



CONTROL TPS-3 STATIC 2049
 6352
 46
 8.39
 453
 36.2

21° 5



Temperature and Humidity
 Wireless Sensor



SUPPLY CHAIN WIZARD

POWERED BY

D3-F

ER-2

FEED VR RT-3

35

Low Rec

CORE TEMP

MAX 26.5 -546

MIN 578 -650

CH1

CH1

CH1

CH1

CH1

CH1

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DIGITAL FACTORY



SCHEDULER

Supply Chain Wizard
 Digital Factory Solutions



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Industry Challenge

Scheduling of work orders has a direct influence on time to production and overall cost. Assignment of work orders to the lines and staff is a complex daily challenge that depends on many variables and constraints. Manual scheduling is a very common practice which results in inefficient use of resources. Cost reduction of more than 20% and capacity increase of more than 50% could be achieved with no additional investment.

What you get?

Machine Learning: Scheduler dynamically learns the production constraints and rules using machine learning algorithms
Optimization: Ability to schedule with different objectives: minimum cost, minimum duration or minimum inventory
Advanced Analytics: Scheduler uses advanced analytics to optimally distribute work orders
Pharma-focus & Expertise: Life-long partnership with SCW, a proven advisor to pharmaceutical manufacturer clients

How does it work?

Scheduler works hand-in-hand with OEE Tracker enabling machine learning. It distributes the work orders to the lines while obeying production constraints.
Master Scheduler could effortlessly revise schedules via drag & drop Gantt charts.
Scheduler is highly configurable that can accommodate hot orders and schedule changes

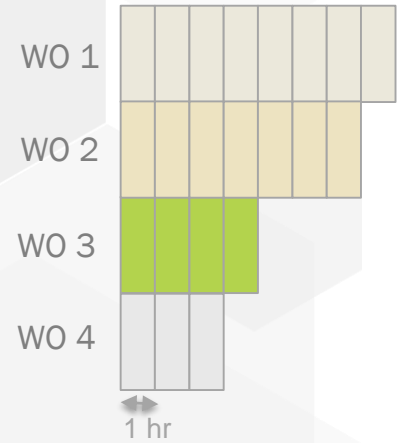
Why you need it?

Enable automatic and optimum scheduling that is transparent, data driven and live
Explore the true production potential of your facility
Find ways to minimize hidden losses and inefficiencies during scheduling
Reduce cost, increase capacity and improve your time to market



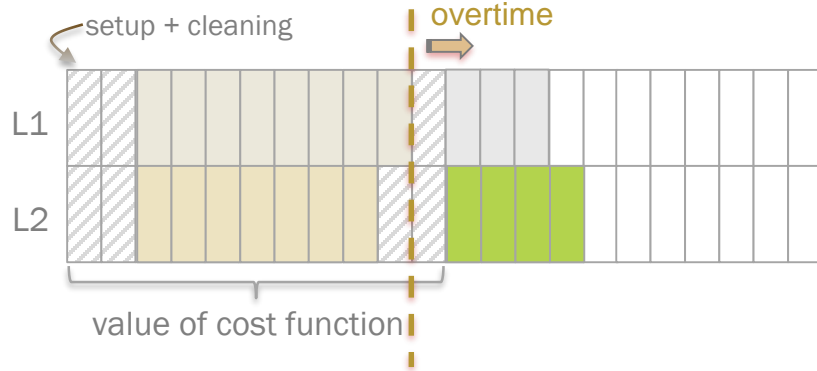
Scheduling Problem (e.g. Packaging)

distribute given work orders (WOs) to time slots on production lines.



Placement
Criteria
a.k.a
Cost
Function

e.g. min time



Not so easy to manually handle with > 200 WOs, > 10 Lines

WOs have:

- Processing Time
- Product Type
- Line Constraints

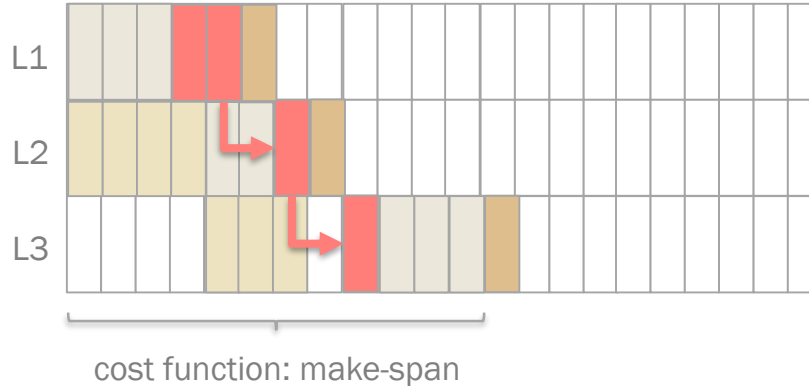
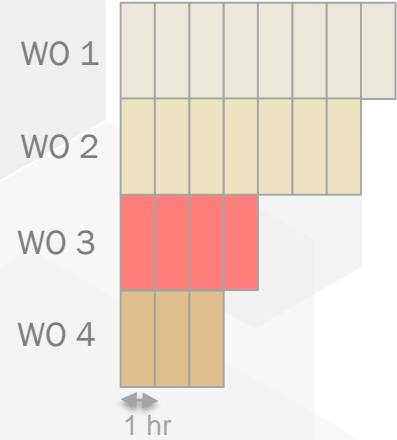
+ Constraints:

- product-line compatibility
- product-line speed variability
- change-over times
- product release date
- end product due date
- inventory costs
- over time hours



Scheduling Problem (e.g. Manufacturing)

distribute jobs on several machines where each job is a sequence of tasks



WOs have:

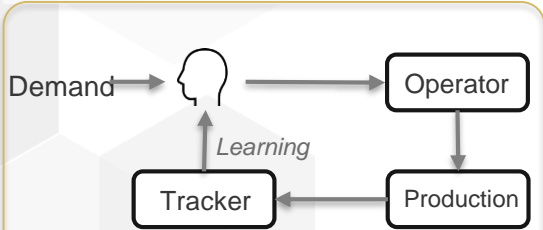
- Tasks (e.g. Dispensing, Granulation, Tableting/Compression, Coating, Filling)
- Product Type
- Line Constraints

- + Constraints:**
- product-line compatibility
 - product-line speed variability
 - task-level release date
 - task-level due date
 - task precedence



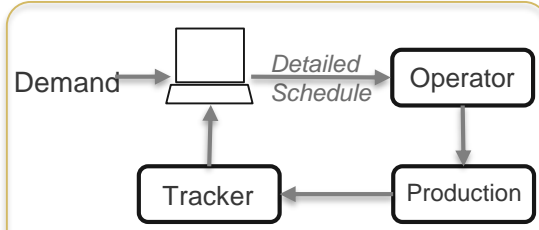
Machine Learning Powered Hybrid Approach

Human (Manual)



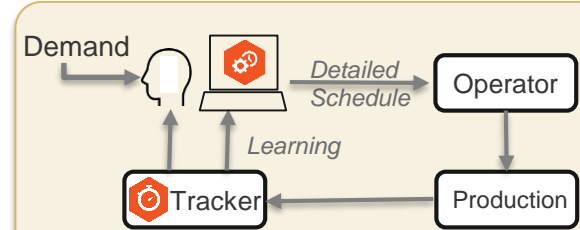
- + can consider unstructured demands
- + can incorporate domain experience
- + can handle uncertainty & learn
- slow, non-actionable after changes
- can not comply with all constraints
- can not follow all KPI reflections

Machine (Automatic)



- can not deal with unstructured data
- hard to integrate domain knowledge
- requires concise data, cannot learn alone
- + can reschedule in short time
- + follows all constraints, reflect KPIs
- + can give meticulous level of detail

Human + Machine



- + can consider unstructured demands
- + can incorporate domain experience
- + can handle uncertainty & learn
- + can reschedule in short time
- + follows all constraints, reflect KPIs
- + can give meticulous level of detail
- + more (simulations, scenarios ...)



Technology Behind Scheduler

Mathematical Optimization

State of the Art Optimization Algorithms

Constraints

- ✓ Line Compatibility
- ✓ Line specific product speeds
- ✓ Change-over durations
- ✓ Shifts with variable labor costs
- ✓ Inventory consideration
- ✓ Release & Due Dates

Objective:

Min cost
Min time

Performance:

Solution in seconds

User Friendly Design

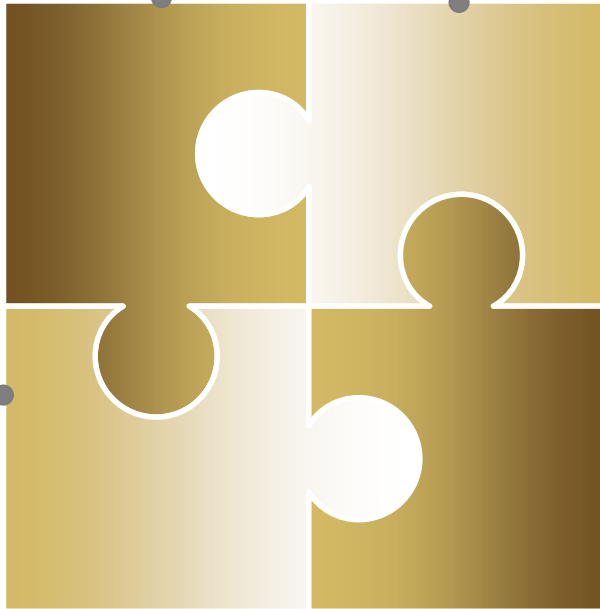
- One pager, simultaneous visibility of schedule and KPIs
- Gantt type drag and drop style, for dynamic scheduling
- List view, with deep level feature capability for detailed production

Machine / Human Learning

- Better estimation of scheduling parameters with **OEE tracker**
- Learns historical patterns, provides feedback to human scheduler

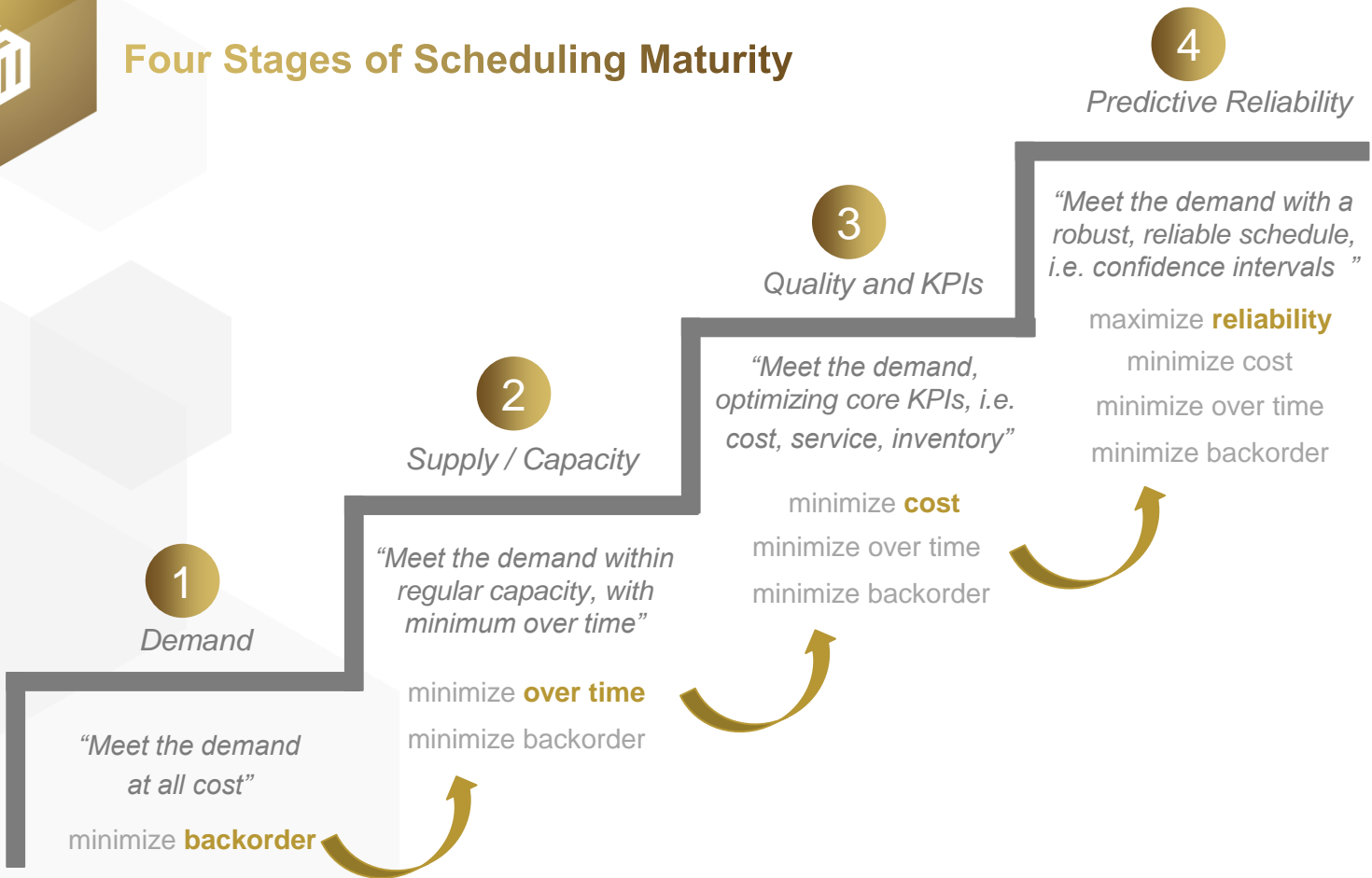
Domain Knowledge

- Pharma-grade expertise
- End-to-End understanding of the process
- Continuous support





Four Stages of Scheduling Maturity





Work Order Scheduler

+ Add Work Order

↔ Export Work Orders

Select Work Orders

Due Date: 04/01 - 04/30

Sites: All selected (3)

Jobs: None selected

Products: All selected (46)

Quick Settings

Schedule Horizon: 04/01 - 04/17

Available Lines and Scenarios: 4 selected

Strategy: Min Cost

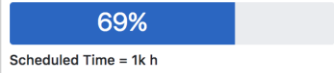
April Schedule

Optimize Clear Manage Schedule

Scheduled Work Orders



Capacity Utilization: Total



Scheduled Quality



Production Schedule

Lines	2018 April 02	2018 April 09	2018 April 16
4 lines selected			
5.Packaging			
Line 5.3P			
Line 5.1P			
Line 5.2P			
Line 5.4P			

Unplanned Workorders

WorkOrder	Product	Duration Avg.
1:WO99003	P1.P.234...	17h
1:WO99004	P1.P.234...	17h
1:WO99005	P1.P.234...	17h
1:WO99008	P2.P.234...	17h
1:WO99009	P2.P.234...	17h

Down Time Activities	Unplanned ...
Down Time - Line Upgrade	1
Down Time - Line Upgrade	4
Down Time - Maintenance	1
Down Time - Clean Up	1
Down Time - Setup	1

List View

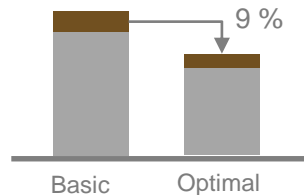
Site	Job	Production Stage	Buffer Duration (h)	WO #	WO Type	Product Id	Product Name	Quantity Ordered	Release Date	Due Date	Inventory Days (DOH)	Schedule Date/Time	Scheduled Duration (h)	Scheduled Line	Actual Date/Time	Duration (h)	Quantity
Demo Site 1				WO99002	VA	P1.P.234.00	P1.P.234.00	50000	04/02/2018	04/29/2018	1	07/20/18 12:00 AM	17	Line 5.3P			
Demo Site 1				WO99003	VA	P1.P.234.00	P1.P.234.00	50000	04/02/2018	04/29/2018	1						
Demo Site 1				WO99004	VA	P1.P.234.00	P1.P.234.00	50000	04/02/2018	04/29/2018	1						



Case Study: Opportunity Analysis

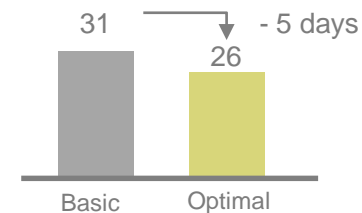
Simulation Analysis on actual work order data to compare “as-is” (actual) vs. “to-be” (optimal) scheduling using SCW’s Scheduler Solution

Labor Cost & Overtime



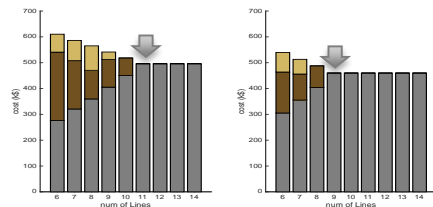
- 10% (9-12%) Total labor cost reduction
- 24-60% Overtime labor cost reduction
- Up to \$600k / yr.* savings on labor cost

Capacity & Service



- 5 days / mo. make-span reduction
- ~240 line-hours saving / mo.
- Increase in sales due to reduced back orders

Asset Utilization



- 18% (2 of 11) higher utilization of assets



Advanced Features



Scheduling

- Single / multi-step scheduling
- Staff scheduling add-on



Tracking

- Reliability score
- Adherence predictions




Simulations

- Simulation and what-if capabilities (e.g. effective cost of adding / removing a production line, estimating ideal number of lines)



Thank you

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