SmartFactory: The Challenges of Open and Low Cost ICT in the Small Manufacturing Industry.

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Materials Science and Manufacturing – MST Competence Area

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our future through science

SmartFactory
Agenda

- Introduction
  - Who we are
  - What we do
- SmartFactory - Architecture
  - Analysis
  - Requirements
  - Design
- SmartFactory – Implementation
- SmartFactory - Future

Introduction

Who we are

What we do

our future through science

Introduction

- Operating Unit: Materials Science and Manufacturing
- MST Competence Area
- 2 Main Activities:
  - Digital Manufacturing
    - Cooperation with MIT's Centre for Bits and Atoms
    - FabLab
  - Affordable Automation
    - Robotics / Mechatronics
    - Automation & Control

Introduction
Past Activities

Water & Waste water Industry

Rooiwal Plant, Live Data & Graphs

http://rooiwal.sst.csir.co.za

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Introduction
Improve Manufacturing Competitiveness

- Competitiveness Fund Assessments (for DTI by M&Mtek)
- Technology Roadmap, Automotive industry (Innovation Fund)
- National R&D Strategy
- Advanced Manufacturing Technology Strategy (AMTS)
- All agree: use of ICT is the key to increase industrial competitiveness.

Introduction
Available Systems

- Established automation and control solutions
  - provided by Siemens, Honeywell, etc.
  - standards like PROFIBUS, PROFINET, etc. (Proprietary)
  - large industrial customers
  - high performance at a high price

- Enterprise Resource Planning (ERP)
  - provided by SAP, Baan, PeopleSoft, etc.
  - large industrial and other corporate customers
  - high performance at a high price

Introduction
BUT: Smaller companies neglected

- Automation and control
  - affordability
  - simpler requirements
  - non real-time monitoring and basic control
- ERP
  - affordability
  - simpler requirements
  - less complex processes and corporate governance policies
  - Example: use of Excel

Introduction
The Dream

- Create an ICT solution for SMME's.
  - ERP
  - SCADA
  - Automation & Control
- Replace High-Cost Imported Technologies
- Building competences and skills in the CSIR and S.A.
  - A collaboration between CSIR & Universities

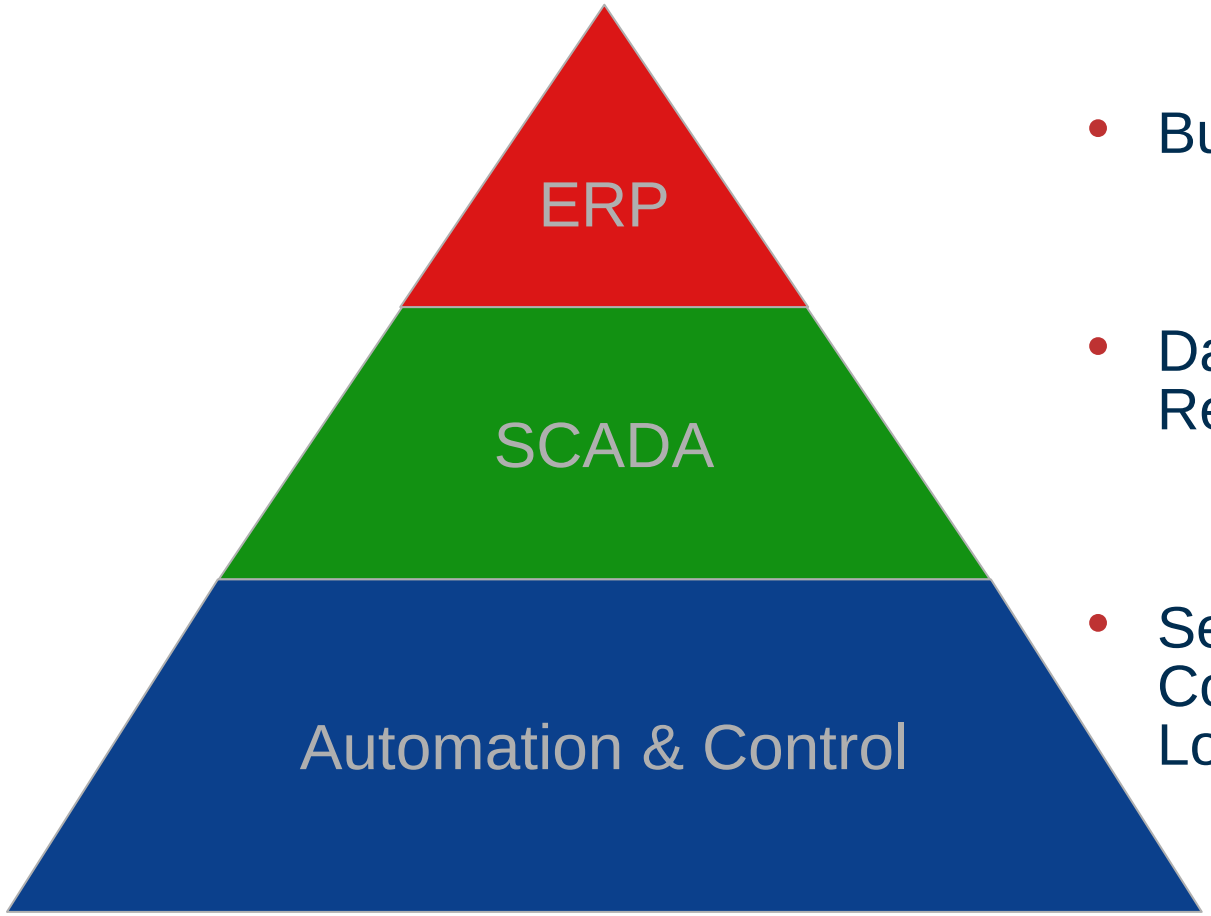
SmartFactory - Architecture

Analysis

Requirements

Design

SmartFactory - Architecture Analysis



- Business Systems
- Data Collection & Representation
- Sensors, Communication & Local Control

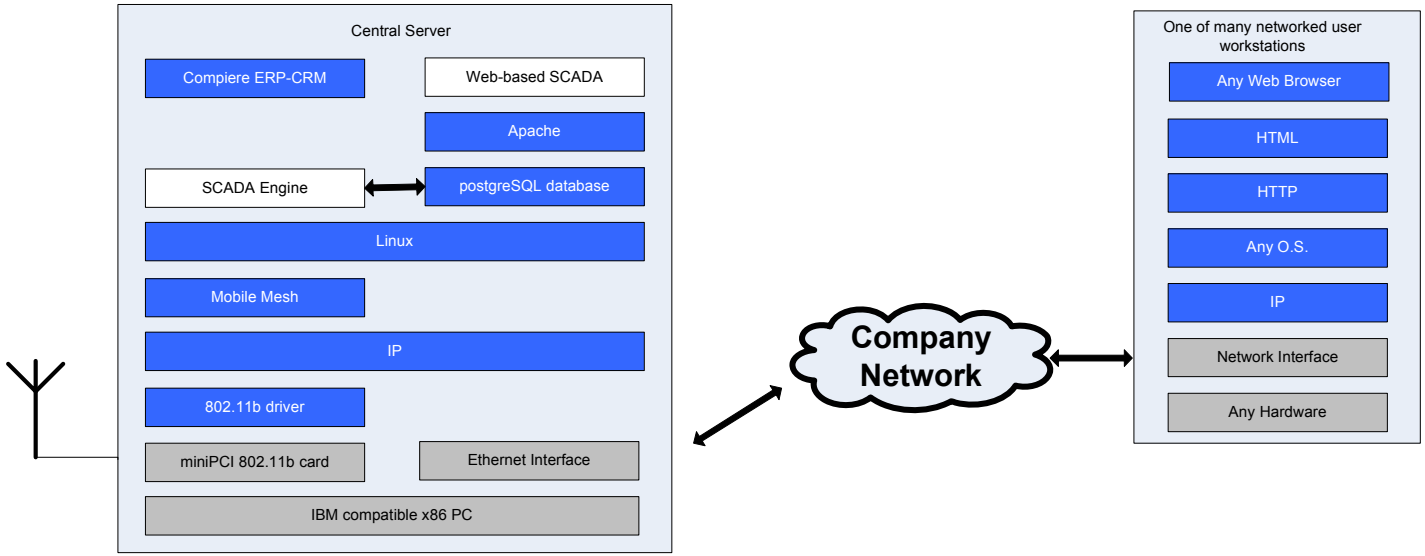
SmartFactory - Architecture Requirements

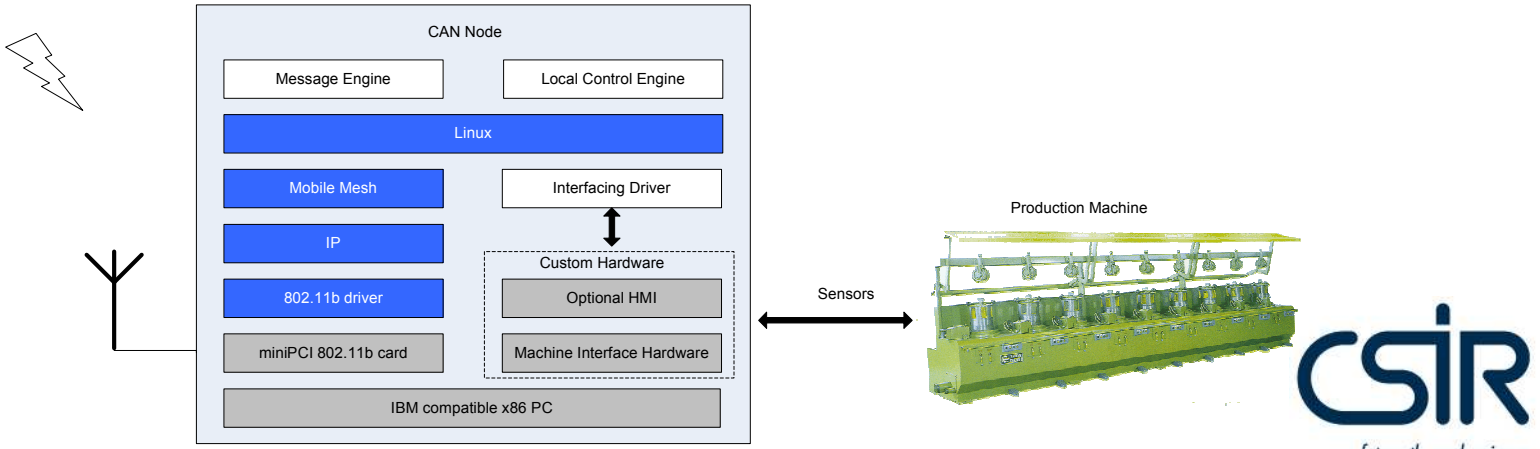
- Ease of Installation – Plug-and-Play
  - High tech behind the scenes, simple appearance
  - Anyone with some computing skills can install
- Ease of use
  - Extremely low learning curve
  - Use should be intuitive, if not daily in use, should easily be recalled
- Low-Cost / Affordable
- Open Standards / Open Source
  - Encouraging cooperation with others
- Modular and Scalable
  - Able to scale with company size

SmartFactory - Architecture Technologies

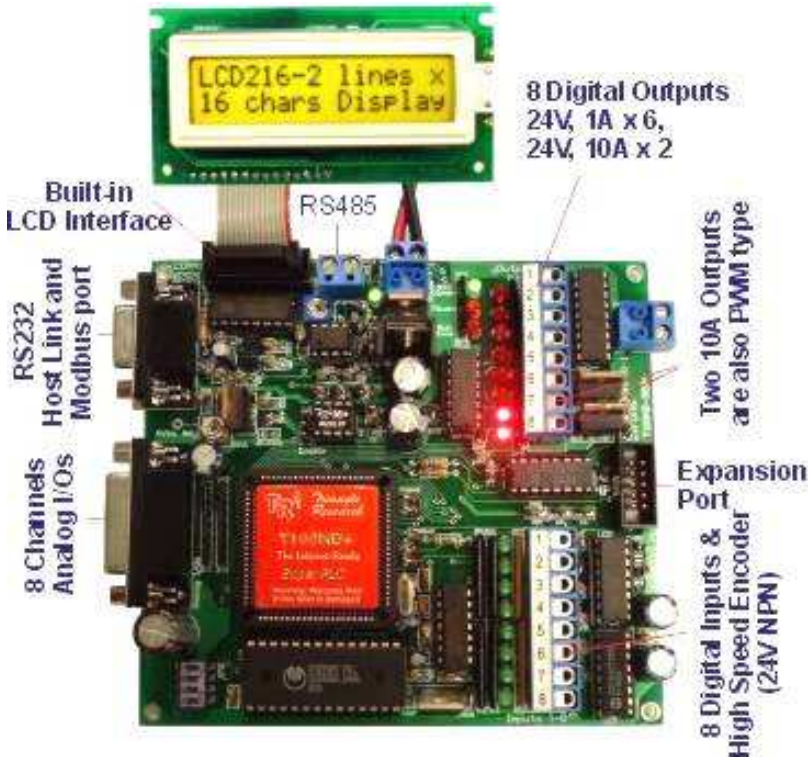
- Wireless Technologies
  - 802.11b
  - Mobile Mesh
- Open Source Building Blocks
  - FreeBSD / Linux
  - PostgreSQL
  - HTML based SCADA
  - Compiere ERP + CRM
- Open Hardware
  - Commodity PC's
  - Embedded SBC's
  - Custom Interfacing Electronics

SmartFactory - Architecture Design

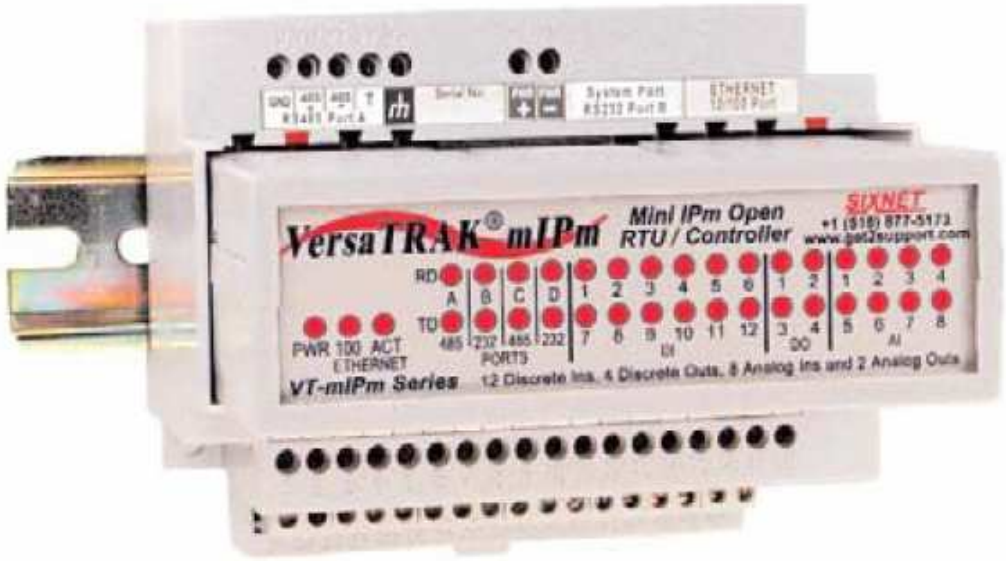




SmartFactory
CAN Node Options - 1

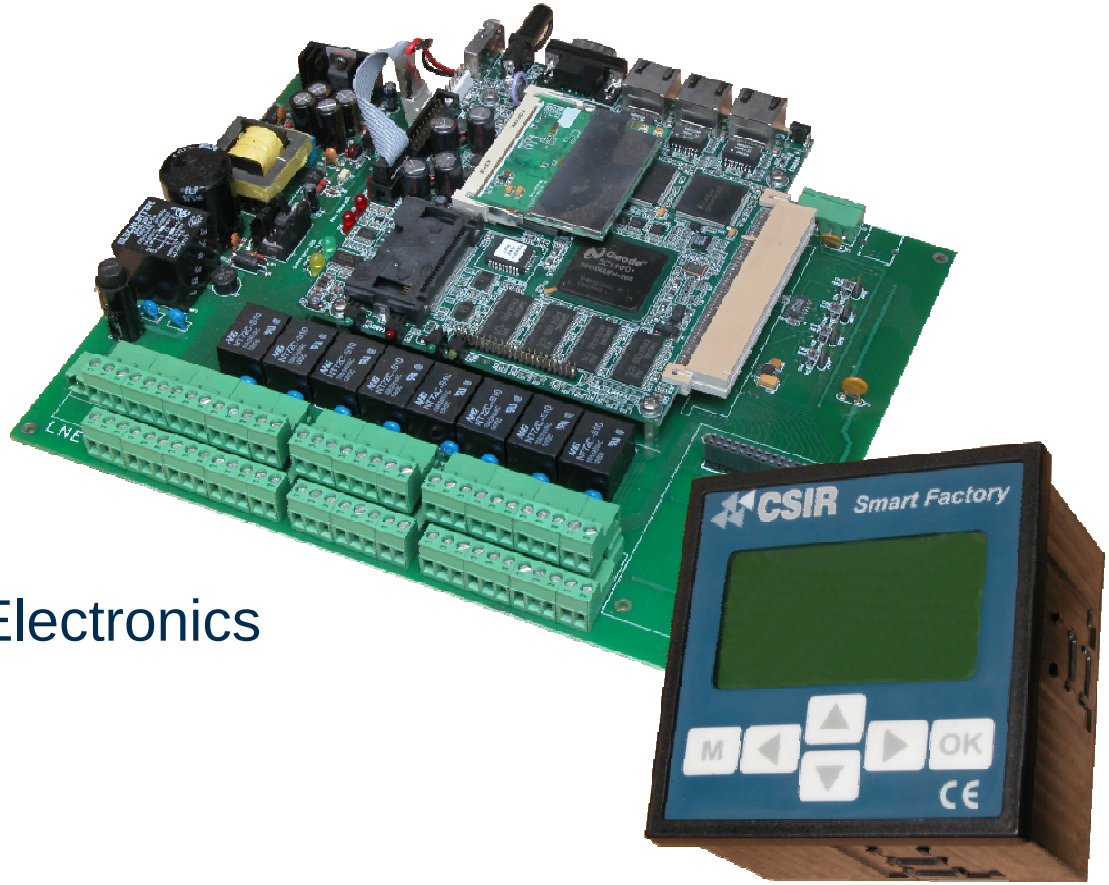


SmartFactory
CAN Node Options - 2



- Open Source PLC

SmartFactory - Architecture
CAN Node – Result



- Standard SBC
- 802.11b PCI Card
- Custom Interfacing Electronics
- Custom HMI
- Low Cost

SmartFactory - Implementation

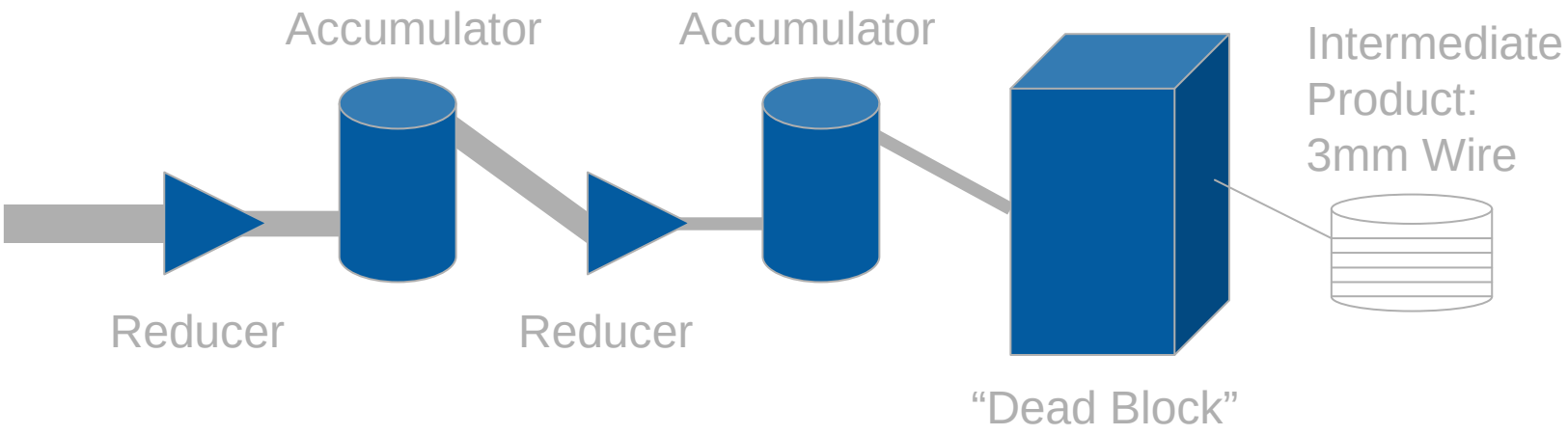
“Getting our hands dirty”

SmartFactory - Implementation Automotive Manufacturer

- GMT (Global Material Technologies), in Babelegi, manufacturers of Iron Products for Automotive & Building Industry.

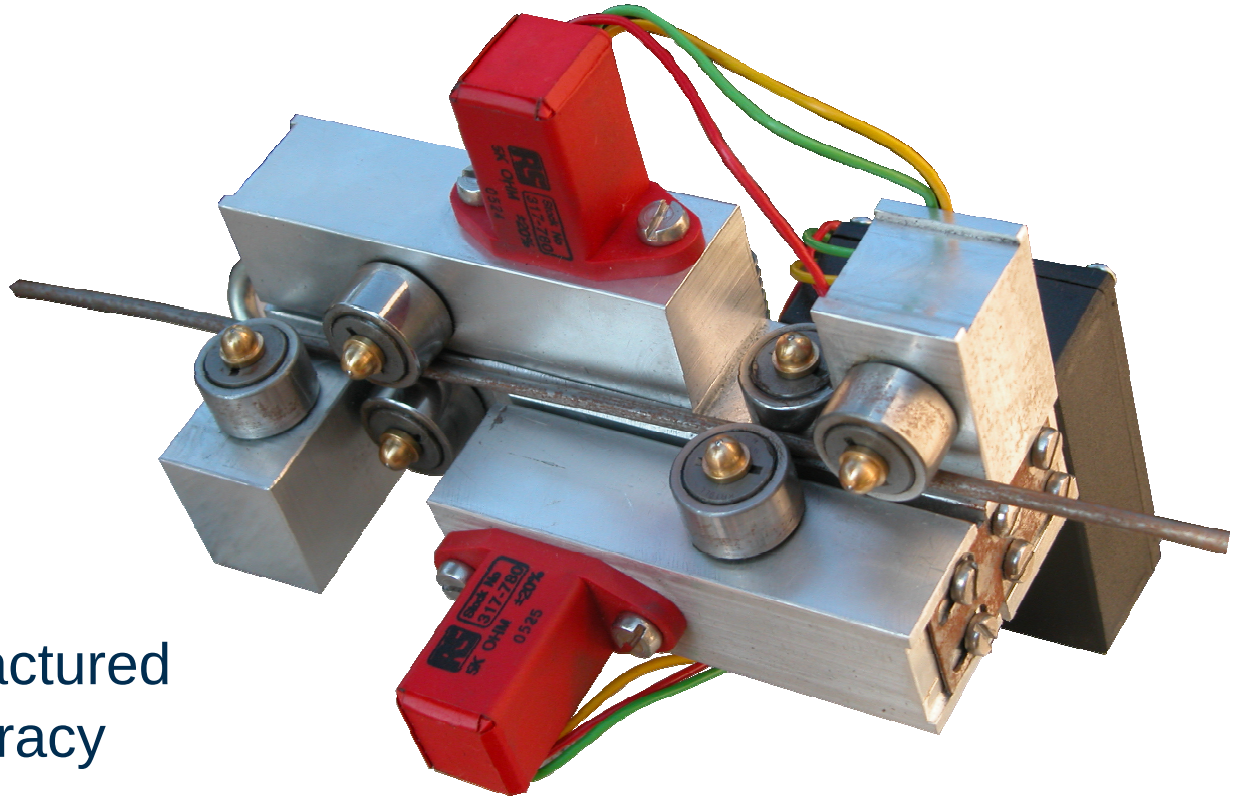
- Manufacturing Process:
  - Steel Rods from ISCOR
  - Wire Draw Machine -> Smaller & Consistent Diameter.
  - “Shave” steel from wire -> Steel Wool
  - Hammer Mill, creates powder

SmartFactory - Implementation
Wire Draw Machine



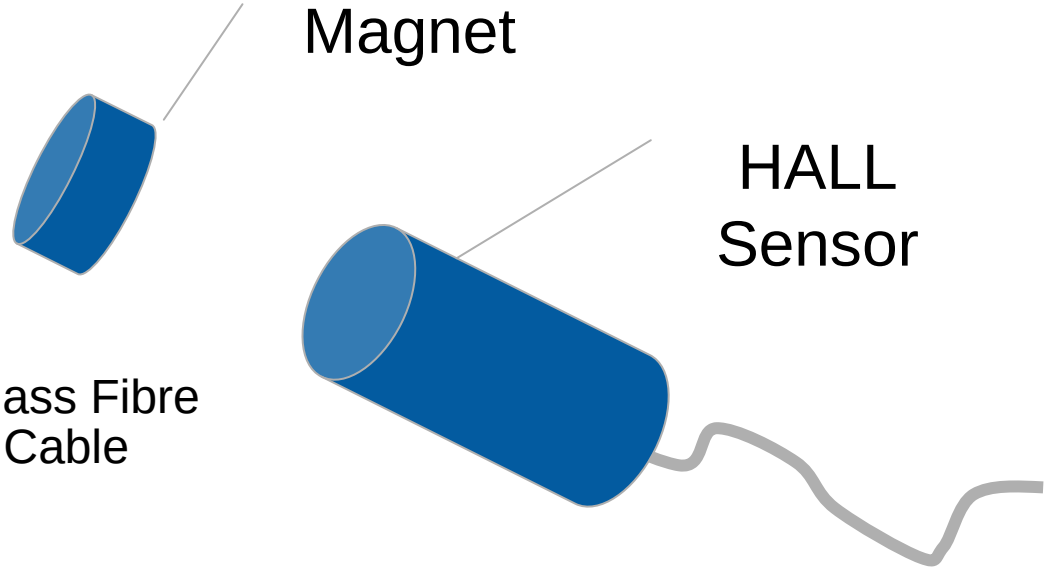
- Sense Temperature of the Accumulators
- Measure Production; how many tons/day
- Measure Wire Diameter & Ovalness (9 Points)
- Operator Report Down-Time Reasons

SmartFactory - Implementation
Wire Sensor



- Low Cost
- Easily Manufactured
- Medium Accuracy

SmartFactory - Implementation Sensor Recipes



Production Sensor:

- HALL Sensor I.C. + Glass Fibre Rod + Epoxy + Signal Cable
- Extremely low cost

- SmartFactory Website to contain recipes for simple sensors:
  www.smartfactory.org.za

SmartFactory - Implementation Lessons Learned

- Factory Installation is NEVER generic, unclear requirements causing delays & lots of learning.
- Never enough I/O
- Select appropriate O.S & Hardware for CAN-Node
- Keep SCADA functionality limited
- Remote Link is indispensable

SmartFactory - Future

SmartFactory - Future

- Establishment of Cooperative Research Network with Universities
- AMTS is funding SmartFactory as a “Flagship Project”
- PRIME used to fund Students in Industry

SmartFactory - Future Further Development

- Smaller Node Hardware
- More versatile HMI Options
- Plug and Play software on SCADA level
- “Building Block” Configuration Software (GUI)

SmartFactory - Future Research Opportunities

- Distributed Sensing, Sensor Mesh networks
- Energy Harvesting