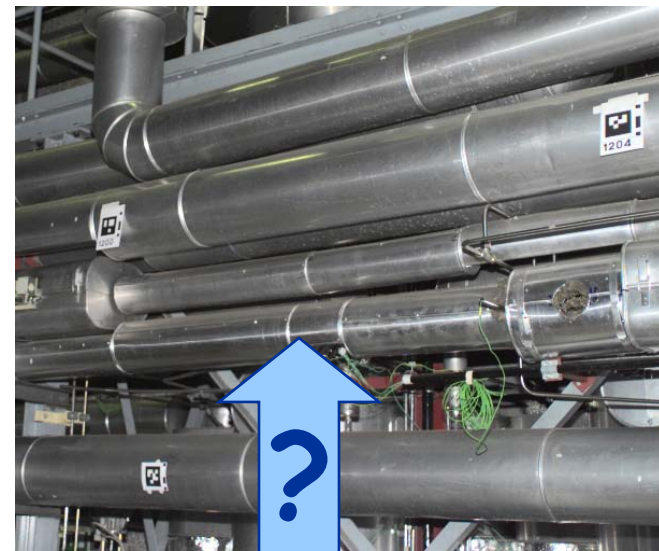


Applications 2/2:

As-Built Verification



Identification of Components

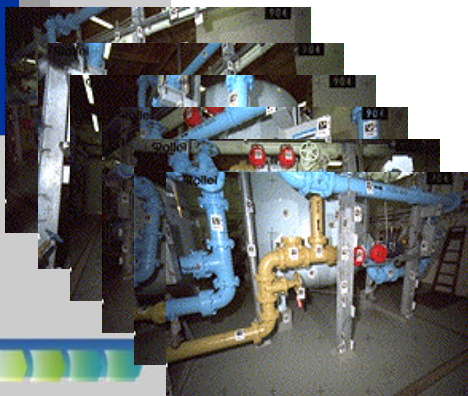
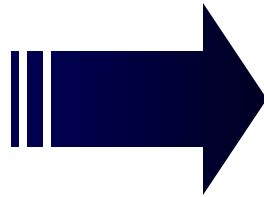
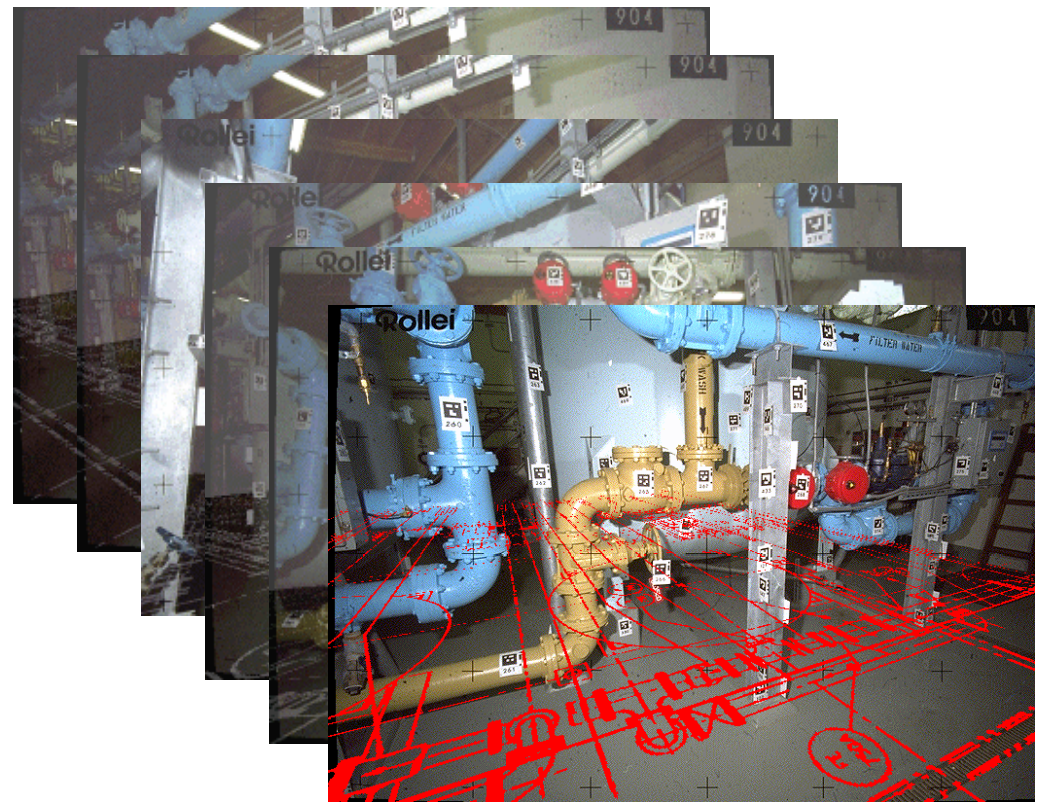
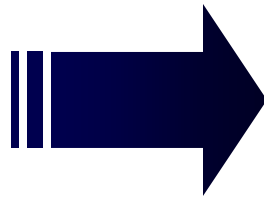
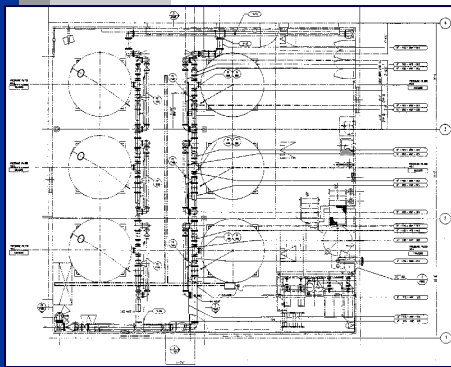


**Component
Identification:
Live Steam Pipe
FD357Z**



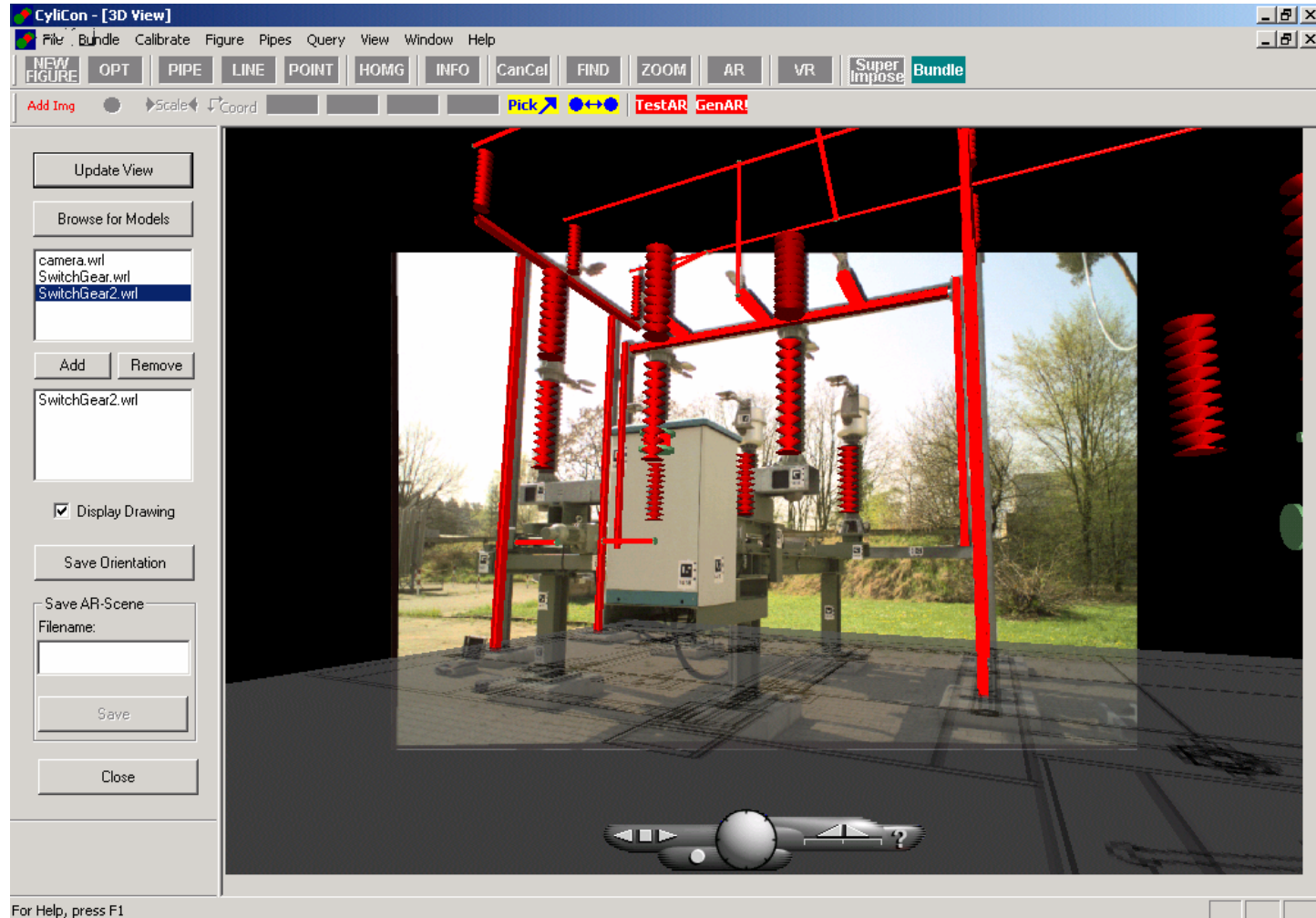
Solution Method 1 / 2

Co-Registered Orthographic and Perspective (COP) Images



Solution Method 2 / 2

Augmentation of Images with Technical Drawings and 3D Models



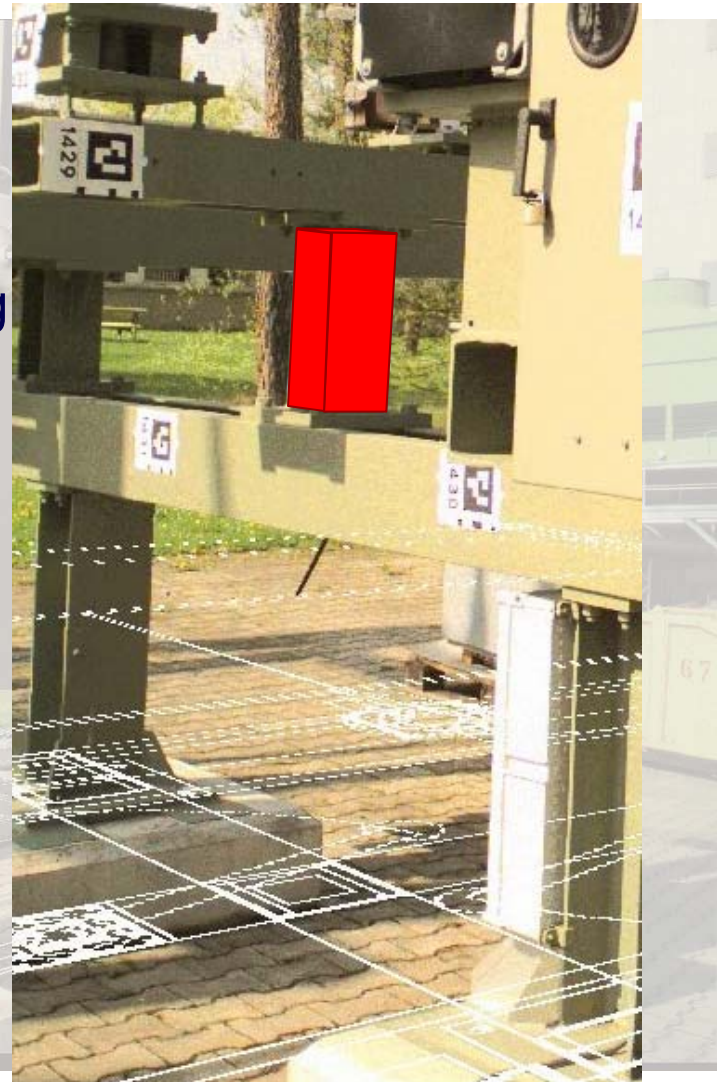
For Help, press F1



As-Built Reconstruction from a COP-Image

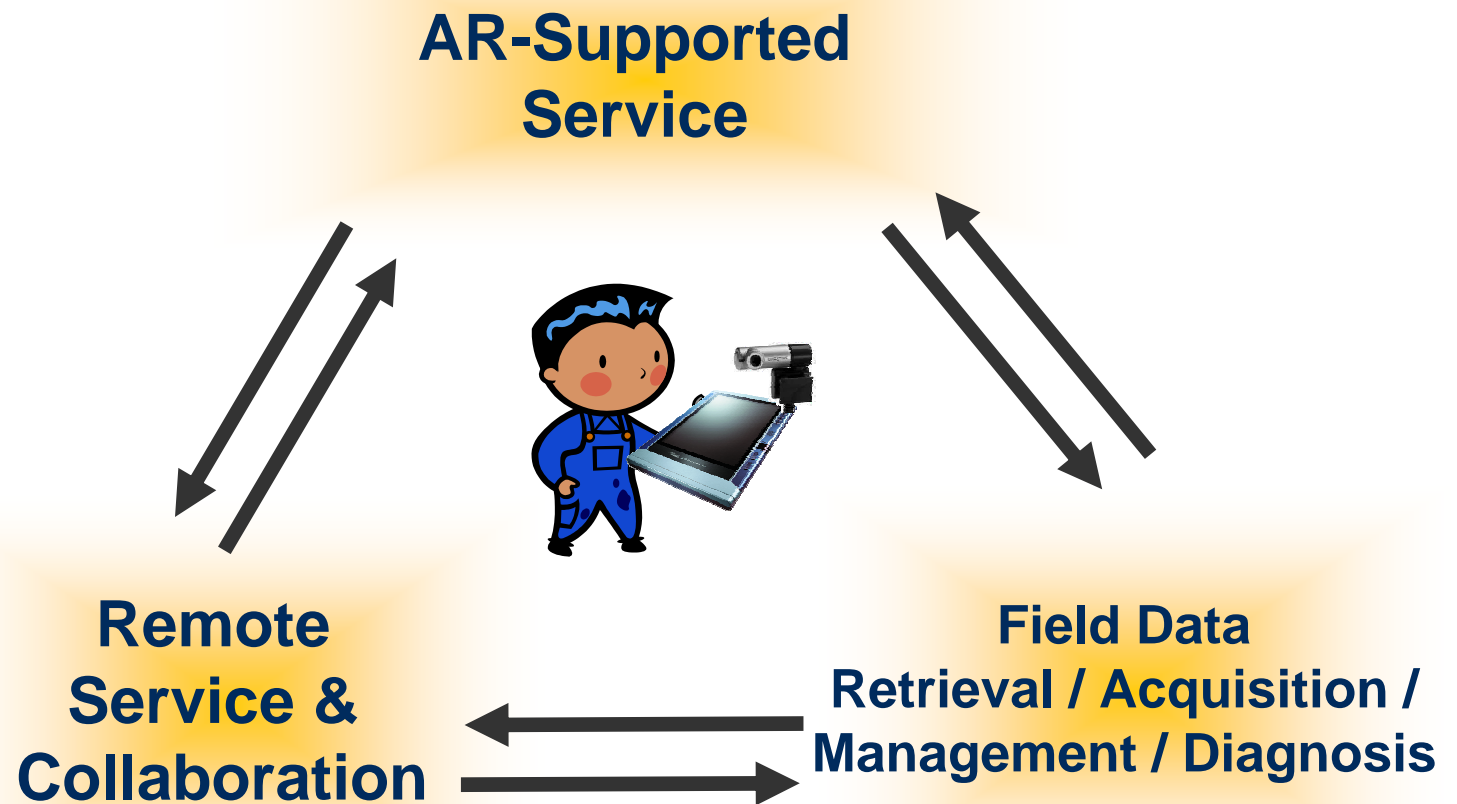
1. Select point in perspective part of the image
2. System indicates corresponding point on drawing by epipolar line
3. Selection of corresponding point in orthographic part of the image

Reconstruction completed



Service Integration Aspects 1 / 2

AR as Part of a Holistic Service Approach



Service Integration Aspects 2 / 2

AR as Part of a Holistic Service Approach

- *AR needs to be integrated with other existing and new service technologies*
- *Example: Problem is located and specified by remote diagnosis, thus AR-system can give the service technician dedicated instructions for fixing*
- *AR is only as useful as the information provided by back-end systems*
- *AR systems must be seamlessly integrated in field data management systems and corporate IT systems*
- *Service technicians should be equipped with a **single** device for diagnosis, procurement (spare parts etc.) **and** AR-supported service*



Conclusion & Lessons Learned

- ✓ CAD Planning of Industrial Plants provides a broad information database which can be utilized by On-Site AR techniques
- ✓ AR proved to be very useful for navigation in CAD-based information systems
- ✓ Many Applications in plant service require rather augmentation of high resolution still images than video
- ✓ Tracking is the most challenging problem in plant environment
- ✓ Complexity of AR applications should be increased step by step to ensure robustness and acceptance:

Example:

- *Usage of devices which are familiar to the technicians, e. g. a Camera equipped tablet PC or PDA*
 - *Use remote collaboration to guide the technician and augment his view by simple information such as symbols, text*
 - *Introduce HMDs only where hands-free is crucial*
 - *Work towards an autonomous system, which provides dedicated AR work-flows for problem solving, CAD-reality checks, etc.*
- ✓ **Wherever possible, AR should be integrated into *standard and familiar* applications**

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Thank you for your attention.

Questions?

