How to ride the wave of innovative mechatronics?

19 June 2018
Bart van Dartel | Utrecht
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Introduction

VANDERLANDE

Research & Development

STORK

TU/e Mechanical Engineering
Reliable partner for value-added logistic process automation
About Vanderlande: Company profile

Global market leader

Established since 1949

> 5,000 employees

1.1 Billion revenue

Innovative systems

Intelligent software

Life-cycle services

AIRPORTS

10.1 million bags per day

600 airports including
13 of the world's top 20

- Atlanta Airport
- London Heathrow Airport
- Hong Kong Int. Airport
- Amsterdam Airport Schiphol

WAREHOUSING

Many of the largest global e-commerce players

- Amazon
- TESCO
- Zalando
- ASDA

PARCEL

39 million parcels sorted every day

5 largest parcel and postal companies

- UPS
- Deutsche Post DHL
- TNT
- FedEx
- SF Express
Industry Segments: Airports
Industry Segments: Warehousing
Industry segments: Parcel
We improve the competitiveness of our customers through value-added material handling solutions.

- Growth
- Innovation
- Internationalisation
- Teamwork
Innovation: Different approaches

Processes & Methods

One way of working (ISO, Process Map)
Modernization (Agile, Model Based Design)

Products

Technology push
Market pull
Co-creation with key customers
Start with Why
“Everything should be made as simple as possible, but not simpler.”
Future solutions: Need for automated item handling

- More and more tasks can be automated with robot applications
- One by one, robots will take over responsibility of current operators tasks
- Operators will oversee a number of robots and eventually oversee whole operation from the control room
- Resulting in a fully automated flexible warehouse running 24/7 with a higher productivity, optimized output and minimum of errors in product handling
Our Challenges: Diversity in a critical process

**Carriers**
- ULD Aircrafts, Pallets, Trailers/dollies, Swap bodies, roll cages
- All different sizes and shapes
- High filling rate required

**Items**
- Very large number or indefinite number of items
- All types shapes, weights, quality, surfaces
- Content of the items sometimes unknown

**Process**
- Time critical and capacity is key
- Operator handles variety of exceptions
- Value Added Services if applicable
About R&D: (Mobile) Robotics & Item Handling

Robotic Item Handling:
> Machine Vision
> Deep Learning
> Gripping

Mobile Robotics:
> Semantic World Modelling
> Operate autonomously in changing environments
Transition: Adding brains to mechatronics

Mechatronics ➔ CyberPhysical
Κυβερνητική

Governance
Today

5-layer architecture

Future

Cyber-physical system (CPS) based automation

Source: IOT-Analytics.com Cyber Physical Systems based automation

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Data architecture for Cyberphysical systems

- **Connect**
  - **Smart Connection Level**: Plug&Play Functions, Sensor network

- **Convert**
  - **Data to Information Level**: Self-Diagnostics, Health Monitoring

- **Compare**
  - **Cyber Level**: Digital Twin Model, Peer-to-Peer Monitoring

- **Conclude**
  - **Cognition Level**: Decision making (support), visualization

- **Configure**
  - **Configuration Level**: Self-configure, Self-adjust, Self-optimize

Source: Lee J., Bagheri B., Kao H.A. A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems 2015
A cyberphysical example

Learning: It is better to follow an alternative path

An alternative path is simulated by virtual twin

It reduced my performance with 20%

I see and report an obstacle on my path

Bring new learnings to all vehicles
The driver: Moore’s Law

< 10 years!

Source: Kurzweil R. The singularity is near: When humans transcend biology
Setting the focus

- Ability to influence design and roadmap
- Act swift and agile on customer demands
- Prepare design work for partners
- Automation of design work

![Graph showing time, effort, conceptual development, and detail development with preferred focus and traditional focus areas.](Image)
Model Based Design: Focus on design & integration

REQUIREMENTS

DESIGN by MODELLING

CODE GENERATION

INTEGRATION

CONTINUOUS TEST & VERIFICATION
Model Based Design: Creation of a virtual world
Continuous Test & Verification

Development PC  
Simulink model: Virtual system

Speedgoat
Ethemet/IP  
24V IO

Ethernet cable  
Status LEDs

Embedded controller

Plant component 1

Plant component 2

Vision application
Development Teams: A knowledge Ecosystem approach

- Autonomous
- Cross-functional
- Many interactions
- Models as technical truth
Partnership approach

Co-development partners

Tooling partners
Complex Cyberphysical Systems

Shift of Focus

Autonomous Teams

Architecture

Design Automation

Partnership approach

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Embrace complexity and work together!

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