VIRTUAL METHODS IN PROGRAMMING AND SIMULATION OF PROGRAMMABLE LOGIC CONTROLLED MAUNUFACTURING SYSTEMS

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Problems of a sequential process chain for planning of PLC software

- Customer
- Marketing
- Mechanical construction
- Controlling technology
- Work preparation
- Production and assembly
- Initial operation
- Documentation
- After-Sales Service

❑ ***Difficulties in communication due to organisational and spatial separation***

❑ ***Different qualifications, ways of thinking and understanding***

❑ ***Insufficient description of functions (large number of enquiries and misunderstanding)***

Mechanical engineering

Control engineering

❑ ***Uncontrolled storage and passing on of information***

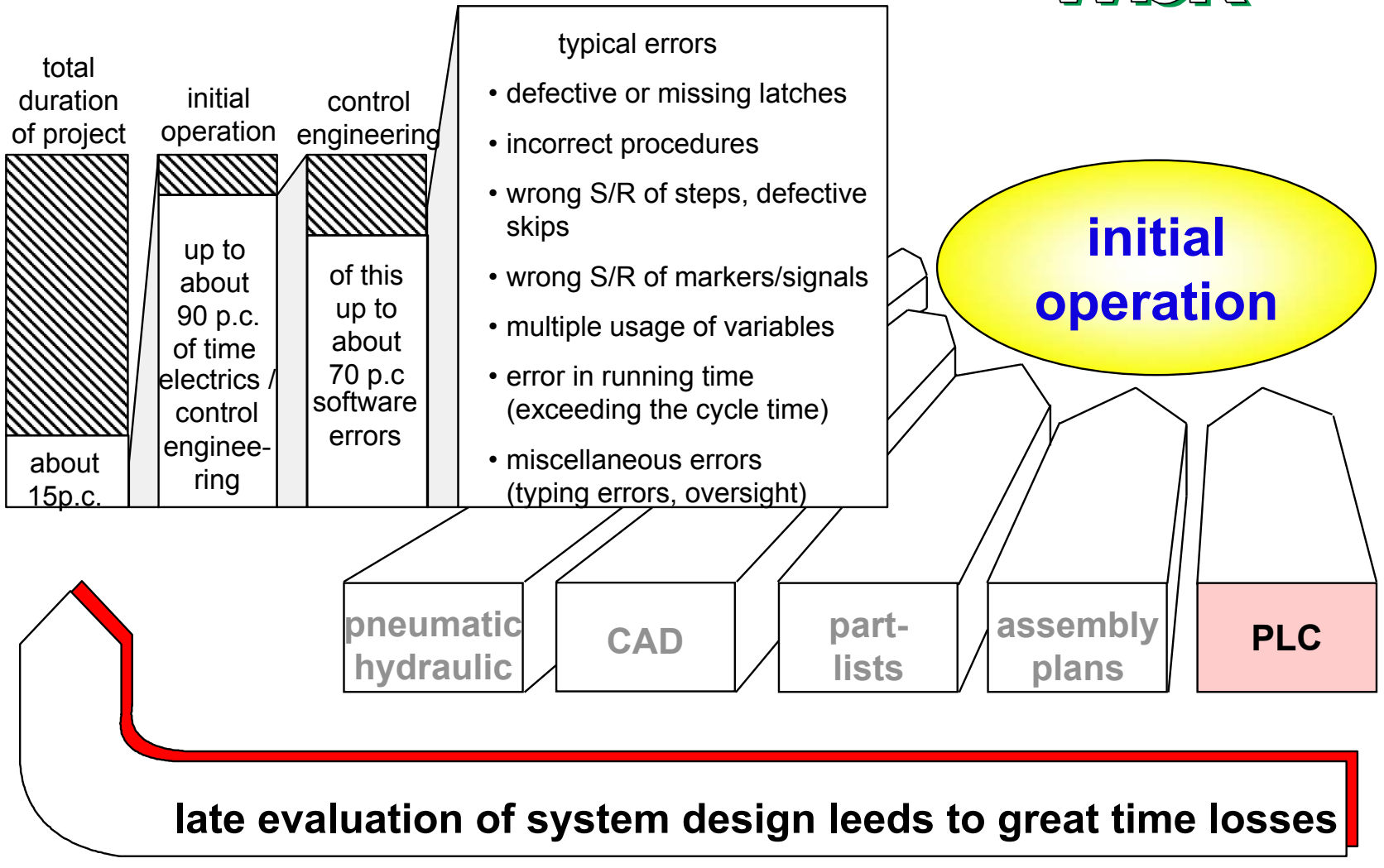
❑ ***Time pressure due to numerous subsidiary tasks (e.g. offers, starting up and service)***

❑ ***Large number of changes and insufficient personnel to cope***

❑ ***Insufficient inclusion of electrical construction into concept phase (insufficient real team work)***

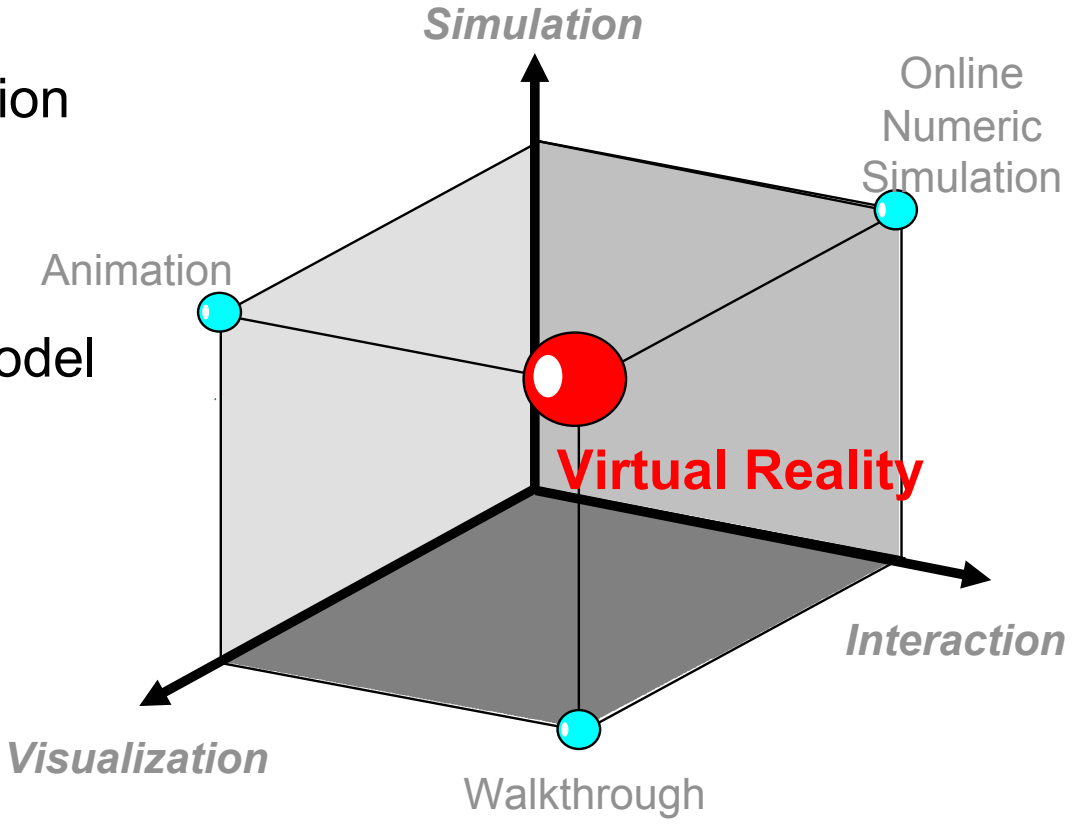
❑ ***Insufficient co-ordination of work in time and sequential working***

Problems at Initial Operation



3-Dimensional presentation of complex systems with the possibility of

- interaction with the model
- immersion
- cooperation
- communication



Advantages of VR interface

- *Increasingly complex tasks during process and product planning*
- *Spatial distribution of planning competence*
- *Insufficiently realized man/machine interfaces*
- *Necessity of simulation before realization*

- *Cessation of 3D-2D abstraction for visualisation, navigation and interaction*
- *Direct application of heuristic problem solving behaviour*
- *Experiencing model utilizing sensoric feedback*
- *Observation of critical rocedures from the point of view of time*
- *Possibility of excluding real restrictions*

See

Experience

Understand

Decide

Conventional programming versus VR interface and visual programming

```
     1 ;
     ; ***************************************************************************
     ; *                                                                         *
     ; *          OB1    Organisationsbaustein fuer                             *
     ; *                 Fischertechnikmodell                                    *
     ; *                                                                         *
     ; *          erstellt von Bernd Zimmermann am 30.03.1994                    *
     ; *                                                                         *
     ; ***************************************************************************

     ; *** Einrichten des Profibus ***

     L     W  -EZ0,A; * Koppeladresse fuer Profibus-DP
     T     W  A,-AZ0; * Koppeladresse fuer Profibus-DP

     ; *** Programmablauf ***
     UN    B  -M_RESET;
     BAB      -INIT ;   INITIALISIERUNGSBAUSTEIN, WIRD NUR AM ANFANG BEARBEITET

ZS0/OB1       PA: 4      PZ: 1                Einfügen        AWL Modus
+----<F1>-------<F2>-------<F3>-------<F4>-------<F5>-------<F6>-------<F7>----+
:: Block   : Zuordnen :  Symbol  :  Suchen  : Kommando :   Ende    : Wechseln ::
+-------------------------------------------------------------------------------+
SPS - Editorprogramm                Version 3.20 (c) 1987-93 Robert Bosch GmbH
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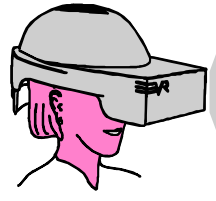
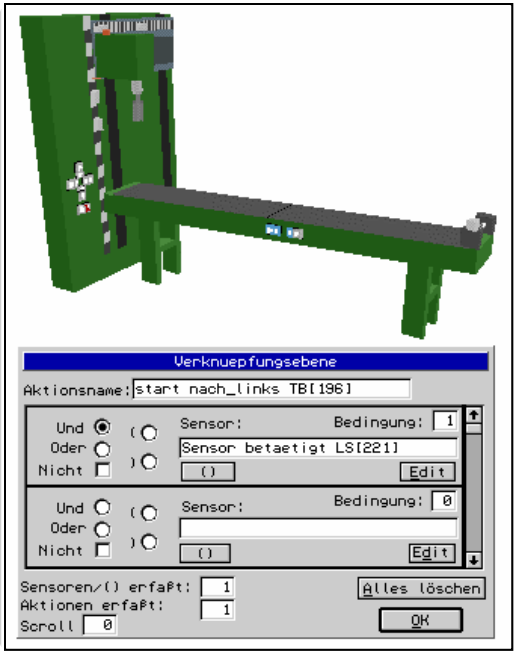
Textual PLC programming

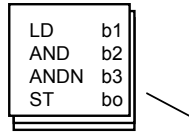




Intuitive connection of inputs and outputs in VR

Three applications of VR based simulation

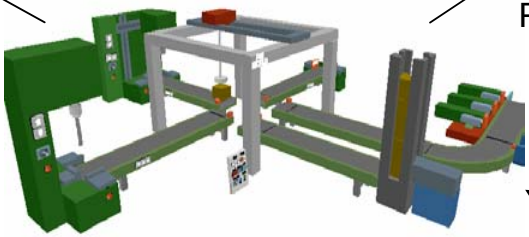
Existing PLC Codes can be simulated by connecting the real PLC and the virtual model



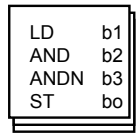
PLC-Code_3

3

PLC

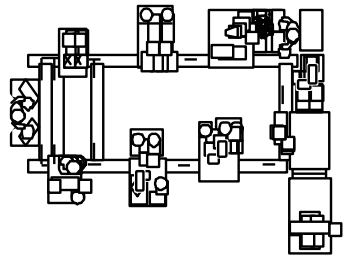


VR-based simulation enviroment



PLC-Code_1

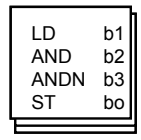
PLC



facility (real)

1

PLC Codes can be generated and validated with the virtual model



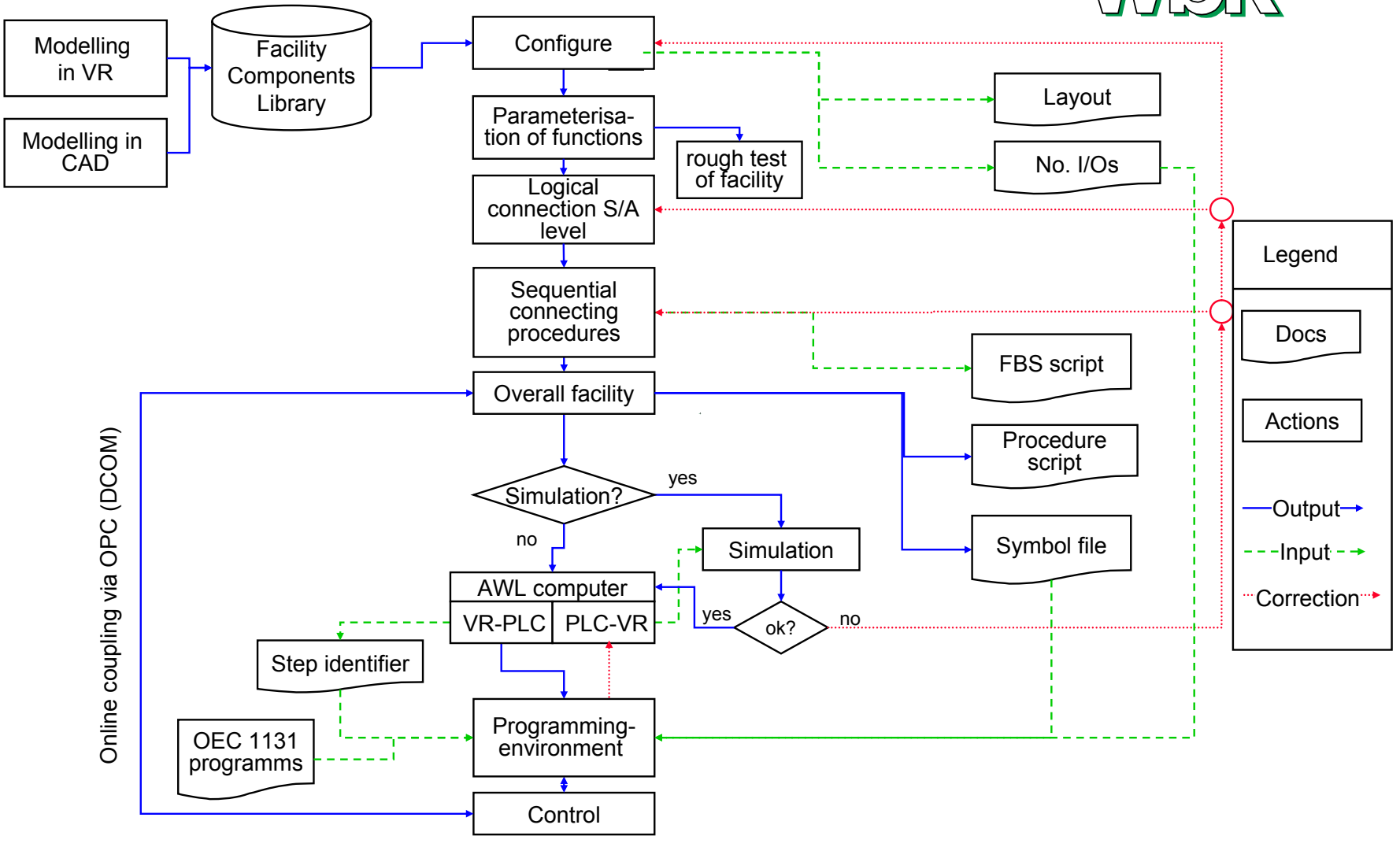
PLC-Code_2

2

PLC CODE built in a common PLC Programming environment can be simulated ONLINE.

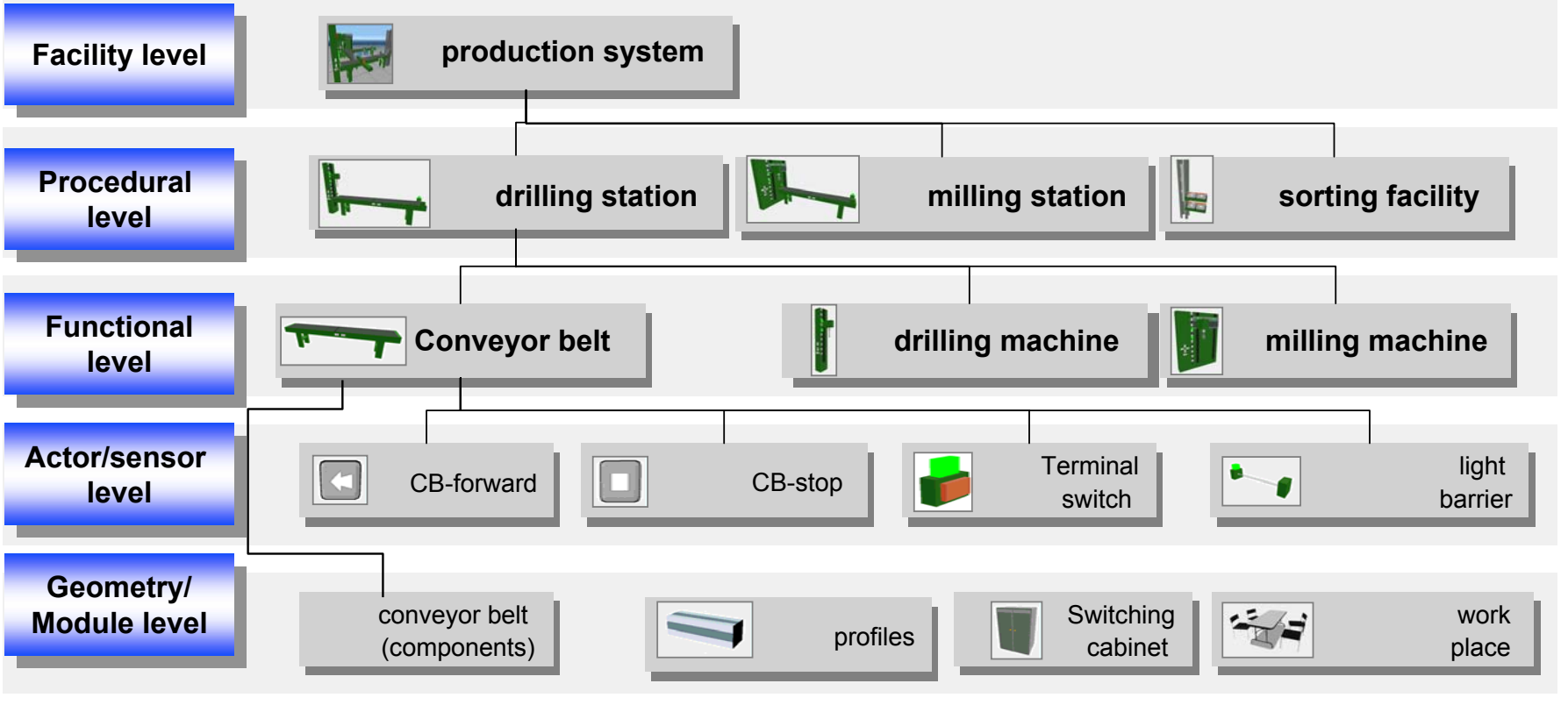
Programming Enviroment

Structure of the system



Aggregation of a technical system in the VR system

Facility structure (geometry)

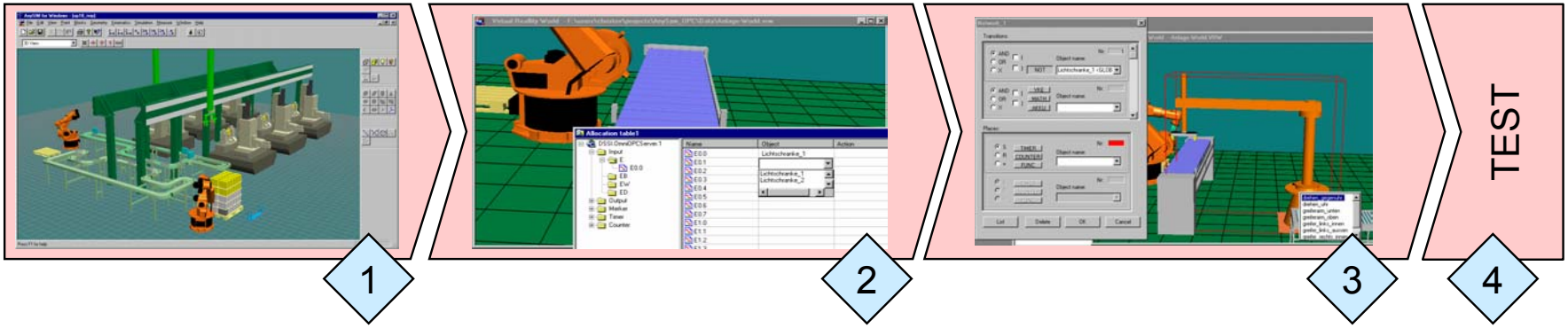


Step 1 Configuration of the facility layout

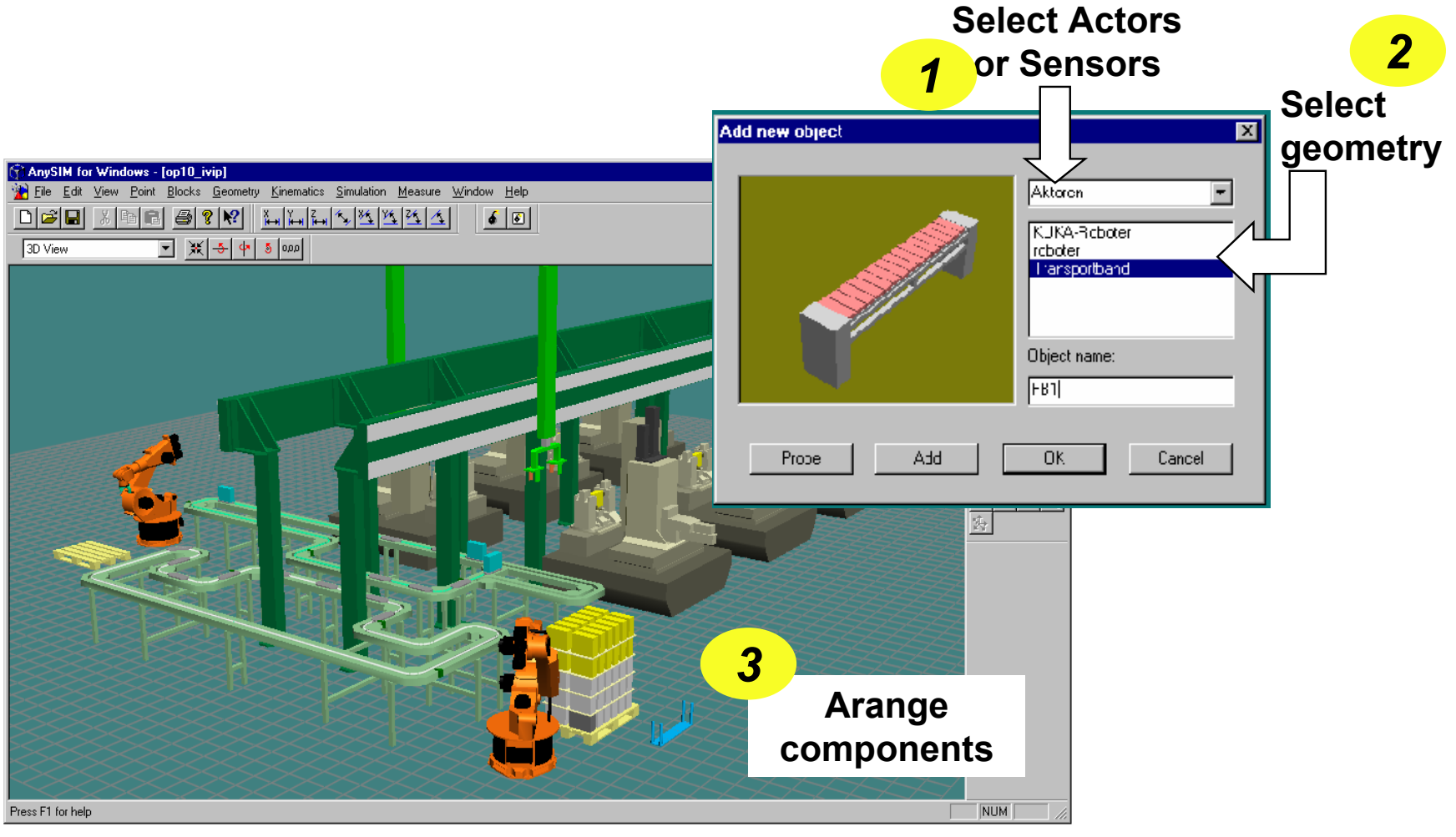
Step 2 Virtual Wiring
(only needed if the PLC CODE already exists)

Step 3 Dialogue supported programming of PLC functionalities

Step 4 Validate the PLC-Code via OnLine-Connection

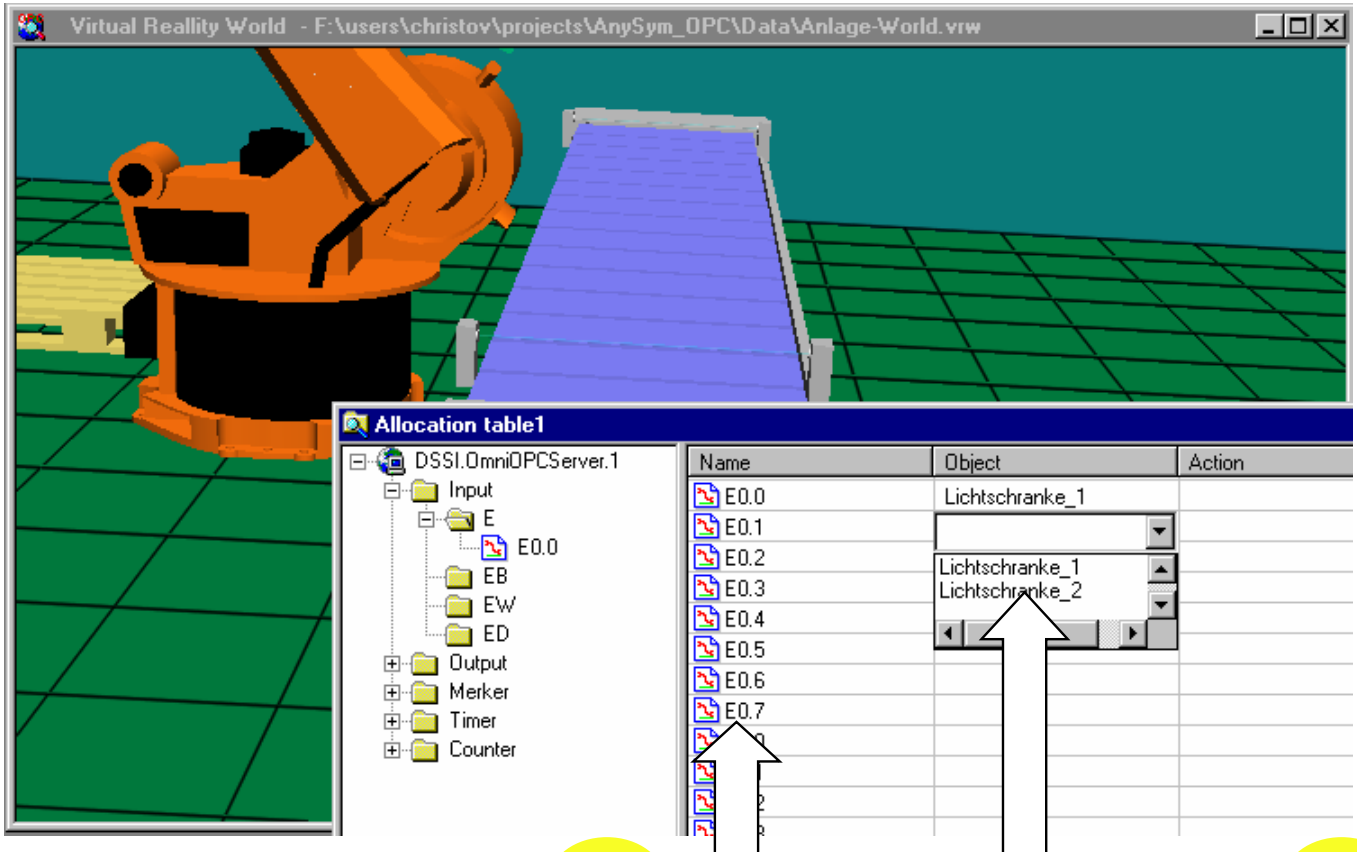


Step1: Configuration of the facility layout



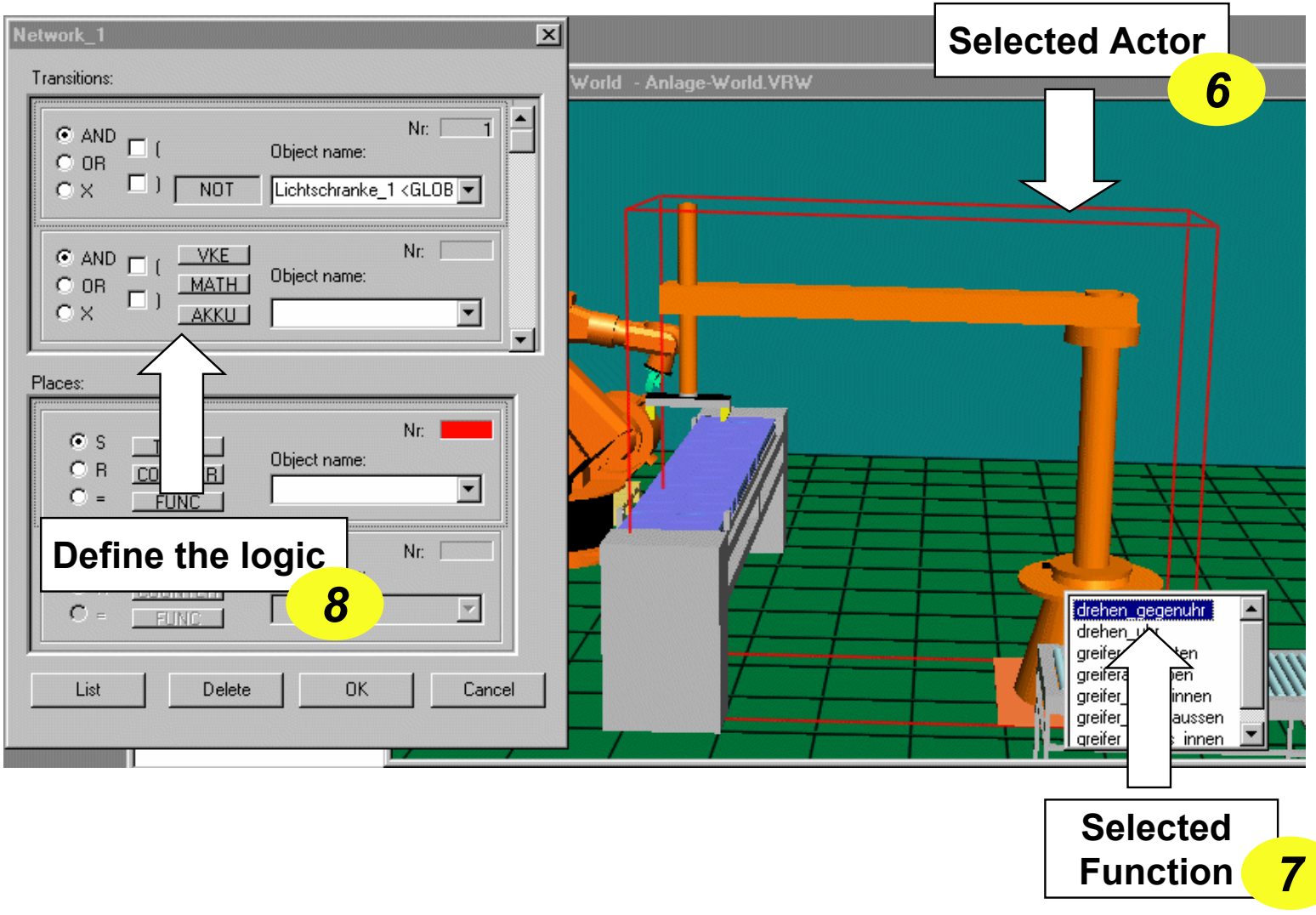
Step 2: Virtual Wiring

(only needed if the PLC CODE already exists)



Connect I/O with virtual components

Step3: Dialogue supported programming of PLC functionalities



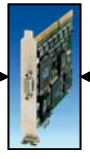
Step 4: Validate the PLC-Code via OnLine-Connection

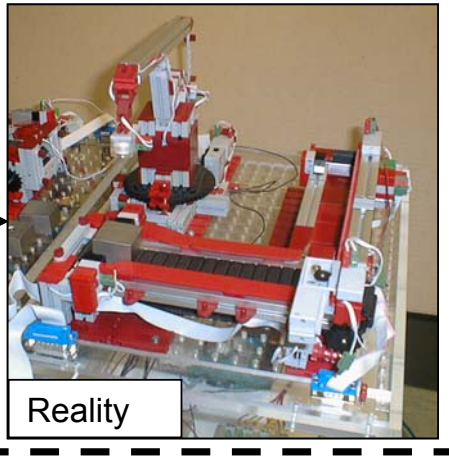
Comunication-processor

Industrial Fieldbus

Distributed I/O s

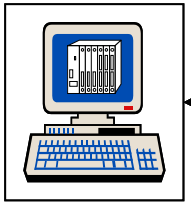
Control of the real model





Reality

SOFT-SPS



Previous way of testing the PLC Code

Test the PLC-Code via OnLine Conection SPS ⇔ VR

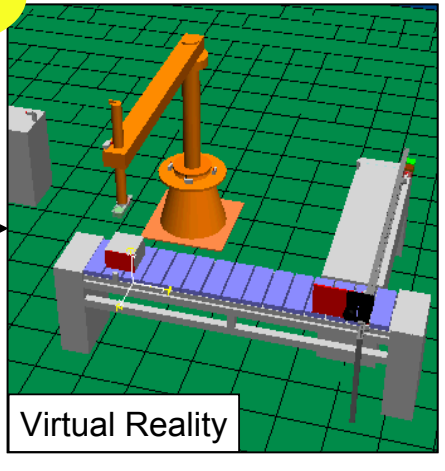
8

OLE for Process Control

Control of the virtual model

LoLi (LogicLink) (VC++ PRG)

VR Enviroment



Virtual Reality

This Program provides the connection between the PLC and the VR enviroment

- Further exchange of components geometry with CAD Systems
- Create an simulate a PLC-Code for a CNC (Sinumeric 840D)
- Evaluate the concept with a big production System of ROBERT BOSCH GmbH, Homburg, Saar
- establishing a data structure according to DIN IEC 1131