蔡司光学中国的“数字化精益”
- 创新转型实践

Lean 4 Zeiss
- Innovative Digitalization Process

蔡司以高精度产品、创新和推动产业进步为己任, 精益生产的理念和蔡司DNA不谋而合
With Lean in our DNA, ZEISS is an internationally leading technology enterprise in providing precise products and innovations for the society

蔡司173年 (1846 - now)

始终以**工匠精神**缔造经典品牌

Carl Zeiss
(1816-1888)

Ernst Abbe
(1840-1905)

Mission 使命

- **Cutting-edge research**
  前沿的研究
- **Extreme precision and maximum quality**
  极高的精度和品质
- **Social responsibility**
  社会责任

Lean In ZEISS DNA

Purpose
Create value for our customers and inspire the world in new ways

Process
Continue to challenge the limits of human imagination

People
Create special moments for people all over the world with our employees

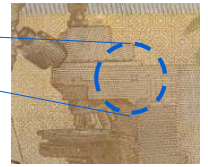
蔡司产品和精湛的生产工艺深刻影响着人类的生活和科技发展
ZEISS solutions and products have been shaping our lives and technology development progress

Semiconductor Manufacturing Technology
半导体制造技术

蔡司新型的光刻技术把半导体结构尺度提升为为头发丝直径的**4000分之一**

Research & Quality Technology
研究与质量技术

蔡司测量技术的精度可达头发的1/100， 许多F1赛车队的精密制造都倚赖蔡司工业测量技术。



35 位诺贝尔奖得主信任蔡司显微镜的品质，蔡司商标也因此印上了加元正面。

Medical Technology
医疗技术

全球每年有 1,500 万次白内障手术藉助蔡司的手术系统完成。

Vision Care/Consumer Products
视力保健/消费产品

蔡司研发和制造镜片、仪器、测量设备以及消费性方案和技术服务，为光学领域建立新标准。

随着市场环境和技术的革新，产品创新和生产流程对精益提出了更高的要求
Increasing needs on product innovation and manufacturing demand higher lean level, to embrace market and technology innovations

Market Trends in China

崛起的消费者
Rising consumer

城市化程度更高
Urbanization

全球化更深入
Globalization

制造业复杂度提升
Complex Manufacturing

产品个性化要求提升
Individualization

数字化转型和应用
Data Science and Applications

Evolution on Customer Needs and Supply Chain

消费者对产品质量和服务的要求迅速提升
Value and Service For Money

个性化要求
Individualization

- **更多的**个性化定制需求和服务
- Growing needs on personalized and customized products and services

- 打造个性化的测量、生产、交付流程
- Develop customized measurement, manufacturing, and delivering process

购买高质量产品
Quality Products

- **更高的**产品质量要求
- Higher requirements on product quality and value

- 研发保障、生产保障、交付保障
- Higher R&D, manufacturing and delivery quality assurance

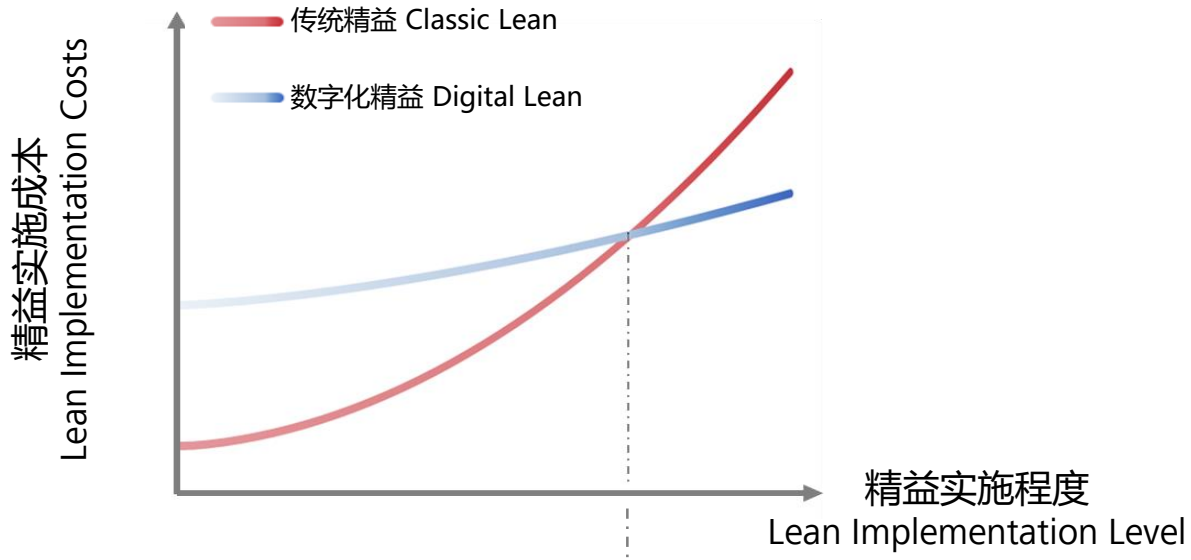
时间就是金钱
Fast Service

- **更快的**生产流程速度
  Increasing expectations on production and delivery speed

- 缩短全流程交付时间
- Decreasing lead time from order to manufacturing to delivery

精益实施：如何平衡不断增长的精益管理运营成本?
Classic lean implementation bottleneck

精益实施成本 - 经验曲线
Cost For Lean Implementation



Classic Lean Phase

Classical lean measures have plenty of opportunities to eliminate waste and create value for customer with low cost

Digital Lean Phase

Digital tools would be useful and cost effective for lean implementation, for the continuously increase level of automation and production

洞见 Insight

精益实施程度遭遇瓶颈时，数字化工具的应用为效率与成本的深入优化带来曙光!

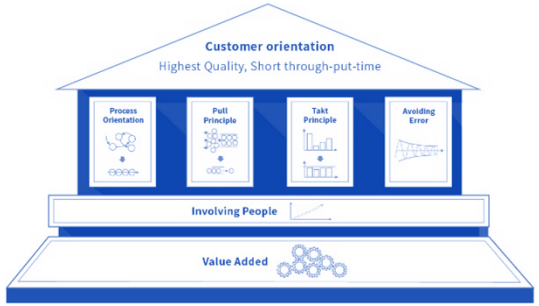
When the level of Lean implementation encounters bottlenecks, the application of digital tools offers a breakthrough in efficiency and cost!

案例 Case

例如： 每天超过10,000副订单时，需要深入协调不同的机器设备，才能获得最好的加工品质和速度。如果使用传统的分拣和单元式生产，则成本较高也并且满足不了生产需求。

Case: With 10,000 lens customized orders per day, equipment sets need to further optimized to achieve higher yield and speed, cost with traditional production line and lean approaches would be too high to fulfill production demand and customer needs

蔡司光学中国的精益学习和数字化转型之路
Digital transformation with “Lean 4 Zeiss”



Classical Lean 传统精益

Digital Lean 数字化精益

2003 蔡司中国开始精益学习之旅
Start of Lean Journey

2010 Lean 4 Zeiss项目启动
Lean 4 Zeiss Project

2012 蔡司精益标杆 “精益审查”
Zeiss Benchmarking
Lean Level Check

2016 蔡司光学中国 工业4.0项目启动
CZV China I4.0 Project Kickoff

2018 蔡司光学中国 达到镜片制造的世界级水平
CZV China Achieved World Class In Lens Industry

2022 打造CPS系统，完成数字化转型的战略里程碑
Realize CPS Architecture

“数字化精益”对全价值链的增值

Digitalization in “Lean 4 Zeiss” through the whole process

■ 从价值链的全景视角，实施数字化，实现增值

定义数据
Define Data

收集数据
Acquire Data

数据分析和集成
Data Analysis and Integration

实现客户增值
Add Value For Customers

精益与数字化相结合，帮助客户成功
Digital lean empowers customers to succeed

更高的客户需求
Satisfaction of customer demands

数码型、驾驶型、快变色、超高折射率等产品
连续快速上市！

Digital lens, Drive Safe lens, Photochromic lens, Ultra High Index lens., just few examples of increasing ZEISS product portfolio !

更好的产品品质与产品体验
Focus on product quality and experience

客户满意度提升
产品全生命周期管理，数字化追踪增强客户体验

Continuous improvement of customer satisfaction
Product life cycle management
Digital tracking of value-added service to customers

更短的交付时间
Shorter delivery time

从收单到送到客户手上只用7天
制造工厂3天内交付订单的准时达成率接近100%

Max 7 days end-to-end lead time from ordering to receiving,
Close to 100% 3 day on-time-delivery in lens manufacturing

中国市场销售额连年高速增长
Robust sales performance in China

工厂通过数字化精益运营，持续满足客户需求
全力支持前端业务的高速增长！

Through Digitalized Lean 4 Zeiss, manufacturing capability has been significantly enhanced to support strong sales growth in global markets

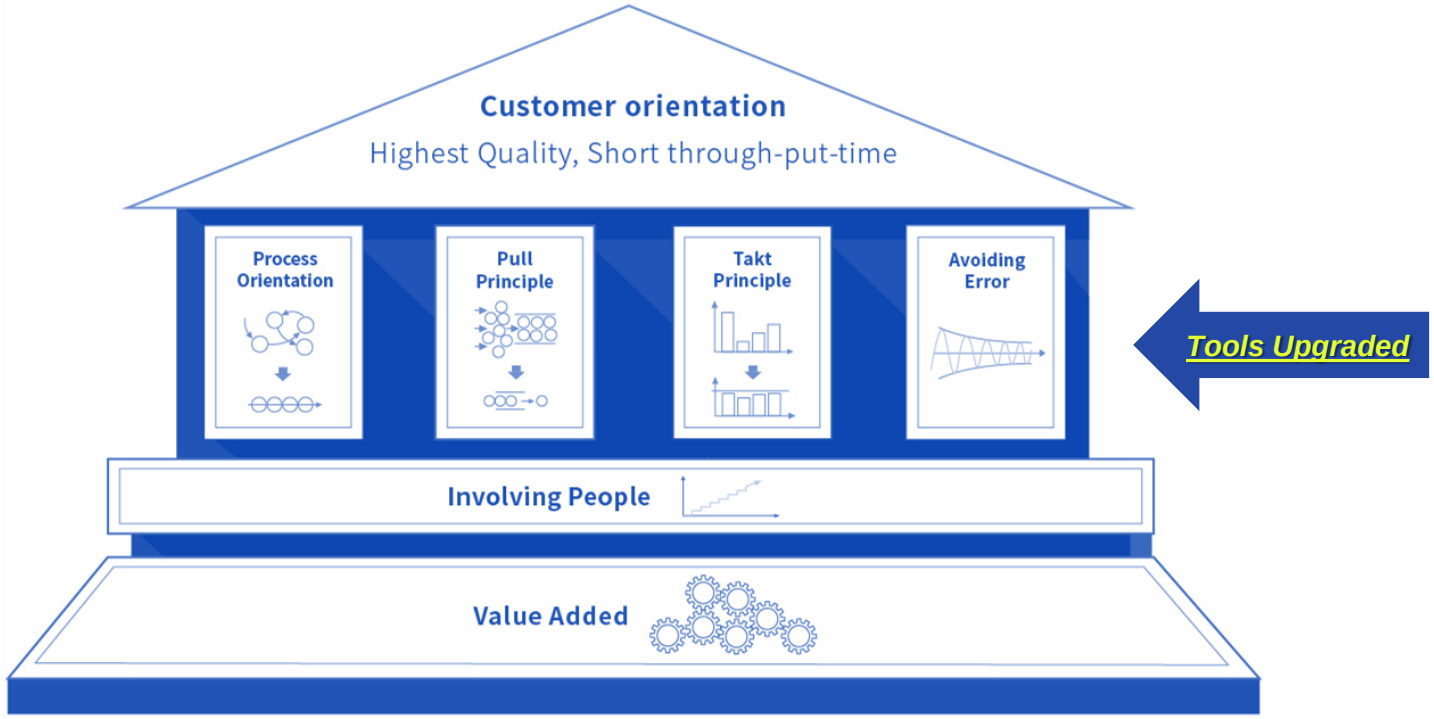
客户持续对于个性化定制，高品质和快交期的要求对工厂运营更大的挑战
Chanllenge in Lens Industry From Higher Customer Demand

	客户的需求 Customer Demand	对工厂的挑战 Challenge For Operation
1	个性化定制 Customization	如何管理超过 10000副参数都不一样的个性化订单 How to Manage more than 10000 customized order/day
2	最高品质 Highest Qualify	如何实现精准的度数控制（精确到+/- 1度） How to realize precise lens power control (+/- 1 power)
3	更短的交期 Short Lead time	如何实现按单生产（成品0库存），3天准时交货率接近100% Make to order （0 Finish good inventory）,Nearly 100% 3days On time delivery

数字化工具的导入实现精益屋的创新转型

Lean house transformation with digitalization tools

Zeiss Lean Framework



Process Orientation:
1.Dynamic VSM
2.Process Simulation
3.RFID system
4.Smart material flow
5.Real Time Adjustment and Changeover

Pull Principle:
1.Dynamic Kanban
2.Smart Supermarket
3.Dynamic WIP Control（Based on MES）
4.Self-driving Logistics Vehicles
5.E-Pull system

Takt Principle:
1.APS
2. Full Visibility of Operation
3.Information-based Standardized work Instruction
4.Auto monthly&daily volume forecast

Avoiding Error:
1.Digital Quality Optimizat（Machine Learning&Big Data Analysis）
2.Digital Poka-Yoke
3.Dynamic Defects Analysis and Display
4.Real-time SPC
5.Auto visual inspection system

Involving People:
1.Immersive Training Sessions（VR&AR）
2.Set up new type of roles(Industrial data Scientist / Robot Coordinator)
3. Remote Collaborative Maintenance
4.Collaborative Kaizen Platform

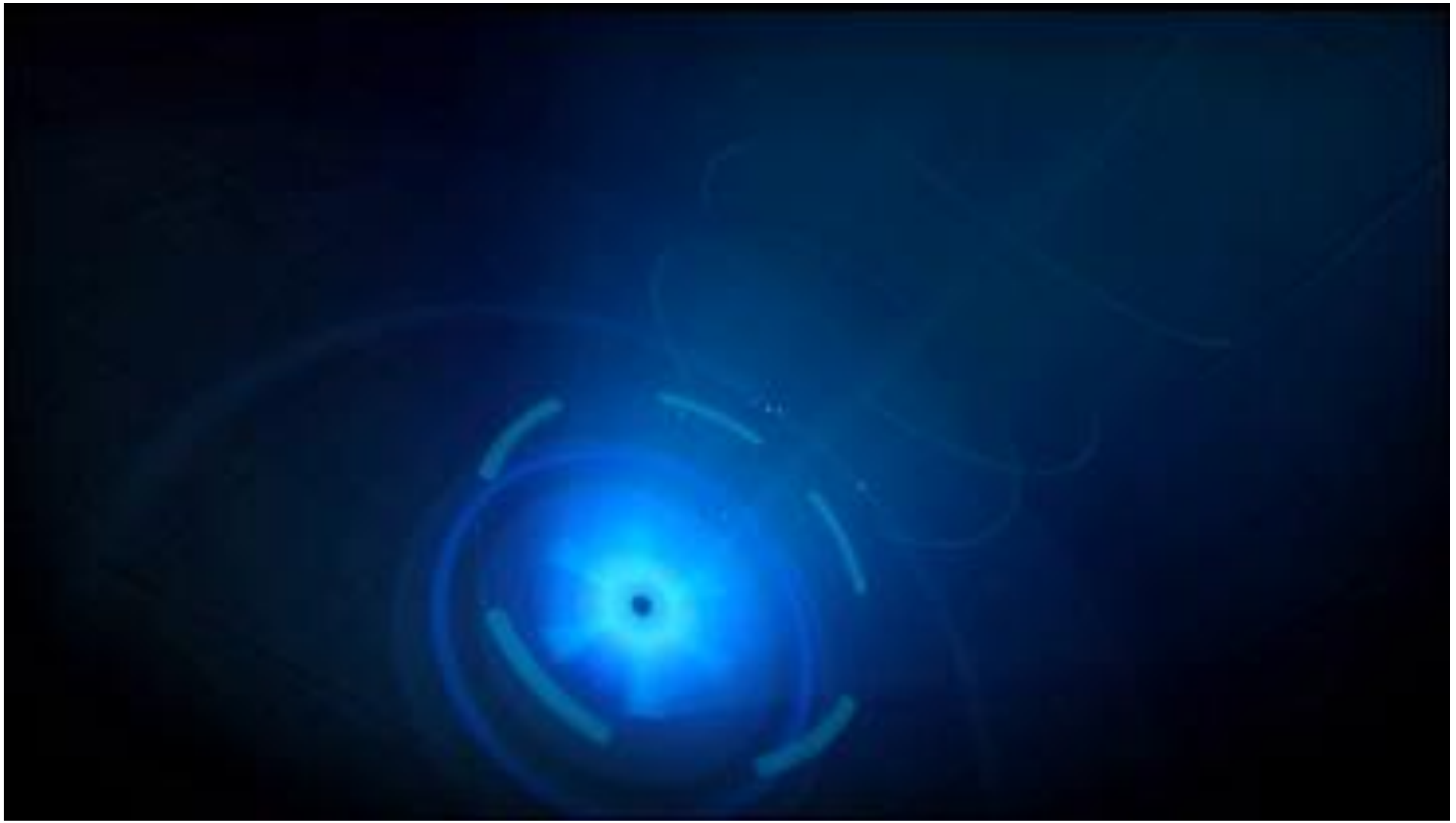
Value Added:
1.Smart Energy Consumption
2.Predicitive Maintenance
3.VR/AR Guided self-maintenance/Operation
4. Real time OEE monitor
5.Didital checklist
6.Collaborative Robot
7.Cost effective automation

实现客户个性化定制的案例
Realize Customization use case

	客户的需求 Customer Demand	对工厂的挑战 Challenge For Operation
1	个性化定制 Customization	如何管理超过 10000副参数都不一样的个性化订单 How to Manage more than 10000 customized order/day
2	最高品质 Highest Qualify	如何实现精准的度数控制（精确到+/- 1度） How to realize precise lens power control (+/- 1 power)
3	更短的交期 Short Lead time	如何实现按单生产（成品0库存），3天准时交货率接近100% Make to order （0 Finish good inventory）,Nearly 100% 3days On time delivery

1 智能物流系统实现个性化定制生产模式

Smart Material Flow Realize Customization Production With RFID(1/2)



1 智能物流系统实现个性化定制生产模式

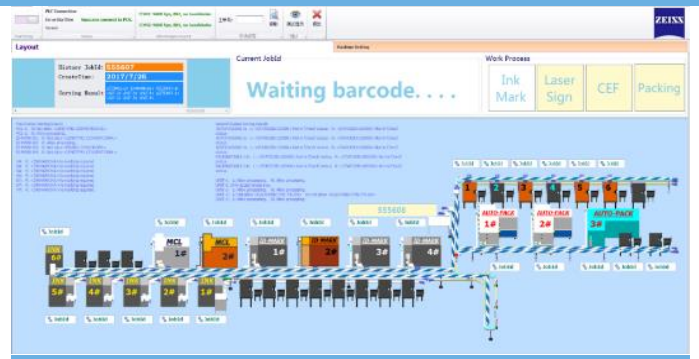
Smart Material Flow Realize Customization Production With RFID(2/2)

- As the complexity of product is increasing, apply RFID system and conveyor system, to improve work efficiency, control WIP, make the process more stable.

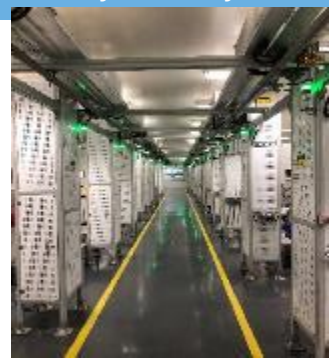
Input: Smart Material Within RFID

RFID inside job tray in all process

Process: Conveyor system with software control

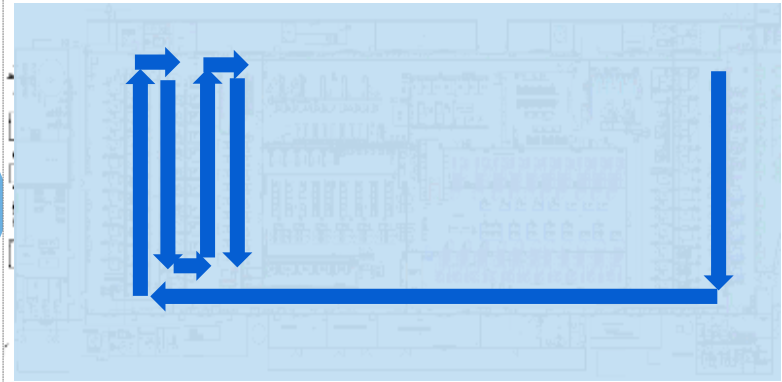


Material flow logic controlled by RFID system



Physical material controlled
by cost effective conveyor system

Output: Flexible Smart Material Flow



Realize whole Surfacing process flexible continuous flow

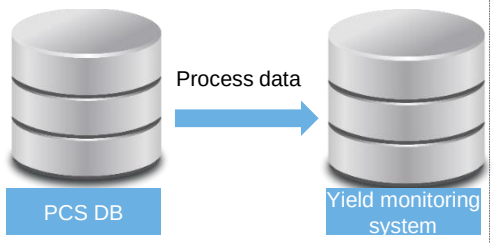
提升产品质量的案例
Improve product quality use cases

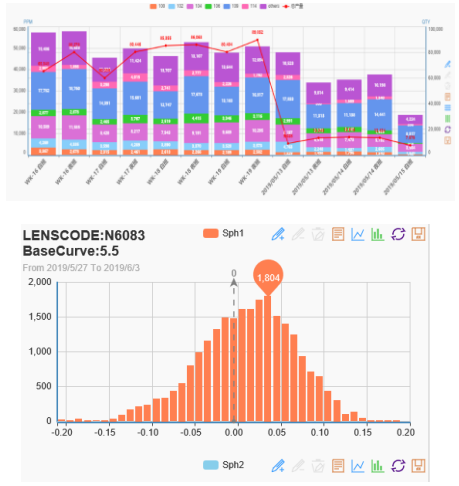
	客户的需求 Customer Demand	对工厂的挑战 Challenge For Operation
1	个性化定制 Customization	如何管理超过 10000副参数都不一样的个性化订单 How to Manage more than 10000 customized order/day
2	最高品质 Highest Qualify	如何实现精准的度数控制（精确到+/- 1度） How to realize precise lens power control (+/- 1 power)
3	更短的交期 Short Lead time	如何实现按单生产（成品0库存），3天准时交货率接近100% Make to order （0 Finish good inventory）,Nearly 100% 3days On time delivery

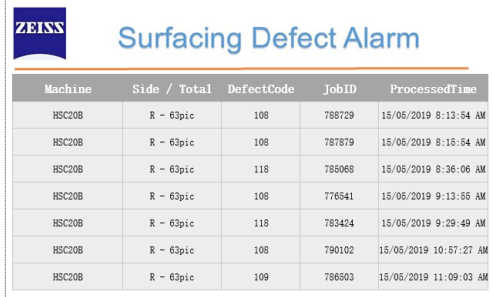
2 良率实时监控和预警系统 （案例一）

Defect Rate Real Time Monitor & Pre-warning System(Case 1)

Data Collection 数据搜集	Data Interconnection 数据互联	Data Visualization and Transparency 数据可视化和透明化	Data Pre-warning 数据预警	Data Self-adapted 数据自适应
• Quality check station input defect data into system.	• Collect process data from PCS（Output/Yield）. • Connect yield performance and machine number	• Display real time yield rate by defect code in Website, and it is transparent to all users.	• Process engineer set the warning rule(DPPM/Defect q'ty). Send the warning E-mail to related engineer and software will stop defect machine.	• Big data analysis, to optimize machine parameter.







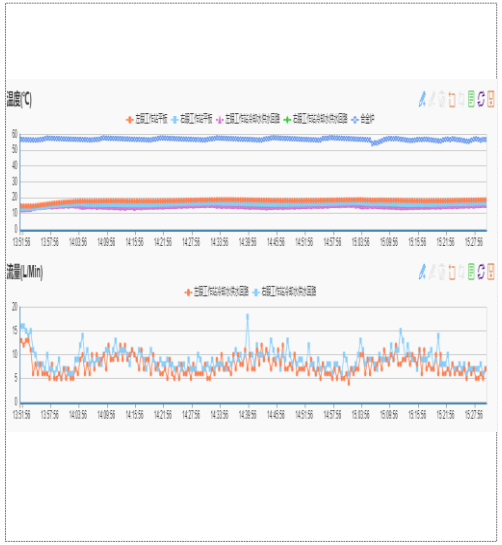
Planned

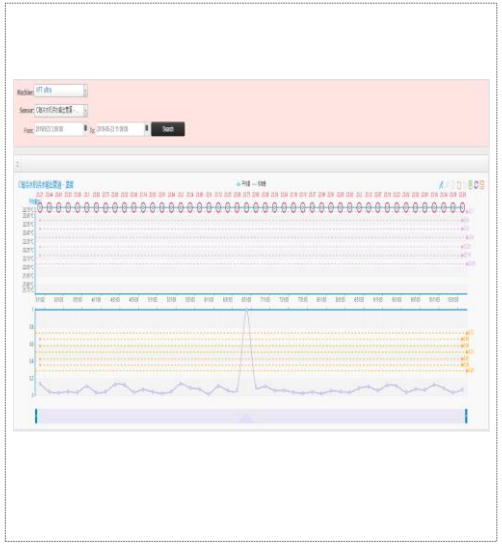
2 安装传感器采集工艺参数监控 并实现预警系统（案例二）

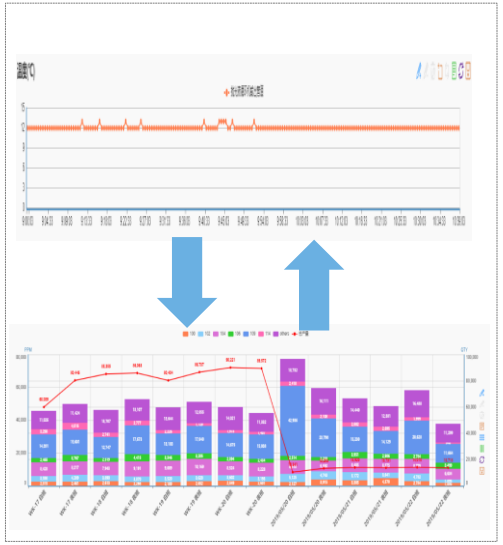
Install Sensor To Acquire Process Parameter & Realize Pre-warning System（Case 2）

Data Collection 数据搜集	Data Interconnection 数据互联	Data Visualization and Transparency 数据可视化和透明化	Data Pre-warning 数据预警	Data Self-adapted 数据自适应
• Install sensor to catch all process &machine data (temperature, flow, pressure, vibration).	• Setup data structure to collect data in one DB. • Connect process parameter data and job number	• Build MES system to make all data transparence for all users.	• If data out of spec, will send E-mail to related process engineer.	• Link the process parameter with quality performance; • Big data analysis to optimize the parameter setting.

Planned



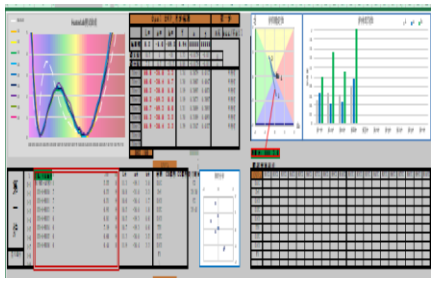


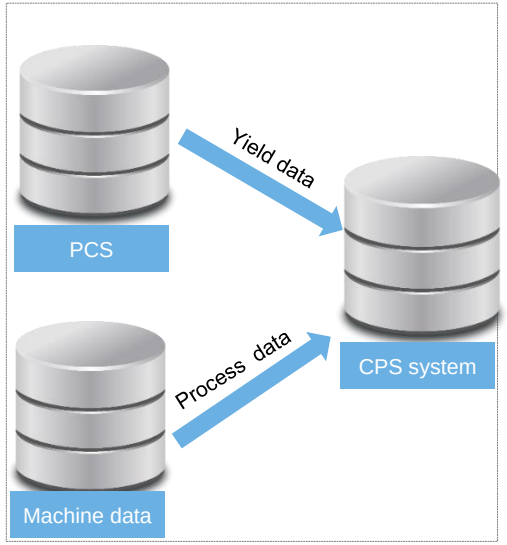


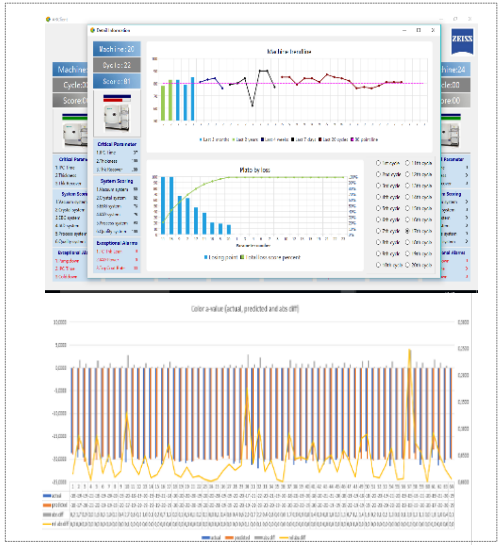
2 基于大数据分析对机器性能状态评估并打分实现预测性维护(案例三)

Predictive Maintenance System Base On Big Data Analysis For machine performance rating （Case 3)

Data Collection 数据搜集	Data Interconnection 数据互联	Data Visualization and Transparency 数据可视化和透明化	Data Pre-warning 数据预警	Data Self-adapted 数据自适应
• Get all process parameter data from machine	• Connect machine data and yield performance • Setup process parameter standard and give a score for key parts of machine	• Base on big data analysis, system will give score for key parts of machine	• Base on big data analysis, system will pre-warning for predictive maintenance.	• Automatic adjust process parameter to improve yield rate







Planned

2 数字化点检表 实现点检数据可视化(案例四)

Digital Checklist To Realize Data visualization （Case 4)

Creation and Editing of a check form

1. Administrator can create check forms based on requirements

2. A check form can include several “steps”.
E.g. if you want to check various parts of a device, and each part has different check points you can define each part as a “Step”.

3. A schedule can be set (e.g. once per day or once per week…)

4. set standard range for each item (baseline for comparison when user enters daily o weekly parameter)

5. The system automatically generates different QR codes for each step, which you can print and stick on the dedicated location

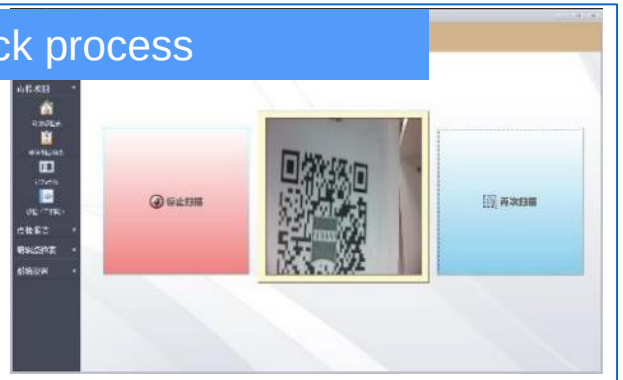
Digital check process

1. Operator uses a tablet to scan the QR code

2. Operators fill in parameters for each check point. If the value is out of specification an alert will be generated automatically

3. Camera of tablet can be used to upload images.

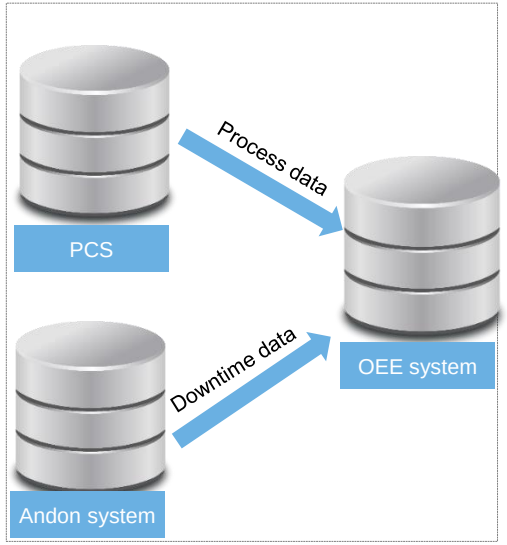
4. Visualization of abnormalities

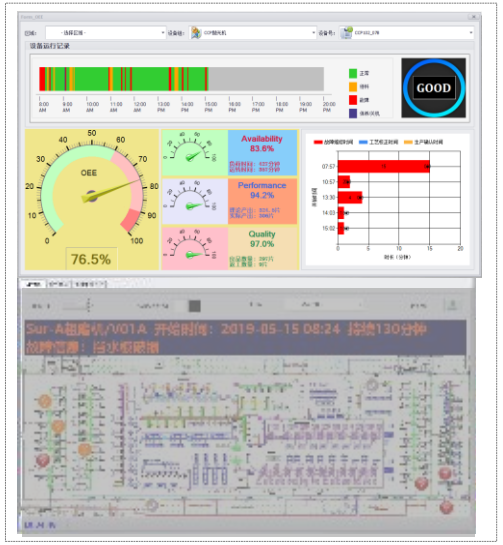


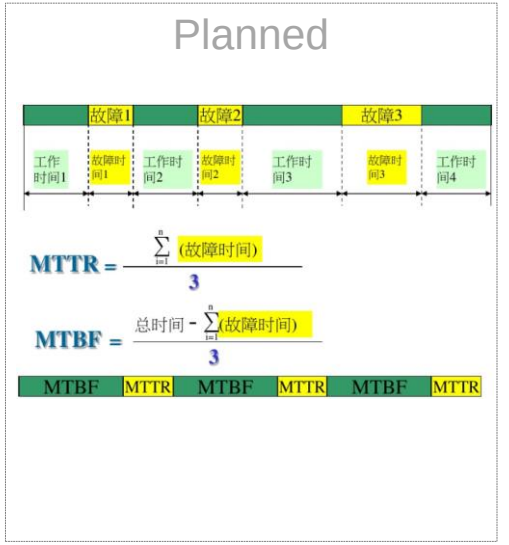
2 设备综合效率实时管理 & 安灯系统(案例五)

OEE Real Time Management & Andon System（Case 5)

Data Collection 数据搜集	Data Interconnection 数据互联	Data Visualization and Transparency 数据可视化和透明化	Data Pre-warning 数据预警	Data Self-adapted 数据自适应
• Synchronize the downtime data from Andon system; • Collect output and yield data from MES.	• Get process data(Output/Yield) from MES; • Communicate with Andon to get downtime data.	• Calculate OEE by Availability/Performance/ • Yield; • Display the system in PE/PRO/ENG dept.;	• Set the target OEE, automatic warning Email • Send E-mail and SMS to related person by system; • Escalation path(Engineer→Manager→ Plant Manager).	• Automatic adjust process parameter to improve OEE • Calculate MTBF/MTTR; • According to MTBF, to conduct predictive maintenance;







定制化车房数字化转型路径

Digitalization Transformation Roadmap In Rx

Phase 1:
Single Automation Transformation
单机自动化改造

Use case

- Manual blocker transfer to Auto blocker by robot
- Auto loading& unloading for Laser
- Auto melting machine
- Brush washer
- Auto package machine

Phase 2:
Integration Automation Transformation
自动化集成改造
实物流动

Use case

- Surfacing smart material flow system表面加工连续流
- RFID system
- Hard coating smart flow system 加硬连续流
- Packing smart material flow system包装连续流
- …

Phase 3:
Digital Plant
数字化工厂
信息流动

Use Case

- Andon System
- OEE Real time monitor system
- Process management system
- Production management system
- Quality management system
- APS system
- E-Pull system

Phase 4:
Cyber Physical System
信息物理系统
实物和信息的交互

Cyber physical system

- CPS
- Digital Twin
- Big data
- Cloud Computing

精益原则 Lean 4 Zeiss

Take Aways

Lean 4 ZEISS

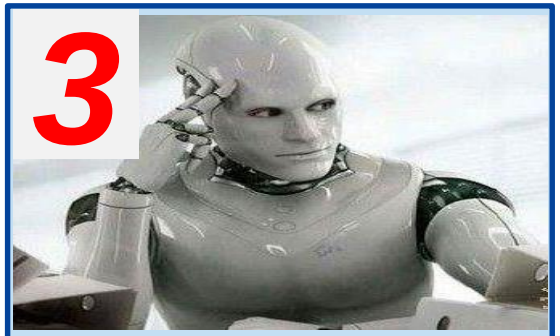
1

Implement Suitable O-chart to integrate OT&IT&AT to support digitalization lean transformation

2

Always think about QCD orientation to set up digitalization lean project priority and implement project

3



Proactive think automation continuous flow possible problems & take action

Lean 4 ZEISS

Enable Operation & Employee Success Within In Zeiss 帮助运营和员工成功

ZEISS Brand

Enable Customer Success 助力客户成功

Contact Us

Carl Zeiss Vision China Wechat

姓名： 彭伟 Wilson Peng

Wechat: Pengwei510555

姓名： 吴勇 Brave Wu

Wechat: Bravewu2012

电话： 183 1240 1970


ZEISS