Greef WP3

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Sustainable production control

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Sustainable production control

Background

- The goal of a carbon-neutral Finland in 2035 requires emission reductions in all sectors. The EU's goal is at 2050
- The costs caused by emissions are increasing
- EU-regulations (e.g. Corporate Sustainability Reporting Directive, CSRD)
- There is an increasing demand for green products on the market.
- Competitive advantage for companies at the forefront of the green transition
- Company image and brand

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Implementation

- Implementation and usability of carbon footprint calculations in production management
  - Data collection and processing
  - Utilization of environmental values (simulation and optimization)
  - Reportage
- Production control system that takes CO2 into account
  - Demo: Machine shop of Univ of Oulu
  - Xprimer (EQ System sp. Z.o.o.)
  - Asprova (EQ System Scandinavia Oy)
  - MSSQL

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Objects of the system

- Environmental aspects as part of traditional production control and decision-making => reduction of emissions
  - Environmental values visible
  - Enabling
- Promoting continuous development
  - Supporting LEAN (reducing waste, working efficiently)
  - Identification of environmental issues
  - Implementation of system to workshop
  - Utilizing in teaching

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System implementation

- Measurement and reporting of production functions is done with the help of KPI calculations
- Measuring environmental values
  - Calculation principle
    - Indicator consumption * emission factor = carbon dioxide equivalent, CO2e
    - Calculation takes place during data collection (by Python)
  - Data collection principle
    - Data related to environmental values is collected using Python from the indicators of various devices and entered into the database
    - Measuring freq 1/sec

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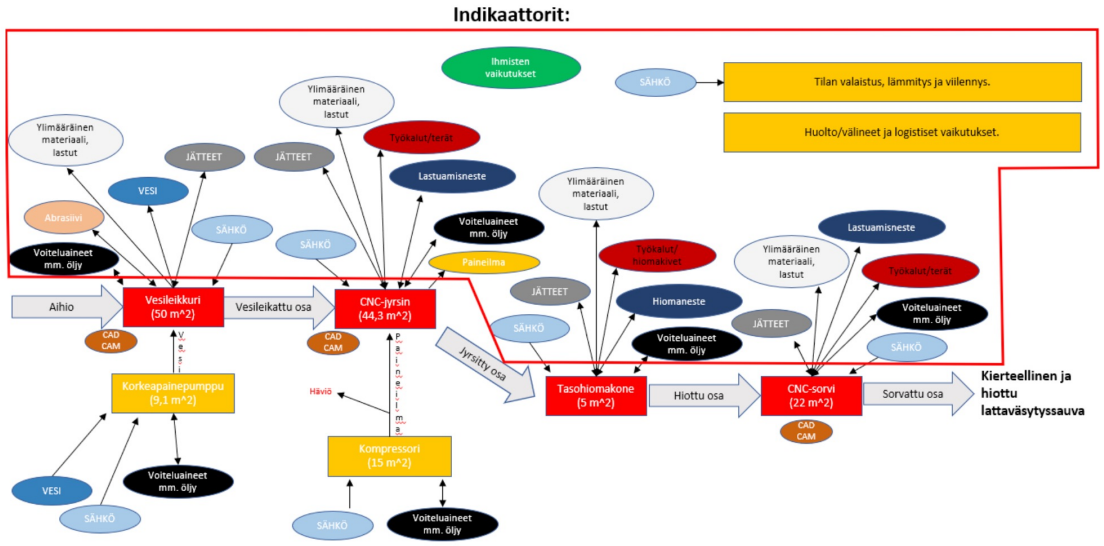
Environmental factors that are taken into account in the calculation



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Softwares: MES ja APS

- Xprimer (MES)
  - Determination of product structures and resources
  - Creating sales orders
  - Production control management
  - Inventory management
  - Communication with devices (IoT)
- Asprova (APS)
  - Simulation and optimization
  - Production scheduling and workload
  - Creating production orders
- MSSQL
  - Database

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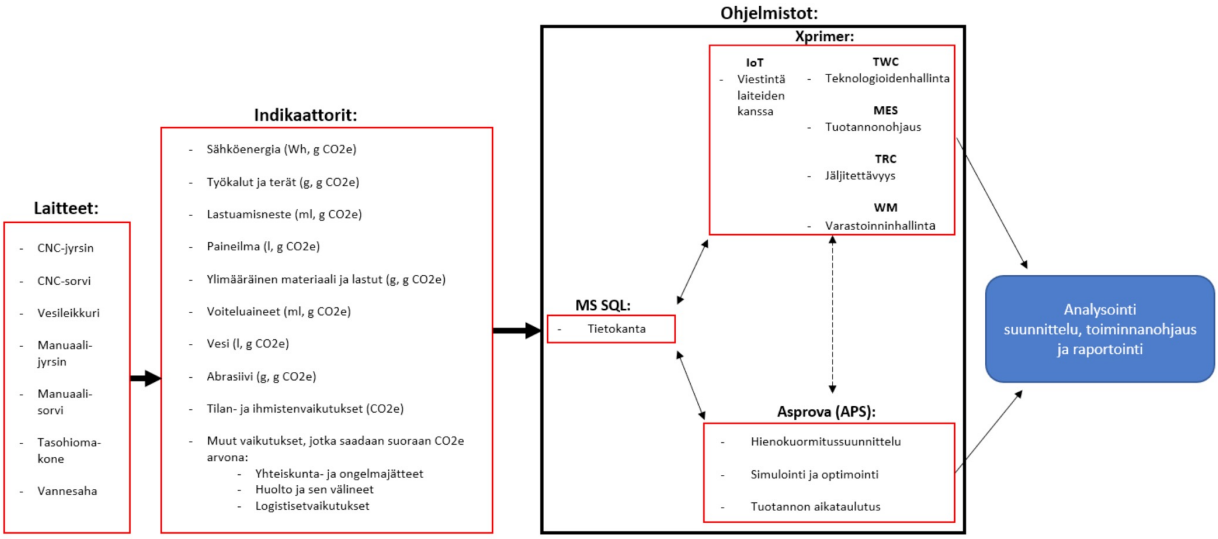
Information flow



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Over time, the amount of primary data increases

Datan laatu kasvaa

Päästönlähde	CO2e Measured data	CO2e Information from database	CO2e Estimation
Energian kulutus, CNC-sorvi	Xx	-	Zz
Parametri 2	-	-	Zz
Veden kulutus, Vesileikkuri	Xx	-	Zz
Parametri 4	-	Yy	Zz
Paineilma, CNC-jyrsin	Xx	Yy	Zz
Parametri 6	-	Yy	Zz
Parametri 7	-	-	Zz
Lastuamisnesteen kulutus, Jyrsin	Xx	Yy	Zz
Parametri 9	-	-	Zz

Käytä mitattua, jos mahdollista.

Käytä tietokantaa, jos mittaus ei ole mahdollista.

Käytä arviota, mikäli muuta ei ole.

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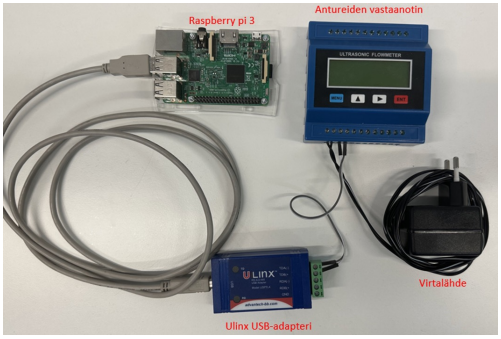
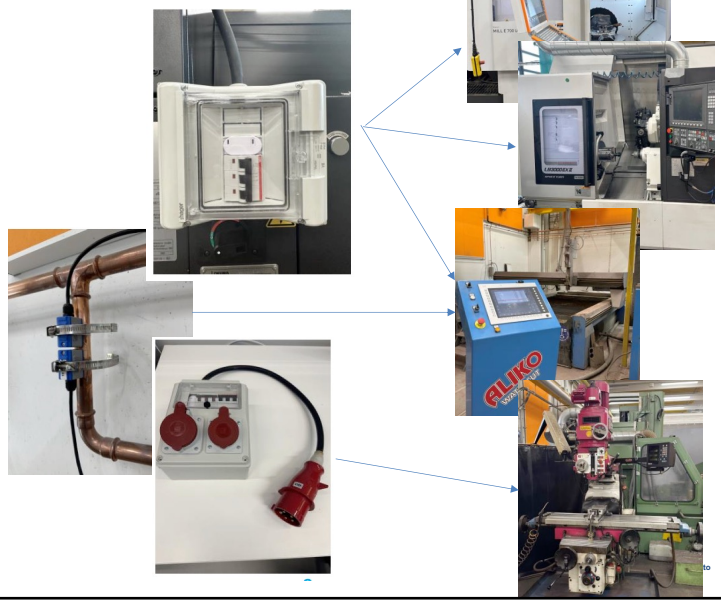
WLAN for collecting data



The receiver and the components needed to transfer the data



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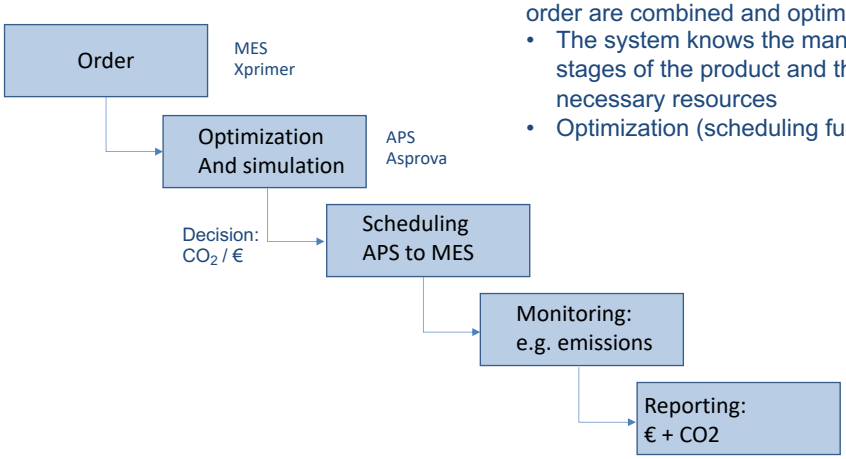
Procedure: xprimer (MES) - asprova (APS)



The workshop situation and the new order are combined and optimized

- The system knows the manufacturing stages of the product and the necessary resources
- Optimization (scheduling functions)

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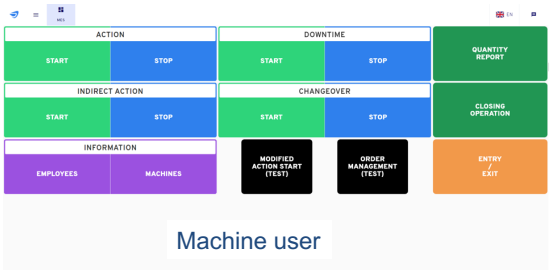
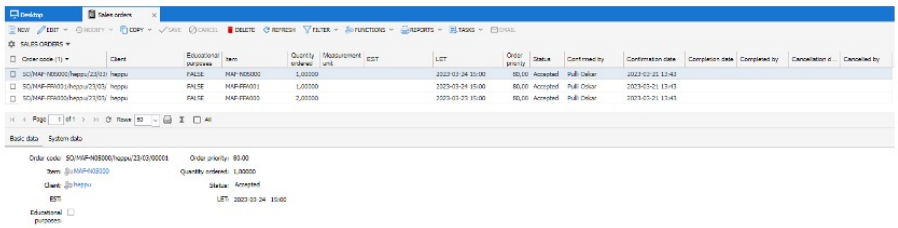
Xprimer main view:

Xpimer.MES view:



Order and code



The product code "contains" the necessary information for APS

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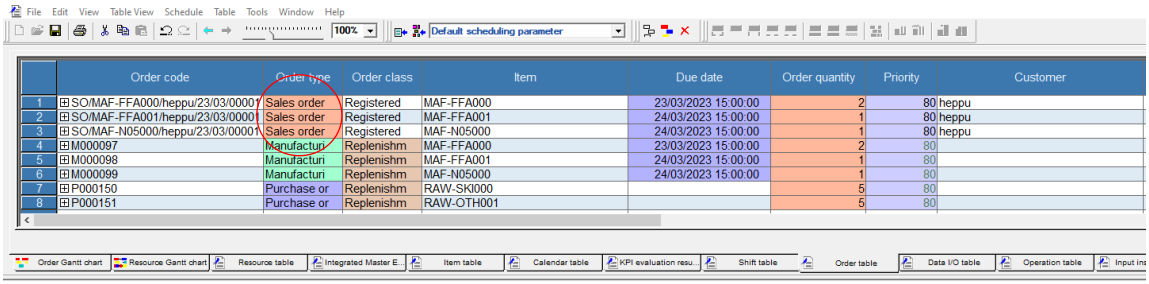
Order from Xprimer (MES) to Asprova (APS) via MSSQL



	Order code	Order type	Order class	Item	Due date	Order quantity	Priority	Customer
1	SO/MAF-FFA000/heppu/23/03/00001	Sales order	Registered	MAF-FFA000	23/03/2023 15:00:00	2	80	heppu
2	SO/MAF-FFA001/heppu/23/03/00001	Sales order	Registered	MAF-FFA001	24/03/2023 15:00:00	1	80	heppu
3	SO/MAF-N05000/heppu/23/03/00001	Sales order	Registered	MAF-N05000	24/03/2023 15:00:00	1	80	heppu
4	M000097	Manufactur	Replenishm	MAF-FFA000	23/03/2023 15:00:00	2	80	
5	M000098	Manufactur	Replenishm	MAF-FFA001	24/03/2023 15:00:00	1	80	
6	M000099	Manufactur	Replenishm	MAF-N05000	24/03/2023 15:00:00	1	80	
7	P000150	Purchase or	Replenishm	RAW-SKI000		5	80	
8	P000151	Purchase or	Replenishm	RAW-OTH001		5	80	

- Manufacturing steps (water cutting and milling) and
- Required purchase orders

Sales order generates production and purchase orders (APS)

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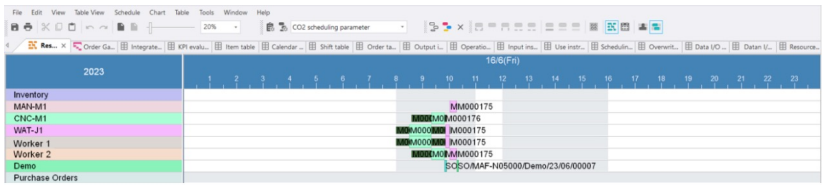
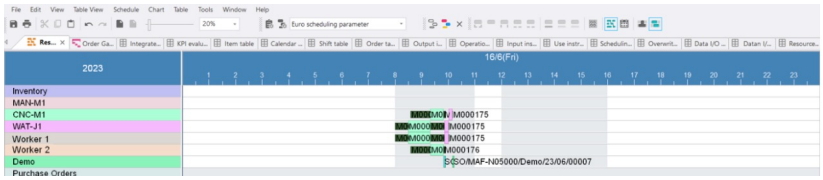
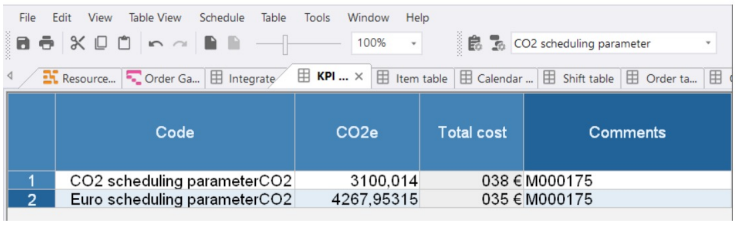




Optimization:
- CO2e
- €



	Code	CO2e	Total cost	Comments
1	CO2 scheduling parameterCO2	3100,014	038 €	M000175
2	Euro scheduling parameterCO2	4267,95315	035 €	M000175

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Summary

Possible challenges

- Implementation and use may cause additional costs (training, development work, equipment investments for data collection, data management etc.)
- Effects of changes in operating methods (new operating methods cause additional load)
- The "transparency" of environmental values brings a challenge, values can be seen as too high => negative image effect

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Yhteenvetoa

Opportunities

- Reducing total costs
  - Optimization shortens the lead time and improves delivery reliability
  - Reports help to identify factors limiting production
  - Managing production data from one tool makes production management easier and faster
  - Minimizing environmental impacts is directly reflected in lower costs
- Changes enable development
- Taking environmental values into account helps to prepare for future pressure to change, which can be caused by e.g. political or group-level decisions
- Considering the environment supports a more positive image
- Analyzes are auditable and verifiable. The information produced is fact-based and transparent

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