



Performance Availability

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Topics

- 1. Intralogistic Systems**
- 2. Current Availability Practice**
- 3. Performance Availability**
- 4. Current Status**
- 5. Statistics**



Intralogistic Systems

Members

- Algol Technics Oy
- Alstef Automation S.a.
- Awa Advanced Warehouse Automation Oy
- BA Systèmes
- Beumer Maschinenfabrik Gmbh & Co Kg
- Cassioli S.R.L.
- Cinétic Transitique
- Cti Systems S.a.
- Dematic Gmbh & Co. Kg
- Fki Logistex
- Jungheinrich Moosburg Gmbh
- Knapp Logistic Automation
- Krones
- Rocla Robotruck Oy
- Savoye
- Ssi Schäfer Noell Gmbh
- SSS-Fördertechnik AG
- Stöcklin Logistik AG
- Swisslog
- Vanderlande Industries Nederland Bv
- Ventomatic S.P.A.



Current Practice

Availability Based on Component Downtimes

- MTBF / MTTR
- FEM 9.222 (equals VDI 3581)

Anmerkung:

Die Formeln für die Verfügbarkeit η enthalten Zeitan-
teile, die während einer bestimmten Beobachtungszeit
meßbar sind. Sie können damit als Meßvorschrift verwen-
det werden. In manchen Fällen wird die Verfügbarkeit
jedoch nicht als Meßvorschrift, sondern als Systemeigen-
schaft betrachtet.

Bild 2 verdeutlicht, daß die Mittelwerte von $t_E - t_A$ und
von t_A den im englischsprachigen Raum üblichen Begrif-
fen *MTBF* und *MTTR* entsprechen.

Die Verfügbarkeit als Systemeigenschaft wird dort defi-
niert zu *A* (availability):

$$A = \frac{MTBF}{MTBF + MTTR}$$

wobei: *MTBF* = Mittlerer Ausfallabstand
(mean time between failures)
MTTR = Mittlere Reparaturdauer
(mean time to repair)

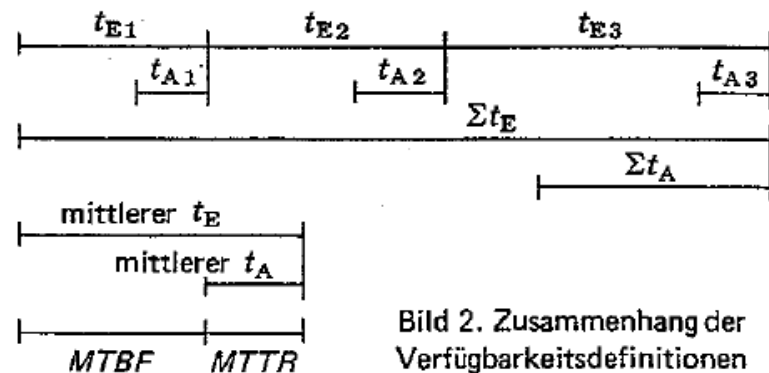


Bild 2. Zusammenhang der
Verfügbarkeitsdefinitionen



Current Practice

Difficulty: component downtimes → system availability
What does this mean for the performance of today's highly complex systems?

Elements to consider

- **performance reserves**
- **redundancies**
- **buffer**
- **order and article structure**
- **duration of downtimes**

New recommendation:

Describing the performance of a system based on the business goals taking in account the operational use of the system



Performance Availability

- **Since 2004 discussions about new guideline**
- **Network**
 - **FEM members of Intralogistic Systems**
 - **VDMA „Intralogistic Systems“**
 - **Fraunhofer IML, Professor M. ten Hompel**



The VDI Working Group „Performance Availability“ Organization

- Founded

5/2007

- Chair

Prof. Michael ten Hompel, TU Dortmund

- Goal

Review of the RAM guidelines for intralogistics

- focus on specific requirements of intralogistic systems
- use of VDI-Handbook of Reliability for Material Handling Industry
- calculation methods and test procedures



The VDI Working Group „Performance Availability“

•Participants

- BEUMER, Beckum
- Dematic, Offenbach
- TU Dortmund
- P & L Hoffbauer
- SSI Schäfer Peem, Graz
- TU Ilmenau
- TU Stuttgart

•Way of working

- 2 plenary meetings per year
- Once a month working meetings by telcon supported by netviewer



Performance Availability Definition

- **Performance availability indicates, if a process is carried out according to the requirements and if the required result is delivered on time.**
- **This includes that at the moment of ordering the performance all the required resources are available, independent of occurring uncertainties, i. e. fluctuating load or breakdowns.**



The Guideline: Overview

- **Introduction**
- **Definition of Performance Availability**
- **Test of Performance Availability**
- **Example Distribution Centre**
- **Sample Test Procedure and Protocol**



Performance Availability General Procedure

business goals

requirements for interfaces at MHS

preconditions and constraints

classification of requirements

resource waiting time

lead time

measurement:
waiting time T_W in observation period T_O

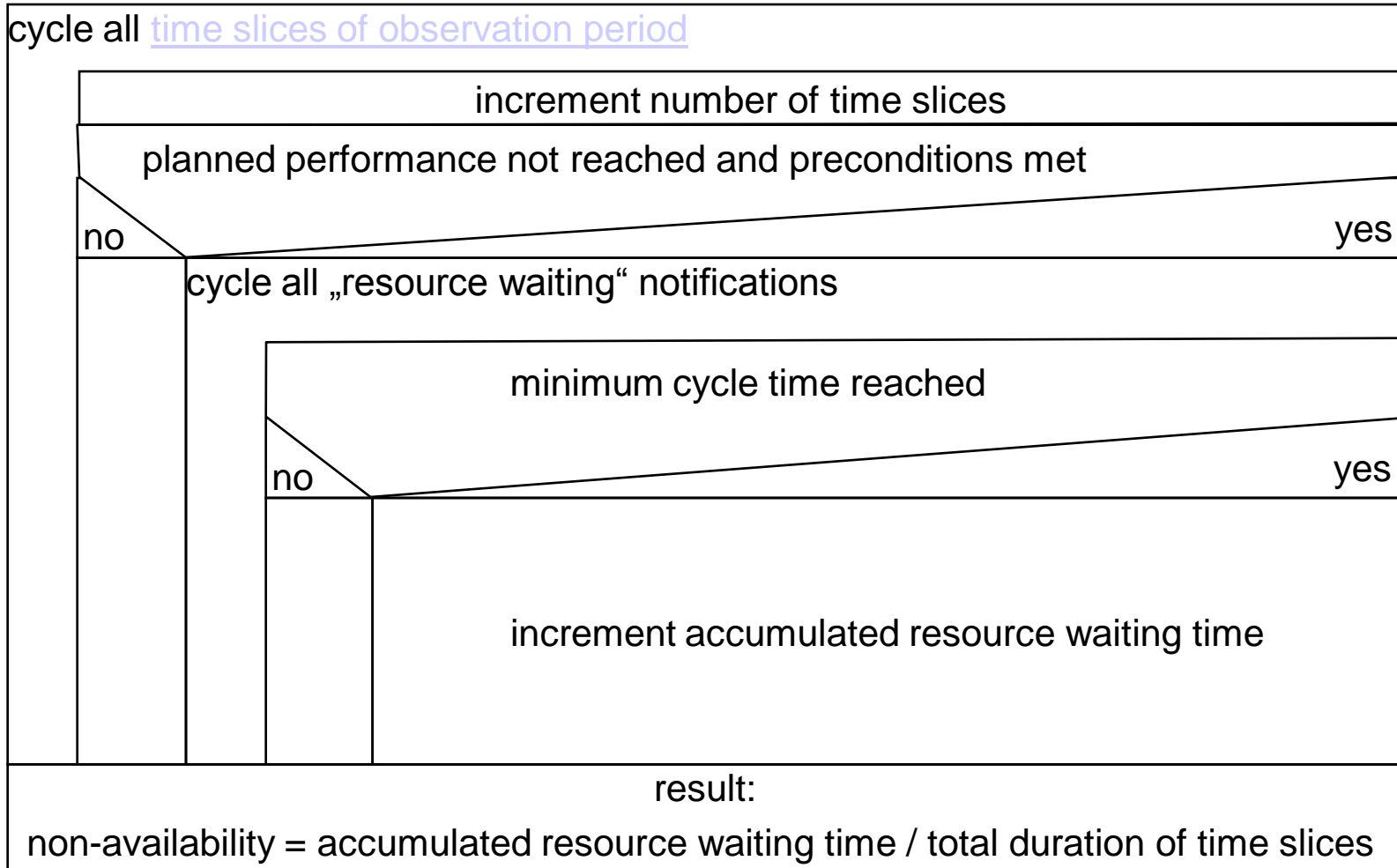
measurement: n late pieces
in observation period (N planned pcs.)

minimum availability:
 $\eta = (T_O - T_W) / T_O$

minimum availability:
 $\eta = (N - n) / N$

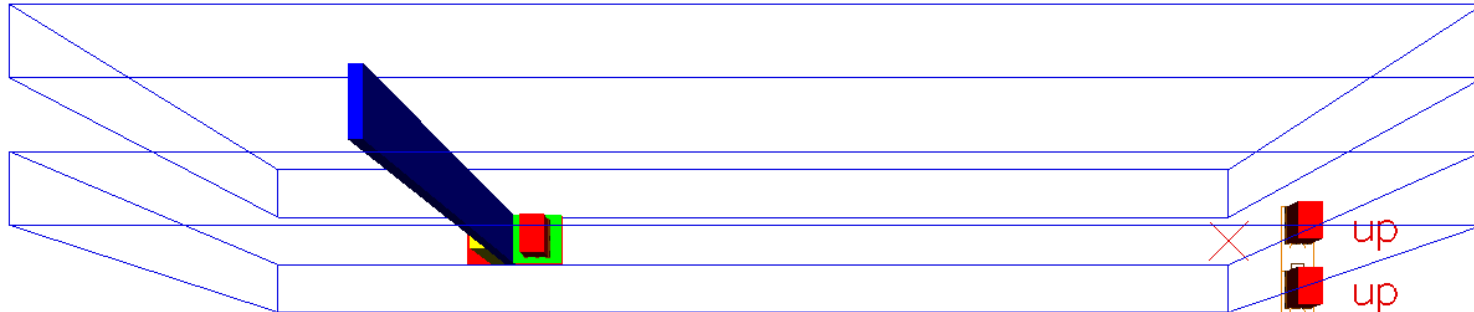


Resource Waiting Time (One Resource) Measurement



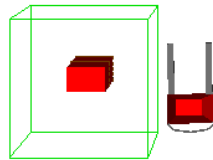


Simulation: Goods Receipt in Distribution Centre



hbw max performance: 58
 hbw loads current hour: 13
 hbw loads current hour: 56

goods receipt contract: 47
 goods receipt av generate: 51
 goods receipt loads current hour: 17
 goods receipt loads last hour: 50



truck max performance: 85 (43 s)
 truck cycle time correction: 47 (77 s)
 truck loads current hour: 15
 truck loads last hour: 50
 truck current waiting time: 0
 truck last hr waiting time: 0



Conclusions from Simulation Experiment

simulation shows that performance availability takes into account

- customer's business goal (in-feed flow, resource utilization)
- buffer capacity
- performance reserves
- MTTR (accessibility)

further experiments will show

- redundancies
- article amounts
- bundling
- lead time

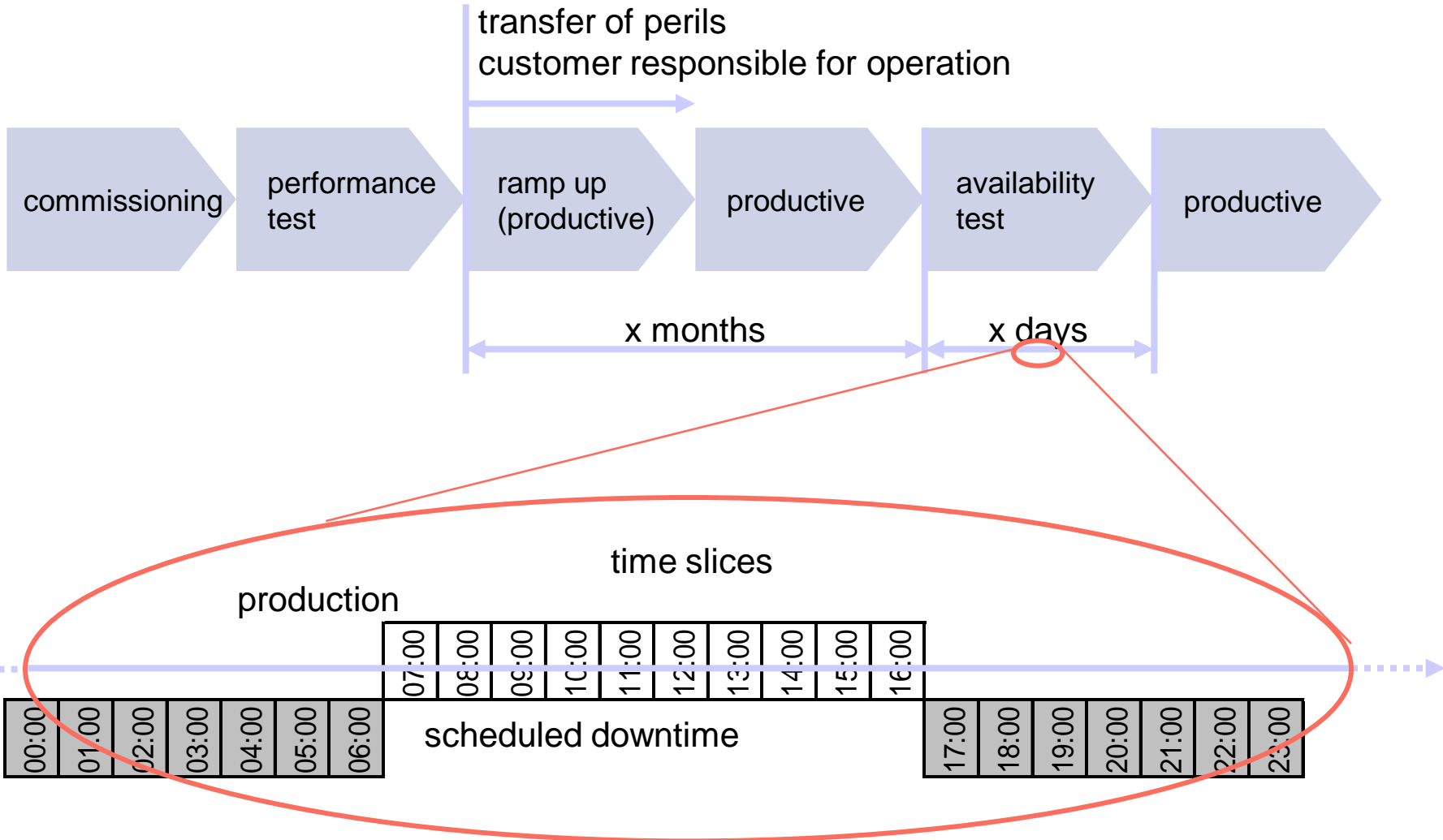


What is Required for Performance Availability?

	performance availability	MTBF/MTTR
analysis of breakdowns	limited to critical hours	all
availability model	no	yes
recording of resource waiting times	yes	no
recording of system performance	yes	no
definition of base data	yes	no
definition of user requirements	yes	yes



Measurement of Resource Waiting Time Observation Period and Time Slices





Current Status

- VDI guideline is available as draft
- Projects are being selected as test
- Guideline expected available as FEM Recommendation:
spring 2010

Do you want to use it: ask your system integrator!!



Intralogistic Systems

Guidelines

- FEM 9.831
 - **Basis of calculations for storage and retrieval machines – Tolerances, deformations and clearances in the high – bay ware house – Part.1 : General, Single and Double deep pallet racking**
- FEM 9.832
 - **Basis of calculations for storage and retrieval machines – Tolerances, deformation and clearances in automatic small parts warehouses (not silo design)**
- FEM 9.8 XXX
 - **Rail dependent storage and retrieval systems – The design of safety (under construction)**



Intralogistic Systems

Ecodesign Directive 2005/32/EC

- FEM has implemented a TaskForce. The TF needs to inform the FEM PGs on the importance of this Directive, and discuss it with their members.
- FEM will:
 - Monitor and inform on the political developments
 - Serve as a platform for PGs to report on their strategies and activities
 - Serve as a coordinating point where a horizontal and political FEM strategy can be developed
- All FEM PGs are invited to appoint a representative to the TF



Intralogistic Systems

- **Statistics**

- Storage & Retrieval Machines
 - 22 participants
 - 1526 machines reported in 2008
 - History > 15 years

- Intralogistic Systems
 - 12 participants
 - >300 systems reported in 2008
 - History 2 years



Questions?

FEM secretariat

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