工艺-催化剂-装备-数智协同：
成套技术的全要素协同迭代升级之路

Technology-Catalyst-Equipment-Autonomous Cognition Synergy :
A journey of Full-Element Collaborative Upgrade for Cutting Edge Competitiveness

李佳娟 Chelsea

Honeywell Technologies

全生命周期服务 | 当前流程工业的愿景
PEFORMANCE+ | TYPICAL CHALLENGES TO ADDRESS

Avoid Unplanned Downtime 避免非计划停车

- Early alarm& faster recovery 早期故障诊断&快速恢复
- Key Equipment failures monitoring 核心设备故障监控
- One stop turnaround with effective &reliable service and lifecycle catalysts management 一站式高效可靠检修及催化剂全周期管理

Optimize Process Performance 优化工艺性能

- Manage changing conditions 应对快速变化的外部环境
- Performance vs expectation, reliable delivery 量化性能目标与预期
- Expand value chain by tech &cats for incremental growth 有技术改进和产品升级支撑的价值链延申

Manage Personnel Challenges 人才培养与安全

- Faster technical onboarding 高效培训支撑新世代成长
- Building and sustaining expertise 构建并保持专业性
- Ensuring safety & compliance 确保安全及合规运营

Reduce Energy and Emissions 减少能耗和排放

- Sustainability Goals 可持续发展目标
- Emission standards 达到排放标准
- Energy reduction 能耗减少，提高效益

Honeywell Technologies

全生命周期服务 | 霍尼韦尔的解决之道
PERFORMANCE+ | SOLUTION PATH

PROCESS 工艺:

- ❑ Proactive expert services
  主动式专家服务
- ❑ Dedicated Performance Manager drives value creation, realization, alignment
  专职绩效经理，挖掘并交付潜能
- ❑ Access to state-of-the-art digital tools based on UOP proprietary models
  接入UOP专有的数字化工具
- ❑ Advanced Process Control (APC)
  霍尼韦尔专有APC
- ❑ Plant Wide Optimizer (PWO)
  霍尼韦尔专有PWO
- ❑ Real-Time Optimizer (RTO)
  霍尼韦尔专有RTO
- ❑ Preferential call-off services
  专有的专家特需服务支持
- ❑ Performance Reviews – action & $ focus
  基于性能，落到行动的研讨会

ASSETS 资产:

- ❑ Proactive review of all assets for performance
  主动评价资产效益
- ❑ Health Checks performed on all units yearly once with recommended actions
  对所有装置每年体检并给出建议措施
- ❑ Modernization services (tray redesign, enhanced flush)
  老装置更新服务（塔盘再设计、增强冲洗）
- ❑ Proactive planning and preparation for successful turnaround through ELITE services
  主动规划和准备高质量检修
- ❑ Advanced training courses on assets
  基于资产增值的高级培训
- ❑ Asset Performance Mgt (APM) – Connected Plant
  互联工厂-资产性能管理

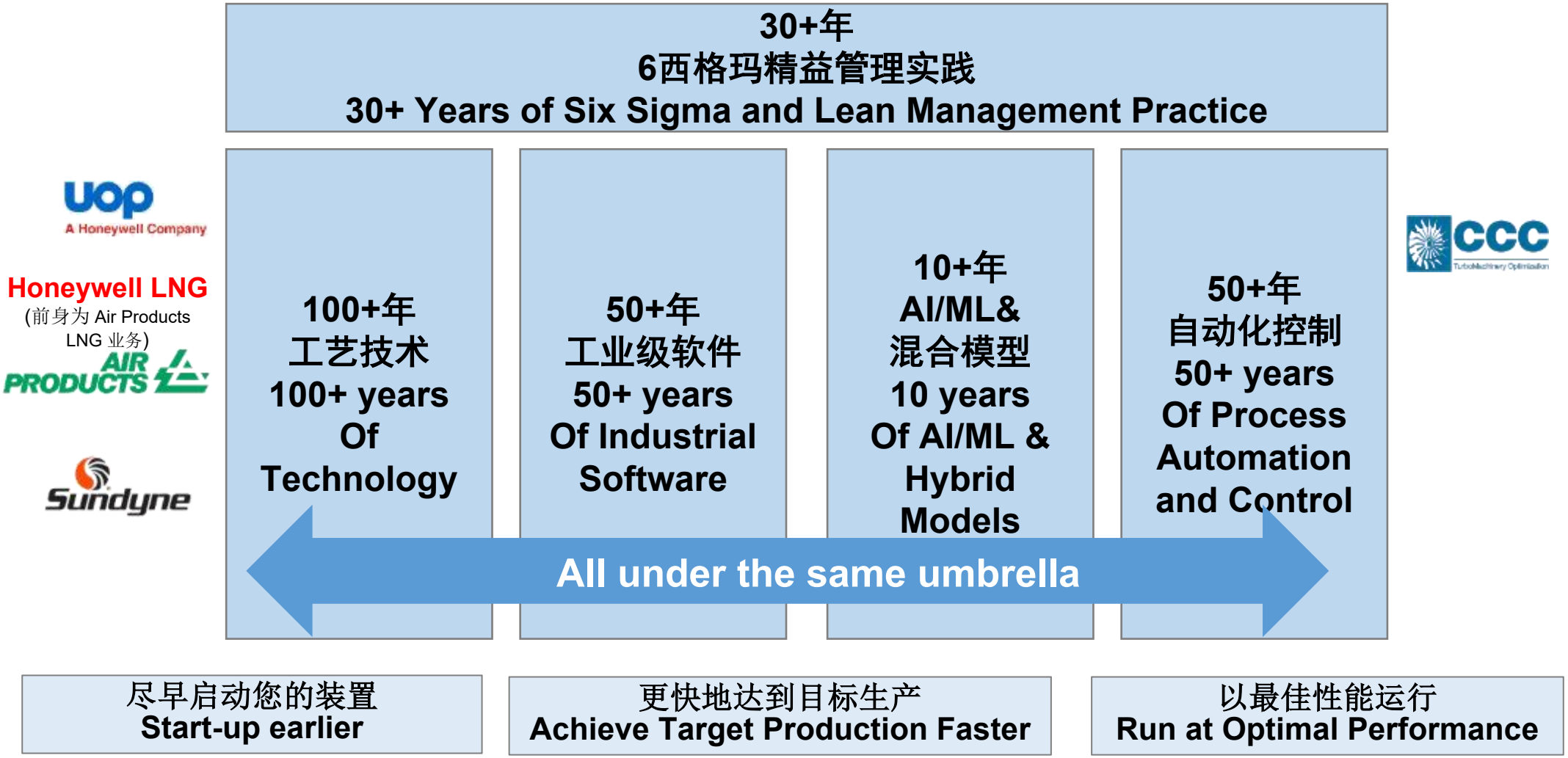
PEOPLE 人才:

- ❑ Competency Map based learning program focused on reducing Operator and Engineer on-boarding times & ability to respond better & faster to upsets
  面向技术人员，针对快速建立能力、缩短响应时间、成熟应对突发事件的能力
- ❑ Access to UOP's web based training, standard Operator Training Simulators (OTS), assessments and case studies
  接入UOP在线课程资源、仿真培训OTS，及评估和方案研讨能力建设
- ❑ Engineering Design Seminar (EDS) yearly in Rosemont
  UOP总部工艺包工程设计培训
- ❑ Multi-company trainings
  跨地区跨公司研讨会
- ❑ Dedicated onsite training
  覆盖全球的在运工厂学习

One stop tailor made solution with Incremental Value 面向增量价值的定制化一站式解决方案

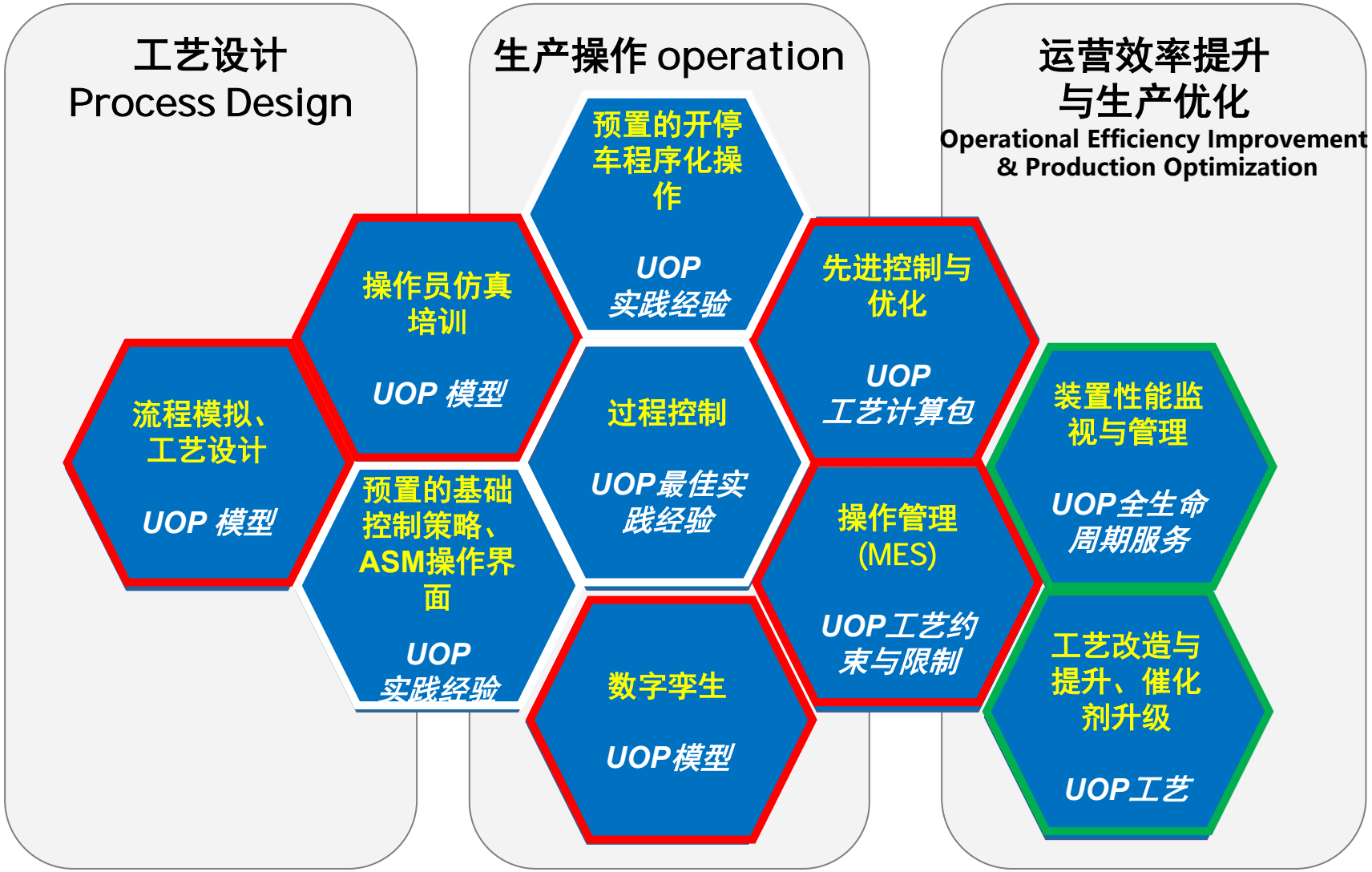
Honeywell Technologies

全生命周期服务 | 霍尼韦尔的解决之道
PERFORMANCE+ | SOLUTION PATH



Bring Together The Right Honeywell Capabilities 汇聚霍家专长

全生命周期服务 | 霍尼韦尔的解决之道



操作员仿真培训OTS

数字孪生PDT

企业级历史数据库PHD

智能运营管理平台MES

先进控制APC

在线优化RTO

全厂优化PWO

控制系统性能监视与运维CPAU

设备预测性维护与管理 APM

腐蚀监视与预测

Corrosion Monitoring & Prediction

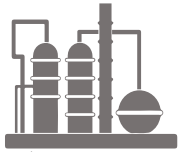
在线油品调合Online Blend Optimization

罐区自动化 Tank Farm Automation

设计即数字 | 投运即优化 | 运营即闭环 | 服务全周期 → 安全、效益、效率

全生命周期服务 | 服务模式
PERFORMANCE+ SERVICES | MODEL

1 DATA数据



Customer connects
to UOP Process Monitor
客户接入UOP工艺管理平台



Operating platform leveraging Honeywell Forge with UOP inside
操作平台基于霍尼韦尔上海数据中心

2 INSIGHTS赋能

全球解决方案及工具

- Process Monitor工艺管理平台
- Exception Based Alerts
- 异常工况报警
- Benchmarking
- 性能对标
- Process Technology Analytics
- 工艺技术分析





ALERTS & INSIGHTS
提前预防与报警

Enables Proactivity
主动而为



UOP技术专家
(技术服务、工程设计、研发)

技术知识、专业意见、发掘价值、技术支持
Technology expertise, recommendations, value generators, and support

Direct usage and interaction with subscribed digital tools



UOP卓越性能工程师
主动挖掘价值并组织实现

紧密合作

3 KNOWLEDGE知识 1 + 1 > 2

主动预警、赋能建议、故障诊断、可靠性提升
Vetted alerts, insights, troubleshooting, reliability and profitability enhancement recommendations

4 ACTION行动

及时采取行动，解决问题、提高可靠性和盈利能力

Extend catalyst life, higher yields, improved selectivity & conversion, higher throughput & production, increased equipment reliability, reduced utilities & emissions, make next turnaround
延长催化剂寿命、提高收率、提高选择性和转化率、提高产量、提高设备可靠性、降低公用工程消耗和排放、提高检修效率



Customer Process Engineers, SMEs, Operations, Planning, Reliability, Management
客户工艺工程师、计划管理、可靠性管理

Constraints, objectives, priorities, Information not transmitted (corrosion, downstream upsets, upstream changes, final product issues)
限制条件、愿景与目标、装置及上下游波动、产品价值提升

Digitally Enabled Proactive Services – Better Value Focused Services Delivering数字赋能的基于主动行动的服务模式

KEY COMPONENTS 关键部分 | PERFORMANCE+ SERVICES



A.
CONTINUOUS MONITORING
持续监测

Comprehensive, near real-time health and performance diagnostics
全面，接近实时的运行状况和性能诊断

Process Monitor
工艺管理



B.
KPI TRACKING & ALERTS, IMPROVEMENT OPPORTUNITIES
KPI 追踪 & 报警, 识别优化机会

Trend visualization, machine learning models, analysis to identify bad actors and associated events, opportunities insights
趋势可视化，机器学习模型，分析识别异常因素和相关事件，洞察潜在机会

Exception Based Alerts
异常工况报警
(EBAs)
&
Benchmarking



C.
KNOWLEDGE CAPTURE & GUIDED ANALYTICS
知识获取 & 引导分析

Embedded process know-how, models to support optimization & operations with actionable insights
嵌入式工艺知识，结合模型提供具有可行性的优化和操作

Process Technology Analytics
工艺技术分析
(PTAs)

CCR & Semi Regen Platforming
Penex , TIP
PSA
Oleflex
FCC, Merox
Ecofining
Aromatics



D.
COLLABORATIVE DISCUSSIONS WITH TECHNOLOGY EXPERTS
与技术专家协作讨论

SMEs, Process Engineers, Operations, Planning, and reliability personnel discuss issues and actionable insights with UOP technical experts in the context of constraints, objectives, priorities
SMEs, 工艺工程师，运行，计划，和相关人员与UOP技术专家在有限制条件、目标、优先级的背景下讨论问题和操作可行性

Consultation & Site Visits
咨询及实地访问

Dedicated Access to Tech Specialists
专属技术专家支持

Web-based & Classroom
Blended Learning
网络&线下 结合学习

Connected Competency Offerings
提供互联力量



E.
PROACTIVE RECOMMENDED AND SUPPORTED ACTIONS
主动提出建议并采取可靠行动

Evaluate and execute operational or technology changes and realize benefits
识别并实施操作与技术优化措施，实现收益提升

Performance Reviews
性能评估

Honeywell Technologies

全生命周期服务 | 工艺管理平台

- **Automated data transfer** of plant data from historian / LIMS to a secure Ali cloud

自动的来自数据库和实验室数据中心的数据传输，专线与阿里云互联

- Calculation steps transform raw data into **KPIs**

采用UOP校正数据对原始数据进行处理，并事实计算成定制化KPI

- Current **unit performance** is surfaced on dashboards through a secure website

管理平台界面实时通过专线展示

- Customizable **reports and trends**

报告和趋势线可根据需要定制

- Customer and UOP have access to the **same information**

客户与UOP实时就装置操作展开研讨

- Subscribe to **Exception Based Alerts and Benchmarking** for proactive support

通过异常工况报警和性能对标提供主动支持

- Additional value from **Process Technology Analytics** leveraging the connected data

通过工艺技术分析提供增量价值



Enables Faster & Better Proactive Support & Problem Resolution 提供更为实时和前瞻性的技术支持

EBA异常工况报警 | WEEKLY SUMMARY周报

- **KPI alerts focused with the right sensitivity to generate alerts**

  基于校正过的数据和灵敏度触发报警

- **Identify actionable insights quickly from the data**

  快速给出可操作的建议措施

- **Automated weekly summary email configured with control charts and stacked bar plots for comparison against previous week**

  每周出具汇总报表并与前一周进行对比分析

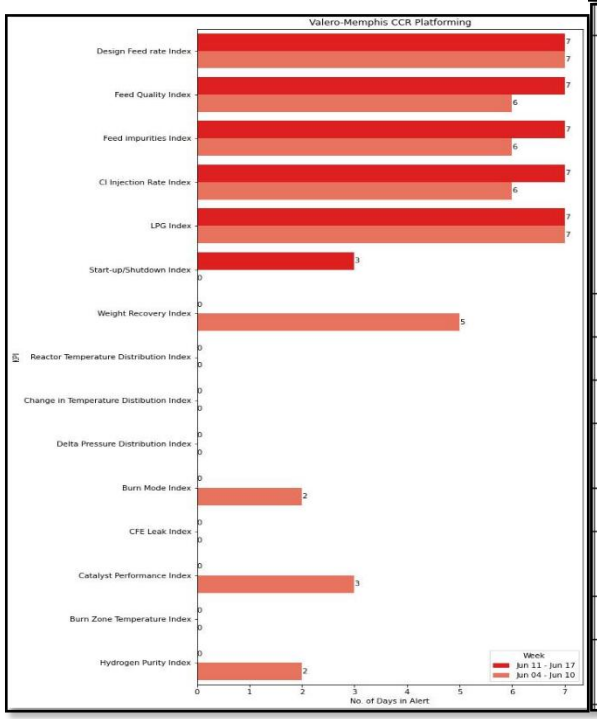
- **Alert Indices “Definitions & Recommendations” attached in email**

  报警内容及建议将附在邮件中



Date	2023-03-26	2023-03-27	2023-03-28	2023-03-29	2023-03-30	2023-03-31	2023-04-01
Weight Recovery Index							
Design Feed rate Index							
Reactor Temperature Distribution Index							
Change in Temperature Distibution Index							
Regen Tower operation Index							
Burn Mode Index							
CFE Leak Index							
Catalyst Performance Index							
Water chloride balance Index							

Lift Engager 3 Velocity Index	100.00 %	100.00 %	100.00 %	100.00 %
Lift Engager 3 Flux Index	28.33 %	22.64 %	25.83 %	29.44 %
Lift Engager 4 Velocity Index	100.00 %	100.00 %	100.00 %	100.00 %



Alerts	Attribute	Definitions & Recommendations	Impact to the customer
Throughput Index	Cycle Time	Cycle time corresponds to the time required for the rotary valve to make one complete revolution	Throughput loss directly relates to profit loss. The lower the throughput the lesser the profit and increased operating cost per unit product.
	Feed Flow Rate	Feed flow rate measures how much feed is processed in the unit.	
	Product Flow Rate	Product flow rate measures how much PX is produced in the unit.	
	Zone 1 Flow	Zone 1 Flow is responsible for the adsorption of PX in the adsorbent. It’s the highest flow among zone flows.	
PX Purity Index	PX Purity	Typical PX purity maintained is 99.7wt%. Below this the product is generally considered off-	Off-Spec product may lead to ~300K/day revenue loss.
Product Toluene	Product Toluene	Impurity component in the product. Limit at 50ppm max. Source- Finishing Column	
Product EB Index	Product EB	Impurity component in the product. Limit at 0.2% max. L2/A Adjustment to reduce the EB	
Product MX Index	Product MX	Impurity component in the product. Limit at 0.2% max. Water Injection and L4/A impacts the Product MX.	
Product OX Index	Product OX	Impurity component in the product. Limit at 0.1% max. Source- Raffinate Column Bottoms	
Product Non Aromatics Index	Product Non Aromatics	Impurity component in the product. Limit at 0.1% max. Source- improper zone 4 and upstream process units.	
Feed PX Index	Feed PX	Feed PX should ideally be in equilibrium with its isomers.	Less PX in feed means less product.
Desorbent Consumption Index	Desorbent Loss/Feed	Desorbent loss/Feed should be in the range of 0.02-0.05. Higher means more PDEB makeup and lower means higher utility consumption	Utility losses / Desorbent loss

CATALYST IMAGING 催化剂成像 PTA | OVERVIEW 概述

Real-Time Catalyst Performance Monitoring for Operational Optimization
实时频繁了解催化剂性能，对应优化装置操作

Alternative catalyst sampling, shipping, and analysis is insufficient for making operational adjustments to optimize unit performance more frequently, with cycle times of 8-12 weeks. Visual inspection lacks consistency, accuracy & sustainability
传统催化剂实验室分析周期要8-12周，而目视分析又缺乏准确度.

Customer Value客户价值:

Oleflex丙烷脱氢:
$1.3 M/yr for a 450 KMTA C3 Oleflex Unit
- 5% production improvement for 3 month; $250/MT C3/C3= spread
- 5%的产量提升

CCR Platforming连续重整:
$1 M/yr for a 1300KMTA CCR Platforming Unit
- Increase in reformate yield (0.5%); Increase in throughput (1%)
- 重整生成油收率提高0.5%，产量提高1%

Testimonial:案例

An American Refiner could detect the Low H2/Pt on the Platforming catalyst in real time and did proactive fixes in the operating variables. Value derived avoiding reformate yield decrease, high coke event (Value: ~0.6M$)

客户快速了解催化剂的氢铂比，并对应修正操作，通过提高重整生成油的收率和优化结焦产生效益

In first 3 months of usage, for one customer identified 6 events using Catalyst Imaging PTA and collaborated with tech service to troubleshoot and resolve

Solution: Catalyst Imaging Process Technology Analytics
解决方案：催化剂影像分析

Software solution to enable operating adjustments to keep performance optimized based on understanding catalyst health. Support by service will be needed to confirm the right recommended actions based on overall unit operations, objectives and constraints.
软件解决方案，通过了解催化剂状态，进行操作调整，以实现性能优化。利用服务团队的支持，可根据整体装置运行情况、操作目标和约束条件，来确定合适的措施。

Operational Planning
操作计划
Better operational awareness with real-time catalyst health analysis
通过分析实时的催化剂状态，提高操作意识

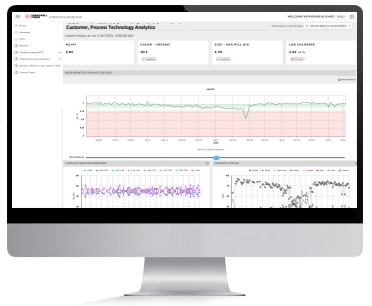
Troubleshooting
故障排除
Frequentt catalyst analysis tied to process data creates targeted troubleshooting

Process Effectiveness
Improved unit optimization with catalyst health as an input

HONEYWELL FORGE Performance+ | Honeywell UOP



Data



Insights & Knowledge



Actions
Operational Adjustments $

Enables advanced decision making using near real-time catalyst health analysis 近乎实时的催化剂状态评估

CCR PLATFORMING PTA | PERFORMANCE PREDICTOR
连续催化重整工艺技术分析 性能预测

Product 成果 | Use Cases 应用场景

HONEYWELL FORGE Performance+ Honeywell UOP



Built in partnership with Microsoft

Proactive What-if Scenario Assessment
假定性情景评估
Ensure consistent optimal operations and unit performance
确保最佳操作的连续性和装置性能

Knowing Available Margins on Unit Bottlenecks
掌握装置限制条件下的优化空间
Know margins on unit constraints for informed operational changes
了解装置的操作极限，实现更高效的操作调整

Operational Planning
操作计划
Promote informed decision-making in techno-economic planning.
推动技术与经济一体化规划中的科学决策

New Engineers Training Tool
新工程师培训工具
Safe trial-and-error learning without impacting actual operations
安全的试错学习，而不影响实际运行

Knowledge Management
知识管理
Enhanced collaboration & improved knowledge documentation.
加强合作 & 优化技术文档

Use Cases / Testimonials 用例/客户评价

European Refiner used the PTA for optimal operations
欧洲炼油厂采用PTA进行优化操作

For more paraffinic feed, Refinery engineer proactively estimated the optimum WAIT for high-octane operations, achieving optimal operations 16-24 hours faster **(Value: ~0.3M$)**
对于具有更多烷烃的进料，炼油厂工程师提前估计了对于高辛烷值操作的最佳平均进料温度，在16-24小时内实现了最佳操作 **(价值: ~300万美元)**

Middle Eastern Refiner used the PTA for Euro V Planning
东炼油厂使用PTA 于欧五规划

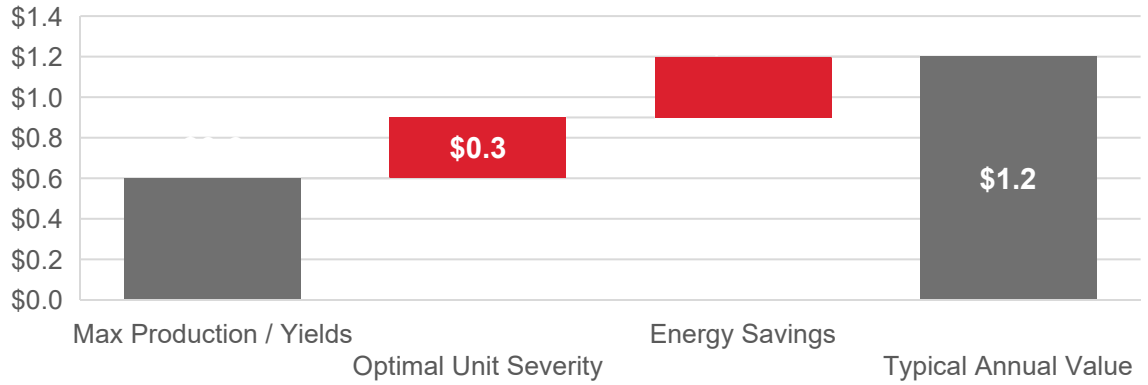
"The tool was a great help to ascertain achievable reformate octane within unit constraints' – Refinery Planner 该工具在确认装置约束条件下，为实现重整生成油最大辛烷值提供了很大的帮助。"



	Functionality 功能	Value to Customer 价值
Performance Predictor 性能预测	Self-serve and Interactive digital analytics for 自助服务和交互数字分析： • What-if Case Scenarios Evaluations 假定分析功能评估 • Unit operation optimization 装置操作优化 • Unit constraints assessment 装置极限评估 • Sensitivity Analysis 灵敏度分析	Improving Product Yields & Optimal Unit Performance 提高产品收率 & 优化装置性能 Improved Reliability, available margins assessment. 提高可靠性, 可得利润评估 Proactive Planning, Assessing profit, and utility differentials. 前瞻性计划, 评估收益, 公用工程的消耗

Value Walk ($M/Year)

For a 30KBPSD CCR Platforming Unit



Simplified, Powerful Analytics For Optimized Operations & Proactive Planning简单有效的优化生产和提前规划工具

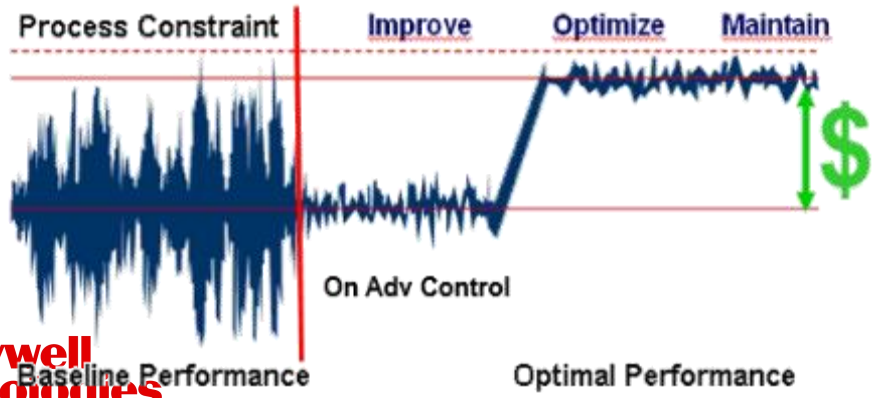
全生命周期服务 | 运行期间智能优化方案

收益

- 工艺及操作优化指导
- 实现装置在长周期运转
- 延长催化剂的使用寿命
- 减少非计划停工

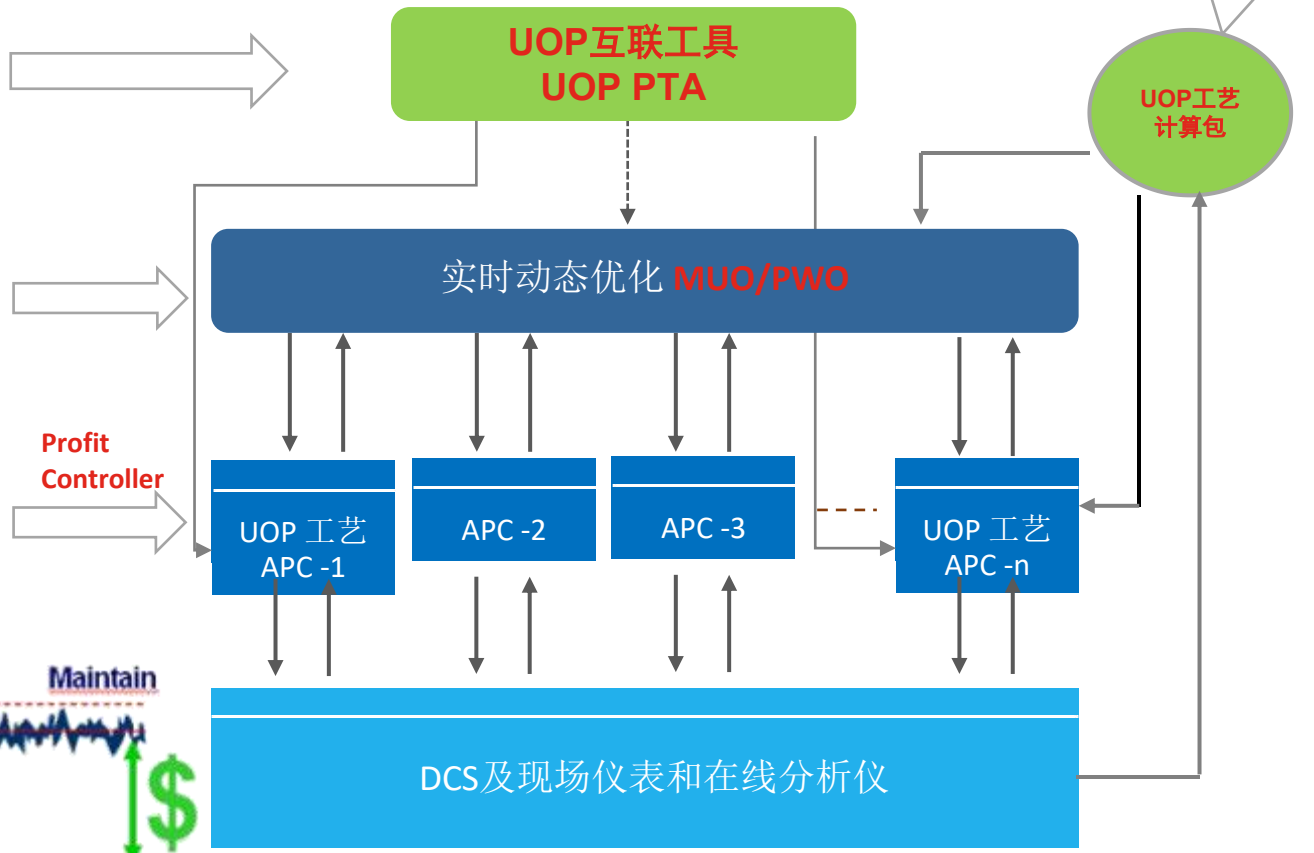
- 实现目标产品收率最大化
- 实现目标产品液收最大化
- 实现装置处理量最大化

- 实现装置操作和质量卡边
- 提升装置运行的平稳性
- 降低装置能耗
- 提升装置运行安全



独有特点

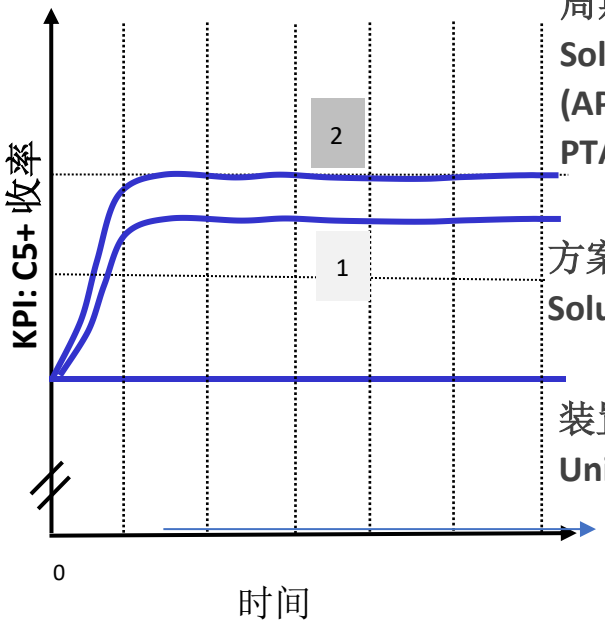
预置在霍尼韦尔APC技术中的UOP工艺工具包采用UOP专利技术，通过机理计算来提高控制和优化性能



Honeywell Technologies

全生命周期服务 | 从工艺设计和操作重点出发

Combining UOP's technology knowledge and process expertise with Honeywell's Advanced Process Control offering delivers "Best in Class" solutions for unit performance optimization and process control
融合UOP的技术专长和经验，及霍尼韦尔的先进控制能力，提供了无与伦比的装置优化和控制方案

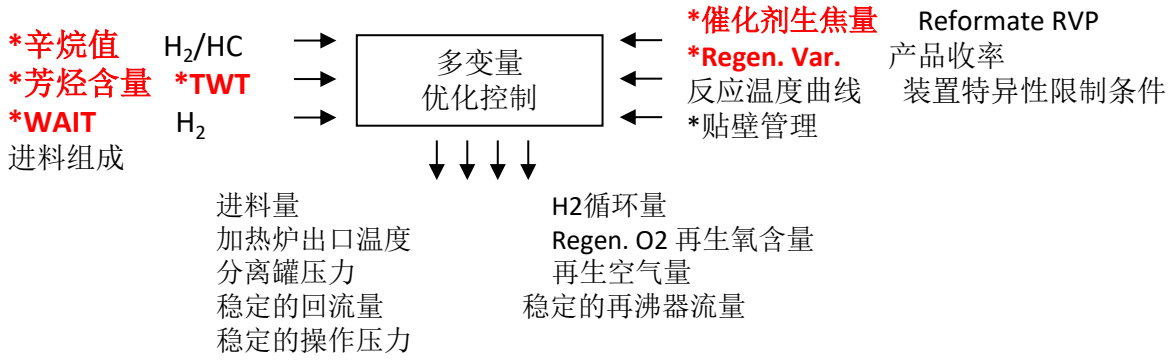


方案2： 综合解决方案（由全生命周期工具PTA给出APC的变量设定值）
Solution 2: Integrated Solution (APC Setpoints Generated by the PTA Performance+)

方案1：仅投用APC
Solution 1: APC only

装置效益基准
Unit base line

CCR PLATFORMING® 连续重整工艺优化方案

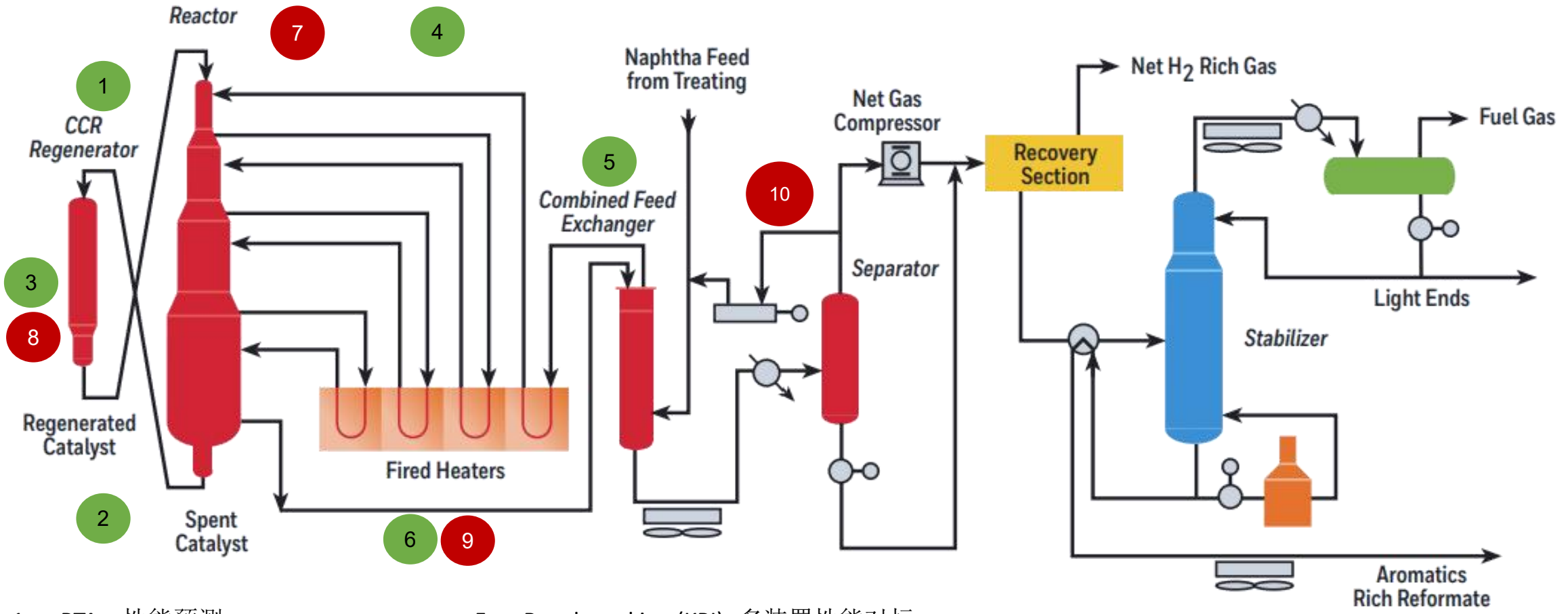


*UOP PTA utilizing a proprietary Kinetic Process Model Improves 70% of inputs for APC to ensure consistent optimized yields & performance
UOP PTA采用专有的动力学模型，相比通用APC提供了70%以上的增量优化收率和效益

- 通过整合全生命周期服务组件，实现闭路的自动优化
  Closed-Loop Optimization Enabled by Integrated Lifecycle Services
- 在装置限制条件下，持续进行装置优化
  Continuous Optimization Within Operational Constraints
- 基于出于工艺设计和操作重点的多变量的实时优化
  Real-Time Multivariable Optimization Based on Process Priorities
- 提高了优化效益，降低了操作强度和危险性
  Higher Economic Benefits with Reduced Operational Effort and Risk

Integrated Solutions for Driving and Sustaining Incremental Value 收获持续增量价值的一体化解决方案

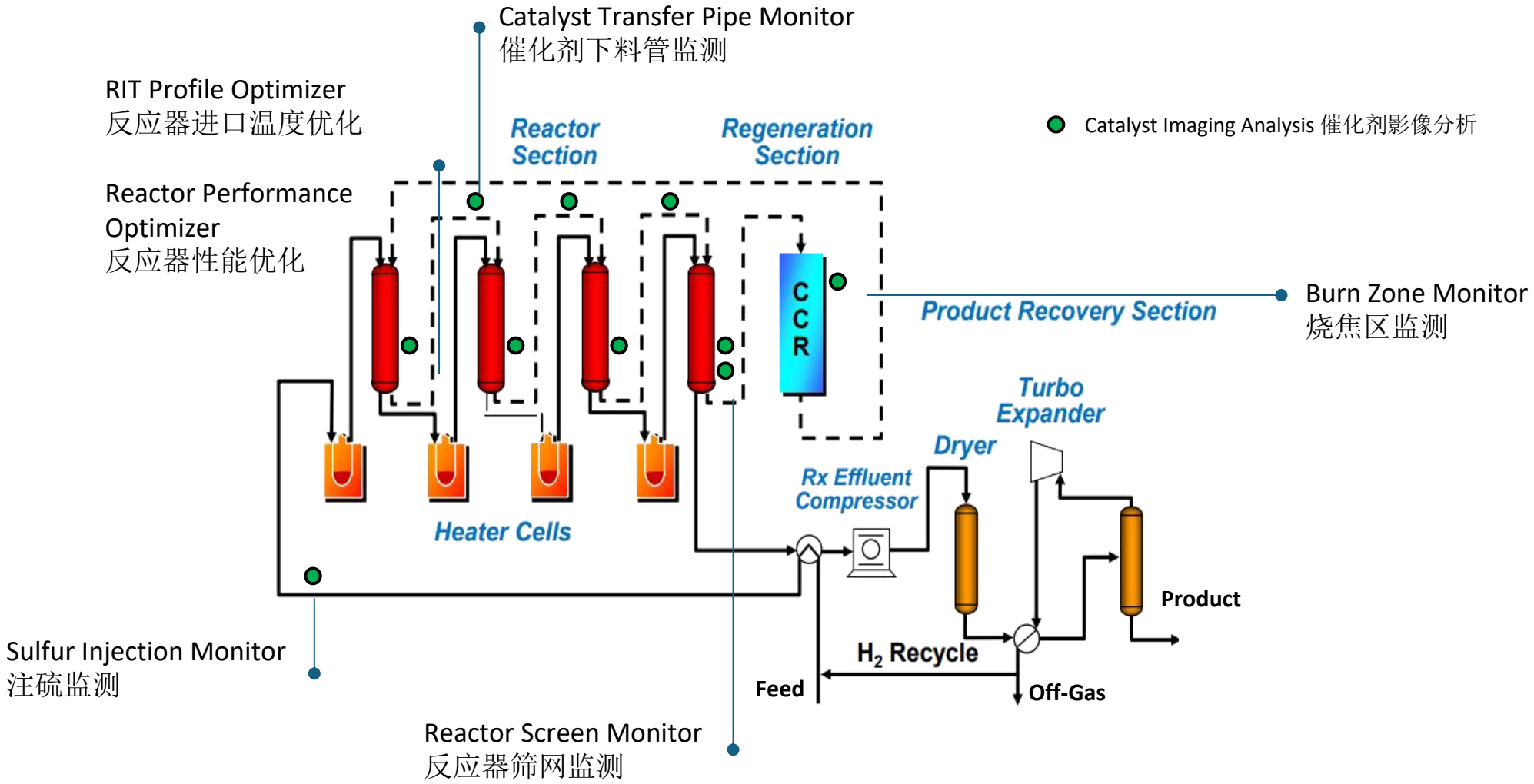
全生命周期服务 | CCR PLATFORMING™ 数智矩阵



1. PTA – 性能预测
2. PTA – 催化剂拍照
3. PTA – 动态积碳分析
4. EBA- 异常工况预警
5. Benchmarking (KPI)- 多装置性能对标
6. PTA – 混合进料换热器健康监控
7. APC – PTA一体化反应-再生管理
8. APM – 再生健康管理(CRCS, 区域效能管理)

提高产能和收率，提高产品芳含/ 辛烷值

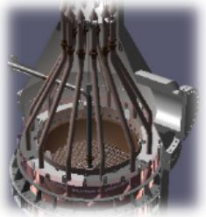
全生命周期服务 | C3 OLEFLEX™ 数智矩阵



反应条件优化、高苛刻度操作管理、精准的检修规划

全生命周期服务 | 高效可靠的检修让停工尽在掌控













Elite Focus Areas
精品检修关注焦点

- Planning & Coordination 规划协调
- Turnaround workshops 检修研讨会
- Site audit and refresher training 现场指导和培训
- In Depth Inspection 深度检查
- Specialist Staffing 技术专家团队
- Commercial best practices 商业最佳实践
- Scope & Responsibilities Alignment 范围和责任划分
- Streamlined internals & transfer piping assembly 简化内件&传输管线的装配
- Comprehensive Preparation 全面准备

Holistic Approach with Proactive &Early Engagement 全面与早期主动参与

全生命周期服务 | 客户案例
PERFORMANCE+ SERVICES | CASE STUDY

Unit 装置	Date 时间	Issue / Opportunity 问题/改进项	How Did UOP Support As A Partner? UOP的服务方式	Benefit 服务收益	$ Value Estimate 价值预估
CCR Platforming 连续重整	May 2024	NHT down. Needed to run CCR Platforming on alternate flowscheme & feed stock 上游预加氢停工。需要调整连续重整进料及流程	UOP experts advised on monitoring & mitigating process impacts of contaminants with different feedstocks. Proactive cadence calls and direct expert contact. UOP专家提出流程切换建议及对临时工况杂质等的限制和影响，及时与客户沟通并现场拜访确定方案。	UOP's input used to decide flow scheme, de-risk operations, and maximize production with feed contaminants. UOP的建议措施帮助确定了临时流程，降低了操作风险，在保障杂质可控的前提下最大化地保证了生产。	$1M
CCR Platforming 连续重整	May 2024	Turnaround due to reactor pressure drop increase out of cycle 因反应器高压降临时停工	UOP experts provided frequent remote support and advised on how to reduce startup-to-full-production time by 18 hours. UOP通过远程支持，在18小时内帮助完成再开工至满负荷生产	Additional production achieved; avoided on-site field service needs and costs. 提高了装置在线率，降低了现场服务需求。	$0.5M
CCR Platforming 连续重整	July 2024	Reduced production from CCR outage caused by control issues 因控制系统故障导致装置降量	UOP experts collaborated on a 12-hour call to restore the control system. Coke laydown was calculated to optimize severity. A PIC expert visited the site to increase system reliability at no additional cost. UOP工程师连续12小时实时在线指导，并通过动态积碳分析模块优化反应苛刻度。通过指导，控制系统上线后可靠性更强也更稳定。	Optimized production, reliability and profitability at no additional cost. 优化了操作、提高了可靠性，并不产生额外支出。	$0.5M

Thank you



Honeywell Technologies