TRANS MIDDLE EAST 2023

SIEMENS
Ingenuity for life

Automatic Container Terminal Performance

Dubai

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Presenter

Gerhard Fischer
1983-1987 University Applied Science Munich
1988 Arizona State University, Tempe AZ
1989 German Military Service
1990 –1995 Siemens AG R&D
1995 –1998 Siemens Pte. Ltd. Singapore
1998 –2002 Siemens Ltd. Taiwan
2002 –2004 Siemens AG Germany
2004 –2008 Siemens Netherlands
2008 – Siemens AG Germany

Memberships:
VDI AK304 „cranes“, member
DKE German electrotechnical commission for IEC 60204-32, member
PEMA equipment design & infrastructure comittee, vice chair
IEEE industry applications society, member

Crane Types - Maturity & Degree of Automation

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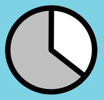
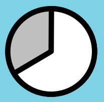
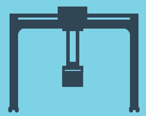
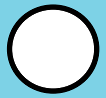
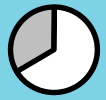
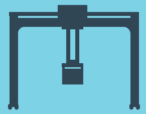
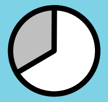
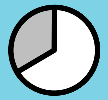
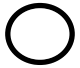
Crane type	Sub-type	Automation Degree	Status & challenges
STS 	Single trolley		LS – Resolution trolley-mounted sensors WS – Presence of personnel, cell guides, vessel drift/tidal shift
	Double trolley		LS – solved/ in commercial operation WS – Presence of personnel, cell guides, vessel drift/tidal shift
RMG 	Portal (ASC)		Ca. 1000 units in commercial operation Majority as ASC with AGV, strad and truck interface ARMG truck interface, critical aspect of driver presence in cabin
	Cantilever (ARMG)		
RTG 	8-wheel 16-wheel		First units in commerical operation 16-wheel more stable than 8-wheel ARMG truck interface, critical aspect of driver presence in cabin
Strad 			First units in commerical operation

 Semi-automated with limited driver assistance

 Semi-automated with extensive driver assistance

 Fully automated with manual intervention

STS Cranes – Current Design Goals

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Productivity 40 mph	**MMBF > 2000**	**Remote control with 1:N**	**Positioning accuracy and speed in semi-automatic mode**
Sway/skew control during wind gust	**Automatic truck landing**	**Vessel profile scanning**	**Removal / insertion of pins**

Current key performance indicators

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- Productivity
  achieve cycle time and moves/hour targets
- Safety, LTIFR
- Autonomy
  cranes can handle operational scenarios automatically
  manual intervention (MI) rate -> 0
- Emission footprint CO2

Operational KPI

- Availability
  no breakdowns during scheduled automatic operation
- Maintenance
  system & component reliability - MMBF, MTBF
  faul recovery - MTTR
  fault diagnosis
  fault prediction - average downtime

Maintenance KPI

LTIFR lost time injury frequency rate
MI manual intervention
MMBF mean move between failures
MTBF mean time between failures
MTTR mean time to repair

Typical automation KPI

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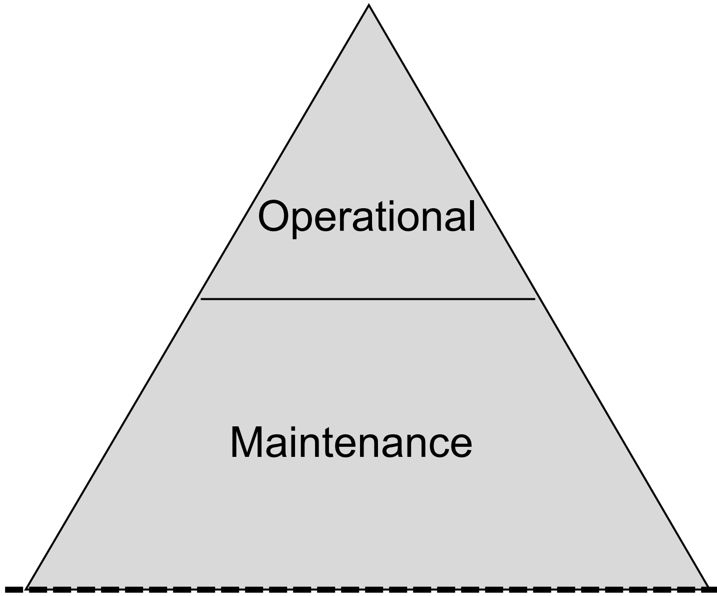
KPI:

Productivity
Autonomy

Availability
Reliability
Diagnosability
Predictability



Impact:

Revenue generation operational expenses — OPEX

Planned & unplanned maintenance cost — OPEX

Extended automation KPI

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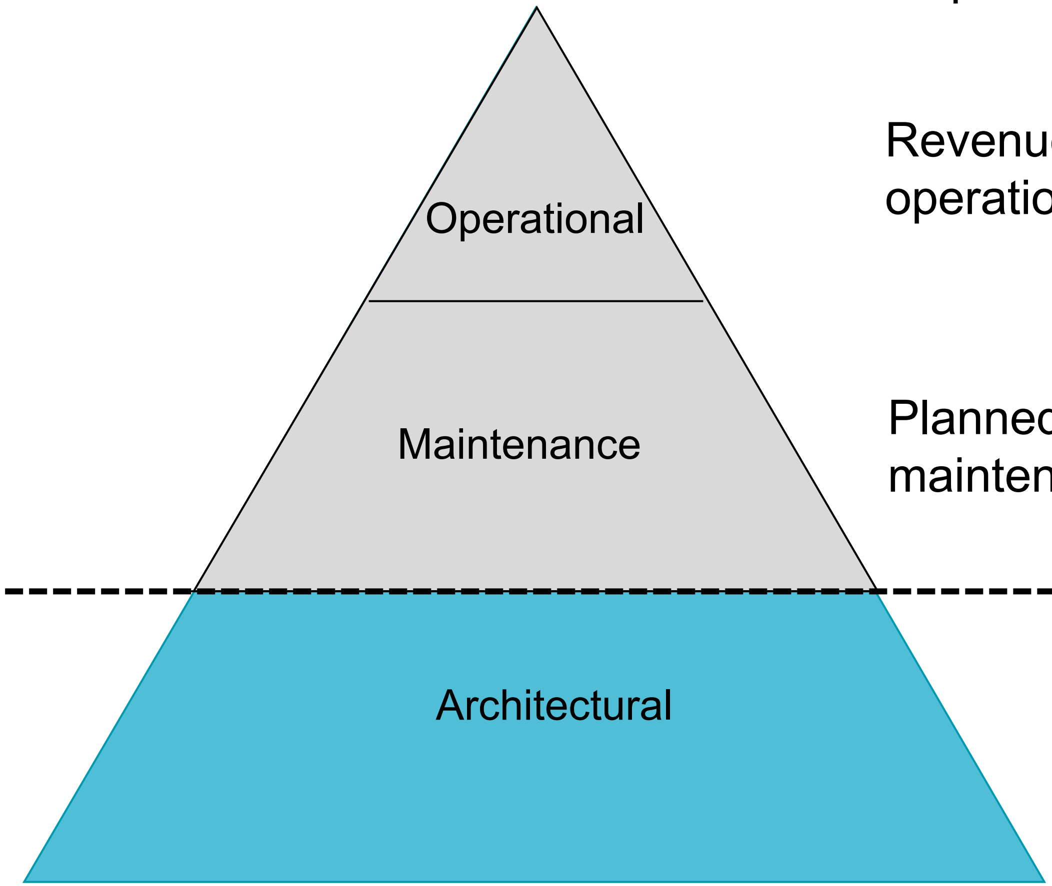
KPI:

Productivity
Autonomy

Availability
Reliability
Diagnosability
Predictability

Robustness
Redundancy
Resiliance
Simplicity



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CAPEX

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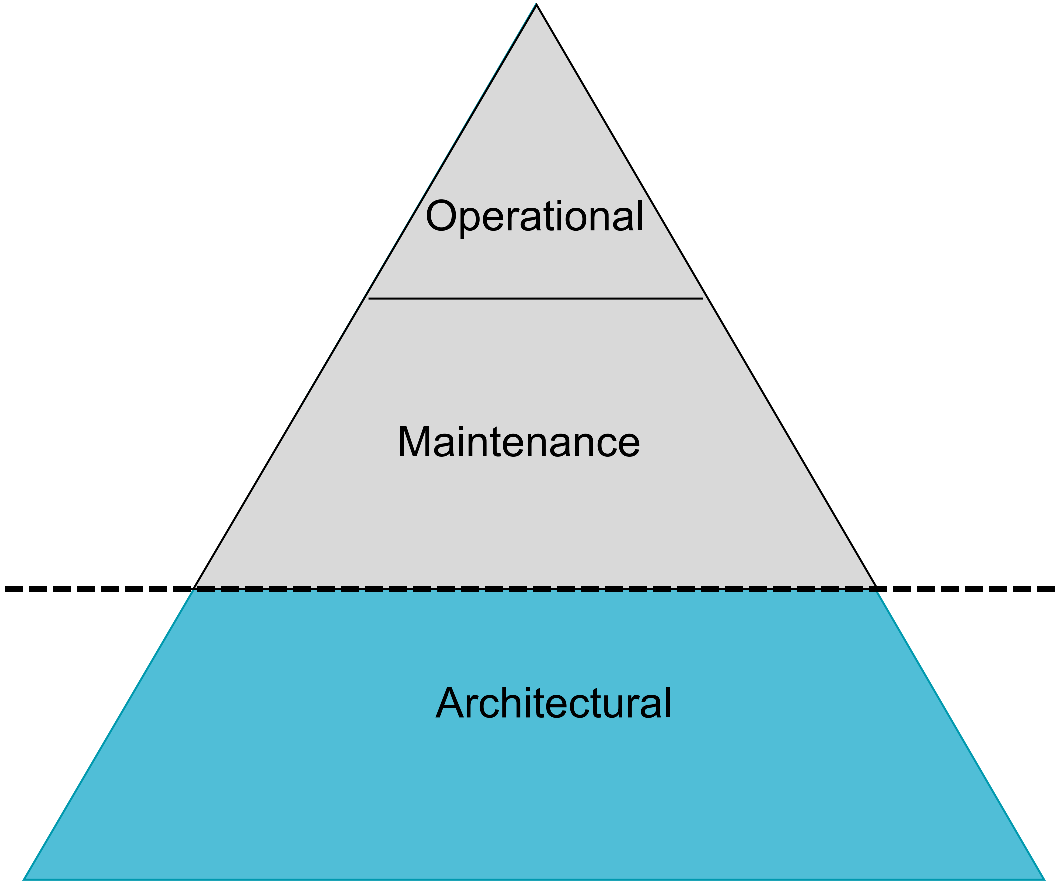

Openness (interfaces)
Modularity
Scalability
Usage of AI/ML
Security (cyber)

Architecture – Investment Trade-Offs

Invest €

ROI
- Go-live time
- Productivity (MPH)
- OPEX
  - Land area concession
  - Maintenance cost (sensors, IT, ..)
  - Manual interventions
- CAPEX
  - Civil engineering
  - Equipment (cranes, ..)
  - Automation solution
  - Optimization algorithms

Technology

- Existing
  - Product platform
  - Expertise
  - Standardization
  - Support
- New
  - Water-side automation
    - Tidal shift
    - Vessel drift
    - Personnel on deck
    - Cell guides
  - Automatic coning/de-coning
  - Equipment integration
  - Safety certified sensors

Risk

- Technical
- References
- Interfaces
  - TOS
  - ECS
  - Maintenance
  - Gate
- Resources
- Go-live time

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Interdependencies/
trade-offs

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- Resources
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References ARMG

PSA PPT 56 ARMG Singapore	APMT Tangier Med 2 32+10+14 ARMG Morocco	BASF Ludwigshafen 2 ARMG Germany	HIT CT6 9 ARMG Hongkong	Evergreen CT7 40 ARMG Kaohsiung
Commercial operation since 2015	Commercial operation since 2018	Commercial operation since 2018	Commercial operation since 2019	Commissioning

References ARTG

Port of Felixstowe 8 ARTG United Kingdom	DPW Jeddah 17 ARTG Saudi Arabia	Ningbo Port 2 + 4 ARTG China
Commercial operation since 2020	Commissioning	Commissioning

Conclusion

- Continued evolution of crane automation
- Estabished KPI for operational and maintenance performance
- Introduction new KPI for architecture
- Trade-offs between Invest – Technology – Risks
- Modular automation
- Open interfaces as basis for application of ETL and AI/ML

ETL Extract Transfer Load
AI Artificial Intelligence
ML Machine Learning