

预测分析：技术、模型与应用

SAP Predictive Analytics

尹海宁, SAP Predictive Analytics
大中华区预测分析解决方案总监



AVIVA



SAP Predictive Analytics——智能预测分析平台

自动化 简单化 普及化 人人会用的大数据



自动模型

针对业务用户，不用编程
数据挖掘工作可以轻松完成

数据管理/自动建模/模型管理



专家模型

针对专业用户，可以通过R语言创建
定制的算法（支持R语言加密）

R语言集成/可视化与分享故事



为所有角色——业务分析师或数据科学家——提供预测分析的服务



IOT大数据平台原生类库支持

完全库内运算，无需传输数据
支持50万以上的变量

HANA PAL/APL

Native Spark Modeling

流处理语言（CCL）支持

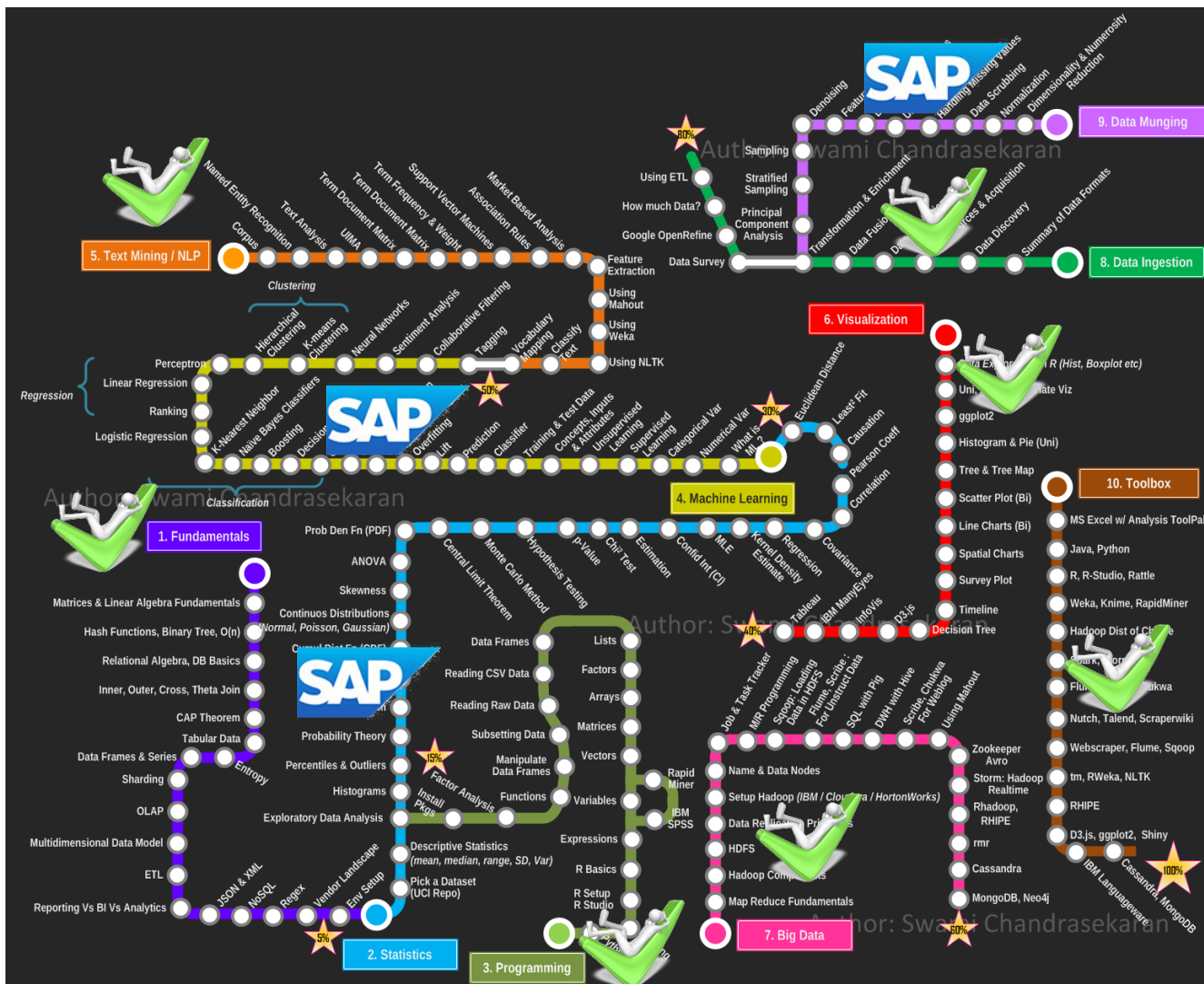
应用场景广泛

客户细分，交叉销售，营销提升，
客户流失率分析，预测性维护，良品率

零售/消费品/电信/高科技/离散制造/
金融服务/公共部门/公用事业



大数据科学家 学习路线图



DBA/BI童鞋们 已掌握的技能树



PA能帮助大家快速点亮的技能

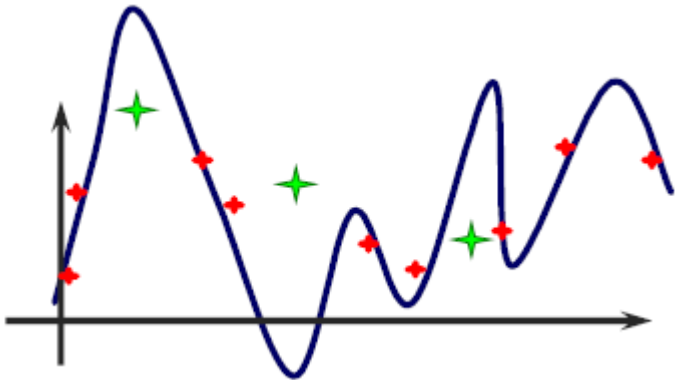


预测分析世界中的自动档：SAP Predictive Analytics

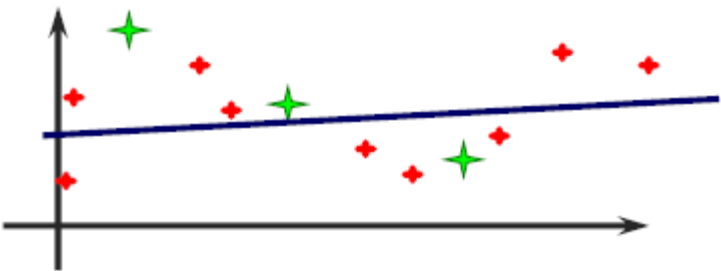


如何保证自动模型的准确度？

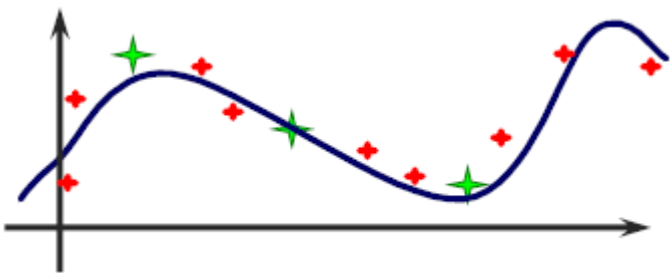
SRM原则如何选择最佳模型？



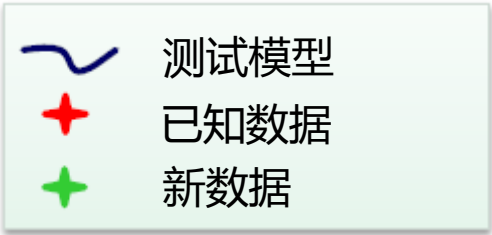
高准确/低稳定
(低训练误差/高测试误差)



低准确/高稳定
(高训练误差 = 高测试误差)



最佳模型
(低训练误差 \approx 低测试误差)



如何保证自动模型的准确度？

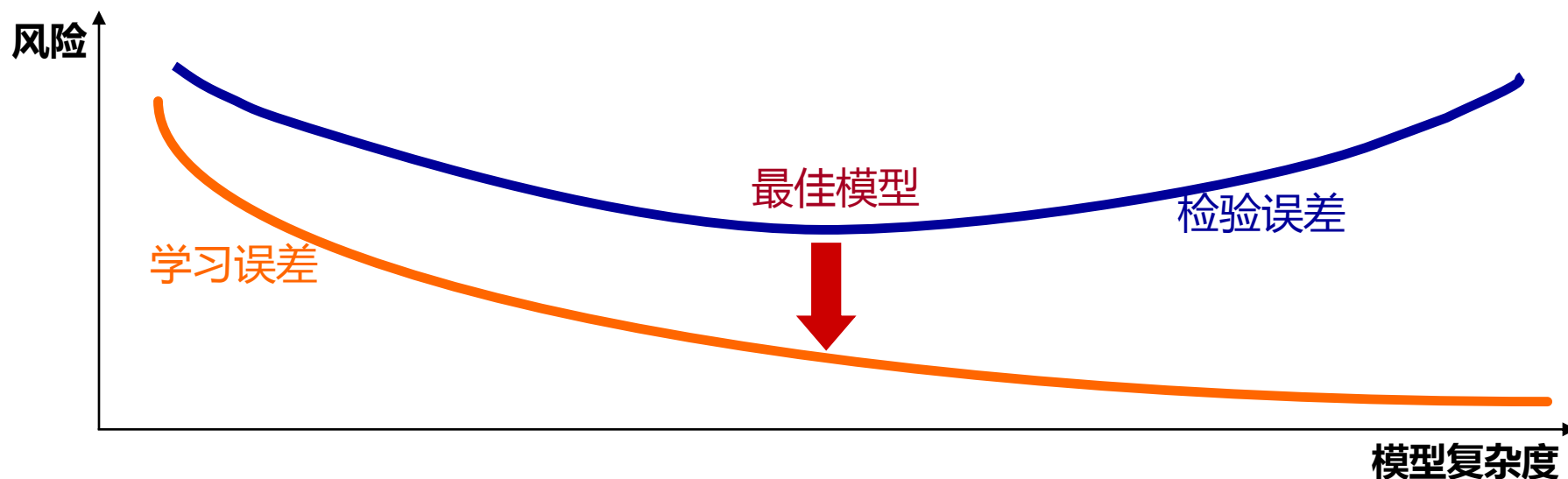
SRM原则如何选择最佳模型？

准确性(KI):

- 模型对现有数据的解释能力怎样？
- 通过最小化误差获得

稳定性(KR):

- 现有模型对将来事件的预测能力。
- 减小不稳定性

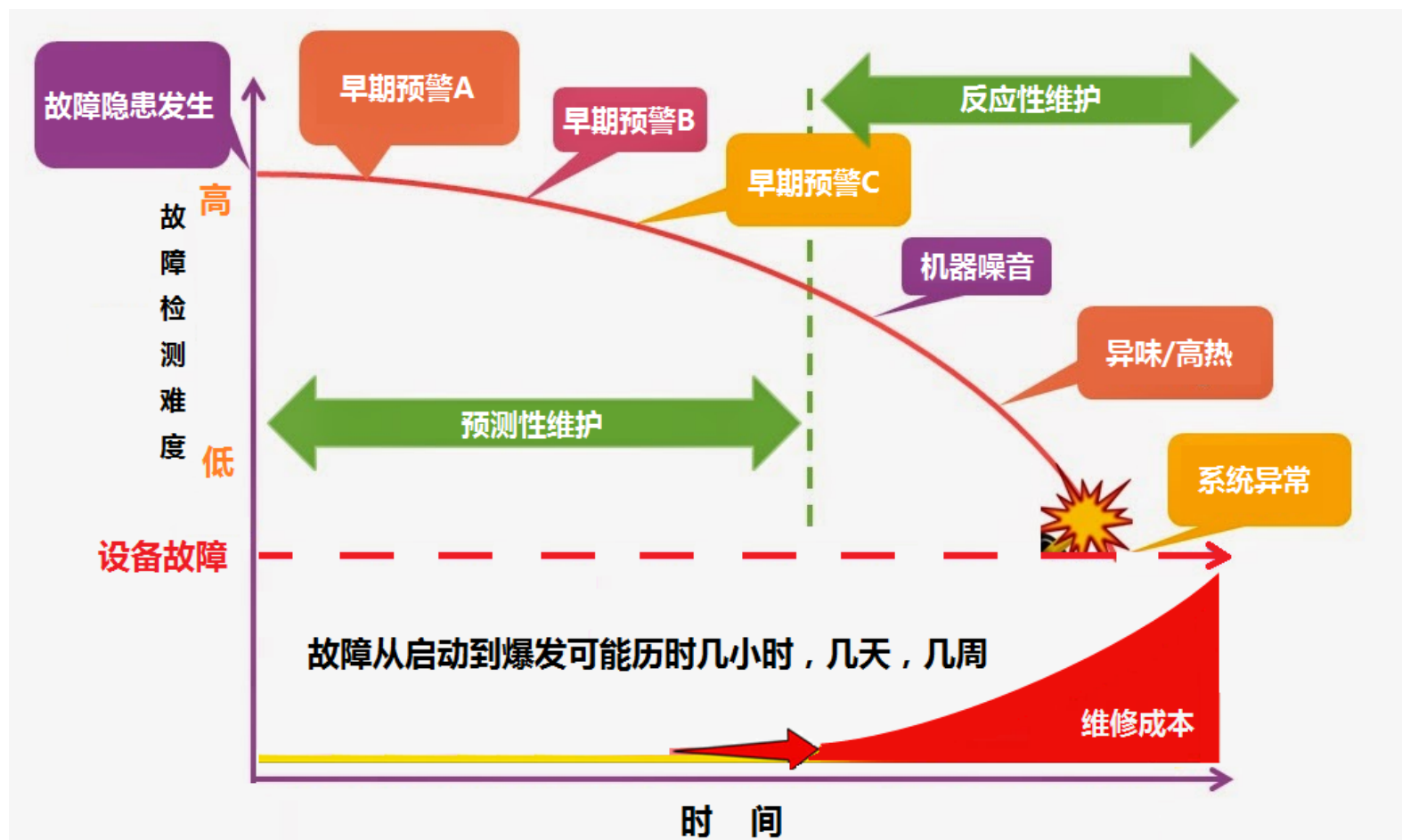


SAP PA不问算法 只问场景



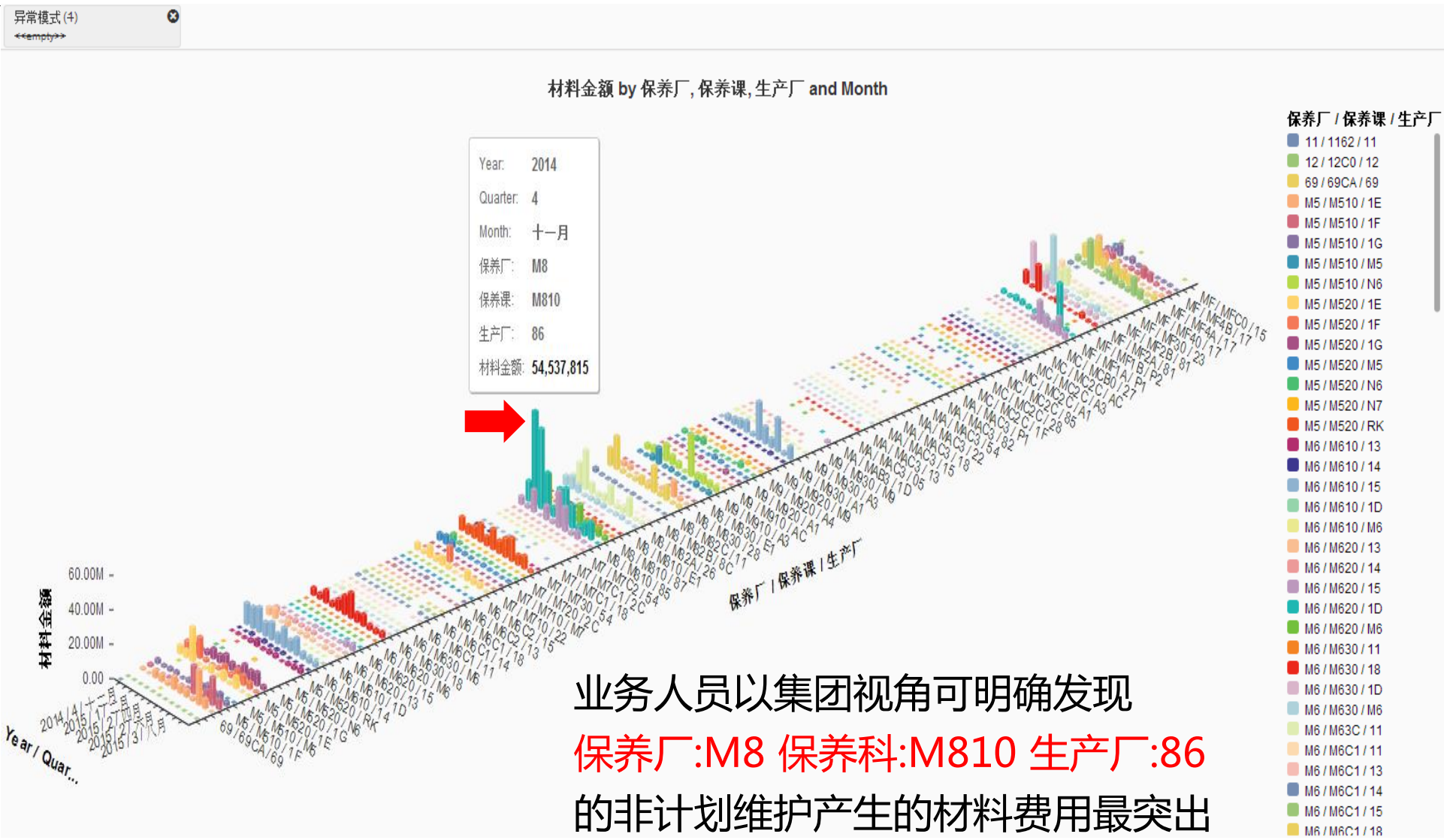
预测性维护

(Predictive Maintenance)

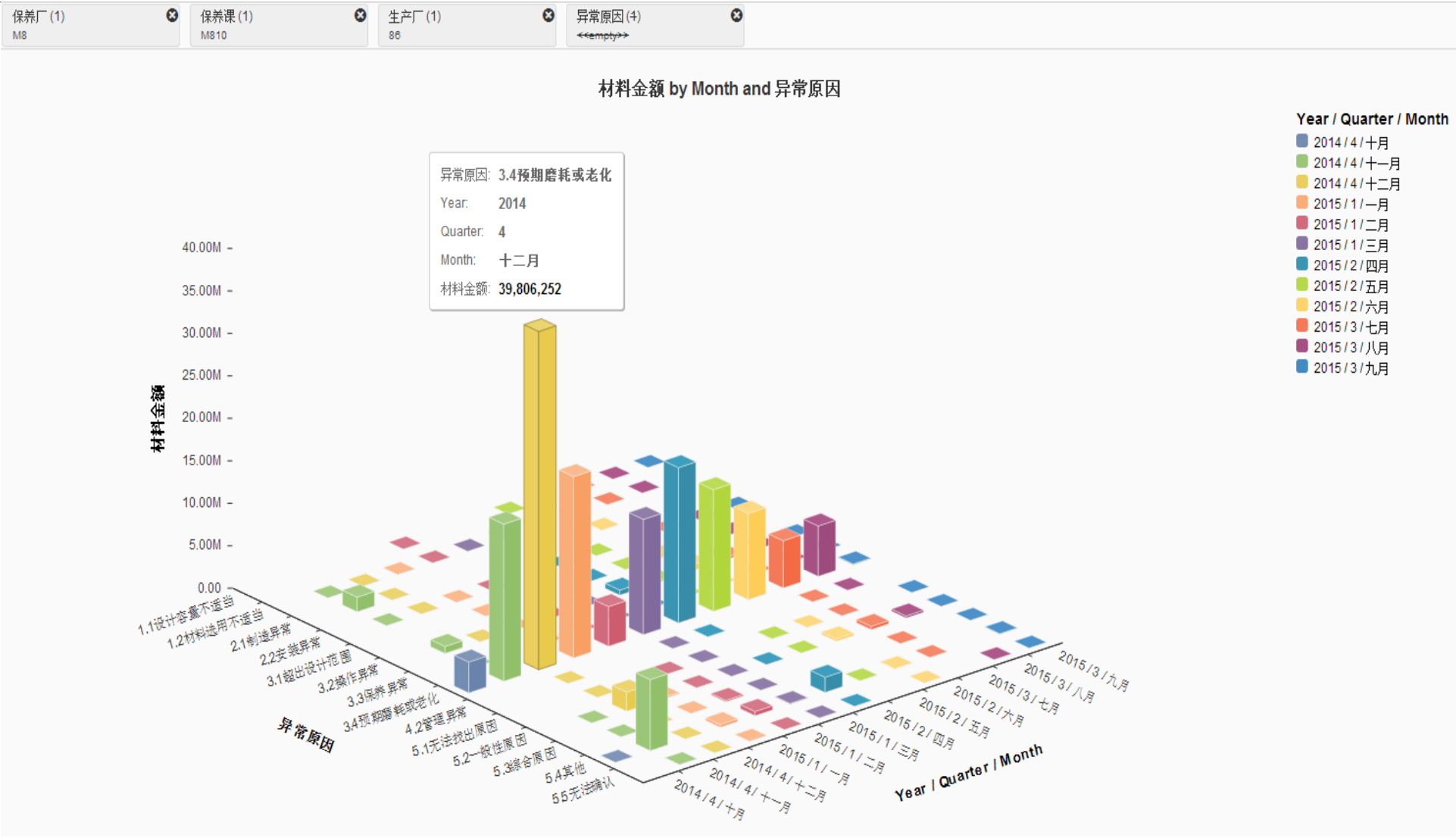


预测性维护技术，旨在帮助确定处在使用中的设备的状况，并预测何时进行维修行为。

以集团视角多维度按时间勘查计划外运维产生的材料费用

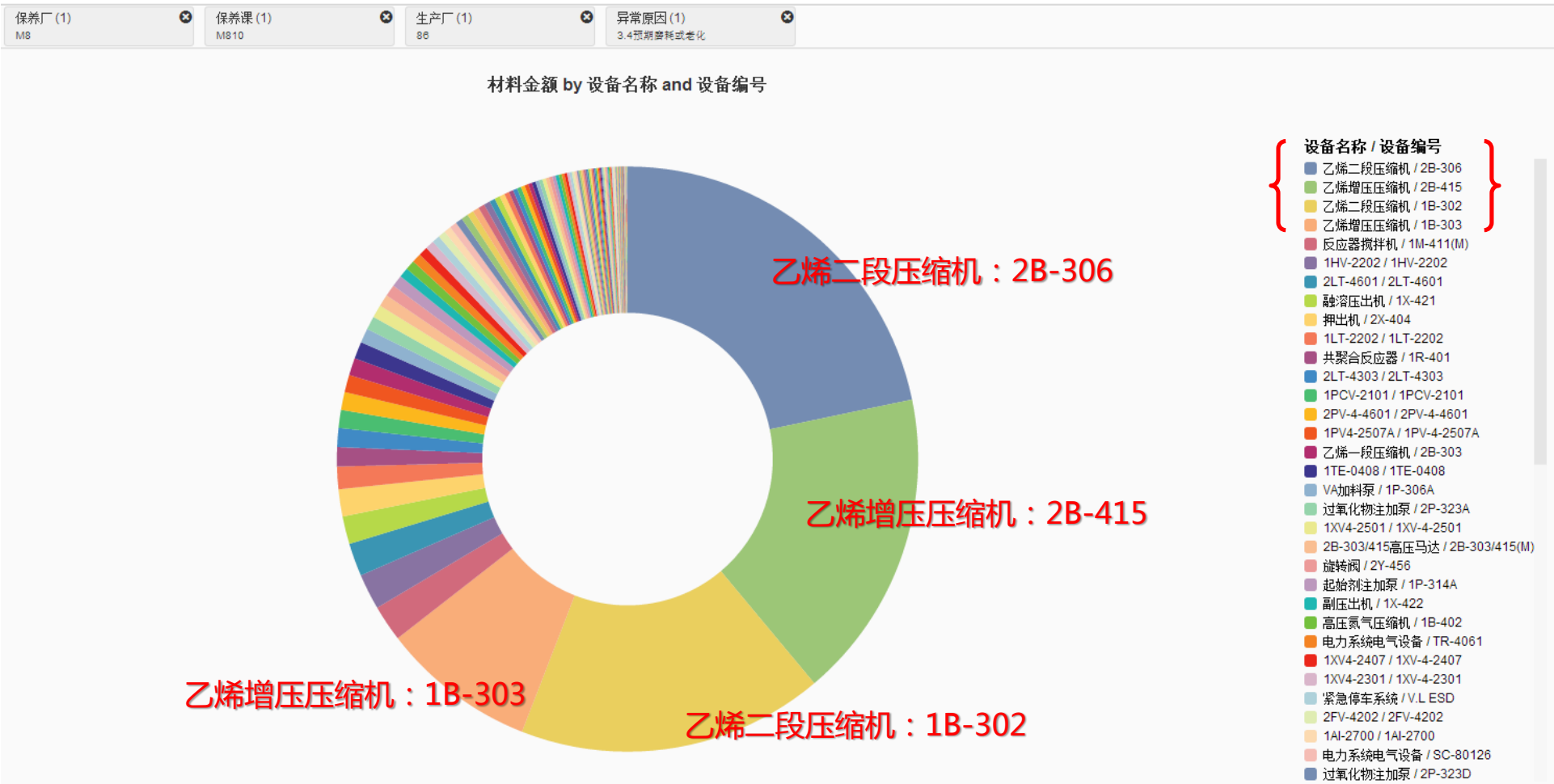


图形下钻针对M8\M810\86厂按时间维度对各种异常原因的勘查 发现主要原因是：预期磨损或老化



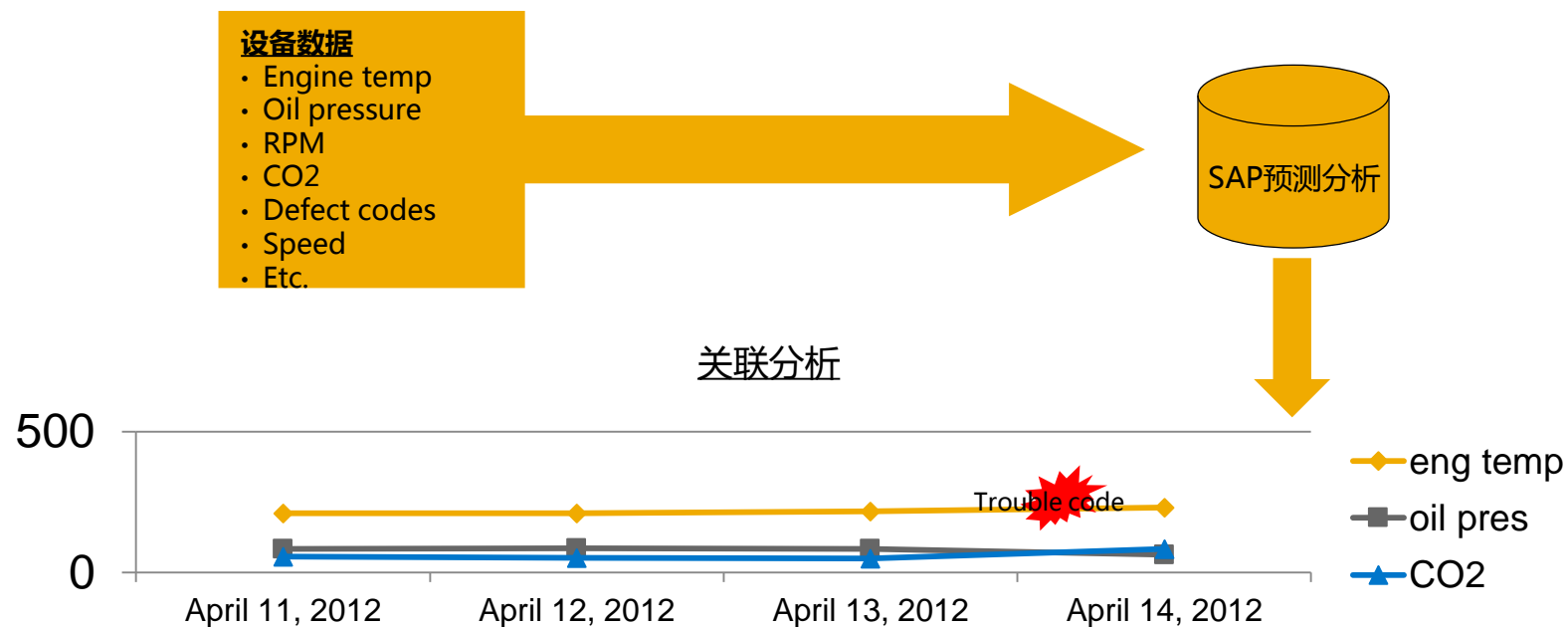
继续下探到具体设备，因预期磨损或老化产生的维修材料金额

前四台设备产生的维修材料金额占M8\M810\86厂一半以上



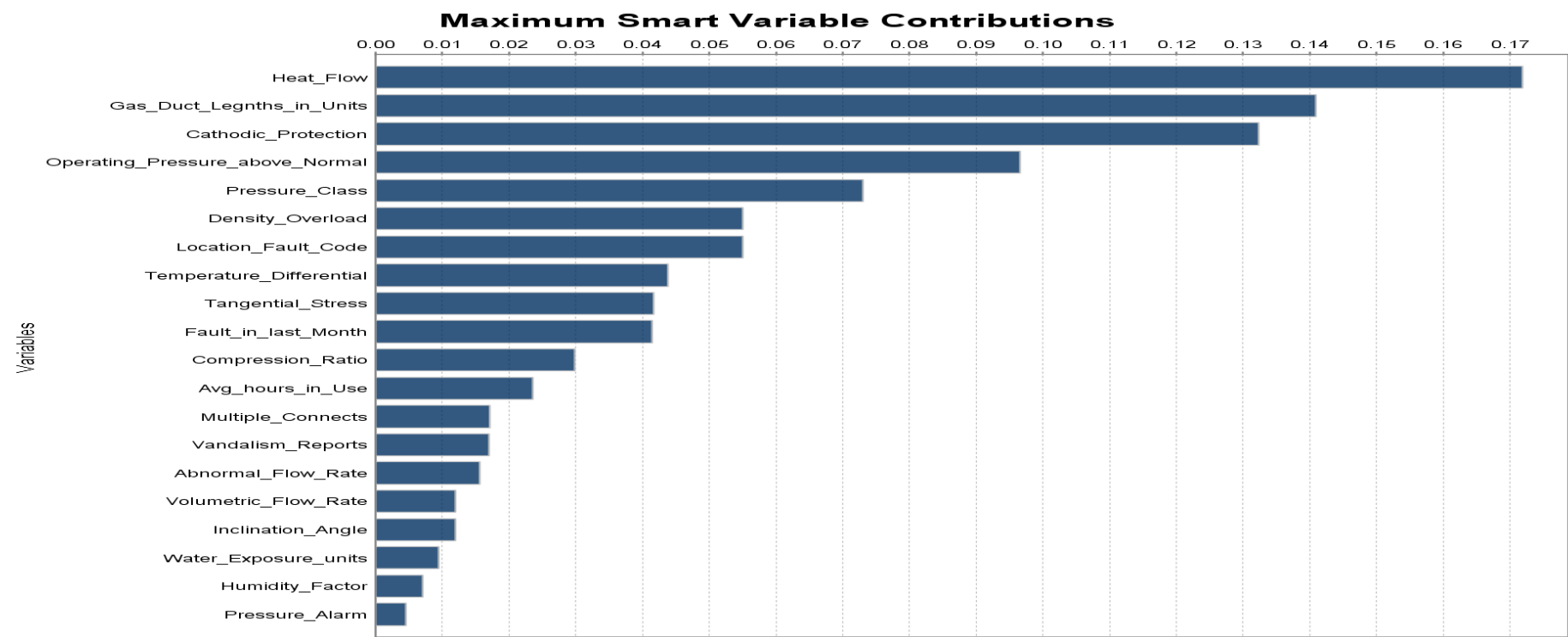
基于设备传感器数据运行SAP高级预测分析

机械可用性分析和故障预测



利用分析工具找到设备严重预警信息,进行故障预测

自动分类模型显示故障相关变量贡献



预测故障的原因分析

	...	rr_Failu...	...	contrib_Heat_Flow_rr_Failu...	contrib_Temperature...	contrib_Volumetric_Flow...	contrib_Tangential_...	contrib_Gas_Duct_...	contrib_Fault_in_Last...	contrib_Inclination_...	contrib_Location...	contrib_C...	contrib_M...	contrib_W...
1	...	1.13849773	...	0.135370570266563	0.191223295383842	0.099783656812895	0.062686856248276	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2584715...	-0.0040011...
2	...	1.2094566...	...	0.135370570266563	0.014854444759381	0.169712805407104	-0.006394140900388	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2584715...	-0.0040011...
3	...	1.1900539...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2584715...	-0.0040011...
4	...	0.1860630...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.063694969619853	0.0185606767842...	0.0439284...	0.2584715...	-0.0040011...
5	...	0.1860630...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.063694969619853	0.0185606767842...	0.0439284...	0.2584715...	-0.0040011...
6	...	1.1788813...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.062686856248276	0.422388494898434	0.005914128011707	0.084272901592242	0.0295635777507...	0.0439284...	0.2011544...	-0.0040011...
7	...	0.1553697...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.063694969619853	0.0185606767842...	0.0132351...	0.2584715...	-0.0040011...
8	...	1.1465395...	...	0.135370570266563	0.014854444759381	0.099783656812895	-0.006394140900388	0.422388494898434	0.005914128011707	0.063694969619853	0.0295635777507...	0.0439284...	0.2584715...	-0.0040011...
9	...	1.1455283...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.062686856248276	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1767855...
10	...	0.1379800...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.038293518827951	0.063694969619853	0.0295635777507...	0.0439284...	0.2011544...	-0.0040011...
11	...	1.1327368...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2011544...	0.0040011...
12	...	1.1313195...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.062686856248276	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1625768...
13	...	1.1313195...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.062686856248276	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1625768...
14	...	0.1287459...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.063694969619853	0.0185606767842...	0.0439284...	0.2011544...	-0.0040011...
15	...	1.1275307...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.075382665460165	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0132351...	0.2584715...	0.1767855...
16	...	1.1269586...	...	0.135370570266563	0.191223295383842	0.138447364888422	0.075382665460165	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1767855...
17	...	1.1122702...	...	0.135370570266563	0.014854444759381	0.044936454515459	-0.006394140900388	0.422388494898434	0.005914128011707	0.084272901592242	0.0295635777507...	0.0439284...	0.2584715...	-0.0040011...
18	...	1.1098003...	...	0.135370570266563	0.014854444759381	0.099783656812895	-0.006394140900388	0.422388494898434	0.005914128011707	0.084272901592242	0.0295635777507...	0.0439284...	0.2011544...	-0.0040011...
19	...	1.1002961...	...	0.135370570266563	0.014854444759381	0.138447364888422	-0.006394140900388	0.422388494898434	0.005914128011707	0.063694969619853	0.0019736292287...	0.0439284...	0.2011544...	-0.0040011...
20	...	1.0962653...	...	0.135370570266563	0.191223295383842	0.138447364888422	0.075382665460165	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0132351...	0.2584715...	0.1767855...
21	...	1.0957083...	...	0.135370570266563	0.191223295383842	0.138447364888422	0.044132332993962	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1767855...
22	...	0.10945977...	...	0.135370570266563	0.014854444759381	0.099783656812895	0.044132332993962	0.422388494898434	0.005914128011707	0.063694969619853	0.0185606767842...	0.0439284...	0.2011544...	-0.0040011...
23	...	1.0883852...	...	0.135370570266563	0.191223295383842	0.138447364888422	0.044132332993962	-0.084363422486165	0.005914128011707	0.084272901592242	0.0185606767842...	0.0439284...	0.2584715...	0.1694624...
24	...	1.0869339...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.062686856248276	-0.084363422486165	0.005914128011707	0.063694969619853	0.0185606767842...	0.0132351...	0.2584715...	0.1694624...
25	...	1.0822103...	...	0.135370570266563	0.014854444759381	0.099783656812895	-0.006394140900388	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2011544...	-0.0040011...
26	...	1.0822103...	...	0.135370570266563	0.014854444759381	0.099783656812895	-0.006394140900388	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2011544...	-0.0040011...
27	...	1.0778896...	...	0.135370570266563	0.014854444759381	0.044936454515459	0.044132332993962	0.422388494898434	0.005914128011707	0.084272901592242	0.0019736292287...	0.0439284...	0.2011544...	-0.0040011...
28	...	1.0757025...	...	0.135370570266563	0.191223295383842	0.169712805407104	0.044132332993962	-0.084363422486165	0.005914128011707	0.063694969619853	0.0185606767842...	0.0132351...	0.2584715...	0.1767855...
29	...	1.0680475...	...	0.135370570266563	0.191223295383842	0.099783656812895	0.044132332993962	-0.084363422486165	0.005914128011707	0.084272901592242	0.0295635777507...	0.0439284...	0.2584715...	0.1767855...

SAP预测性维护

Create Work Order

Air Temperature

39.0 °C

Cloud Cover

57.0 %

Production

▲ 1,210 barrels

Current Month

Revenue

▼ \$793 K

Current Month

Utilization Rate

81%

Current Month

Unscheduled Shutdown

▲ 2

Last 10 days

Accidents

▼ 1

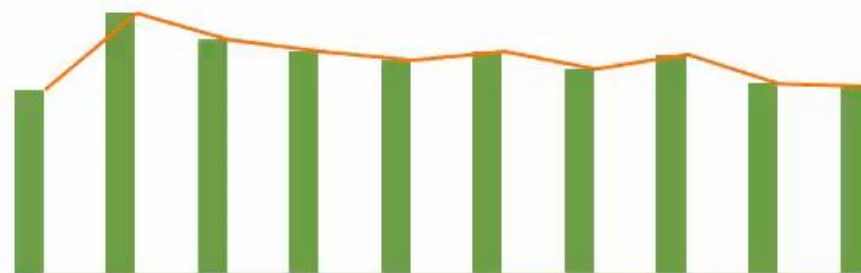
Last 10 days

Near Misses

▼ 2

Last 10 days

Production Forecast Chart



预测性维护

为设备制造商和运营商提供显著的商业价值

设备制造商



提高服务盈利能力较低的服务成本和新的收入流

更高的故障分辨率

较高的首诊修复率

客户的满意度和忠诚

更高的服务合同续签率

启用新的创新的商业模式

设备运营商



较高的整体设备效率？（资产可用性和性能及品质）

提高维修效率

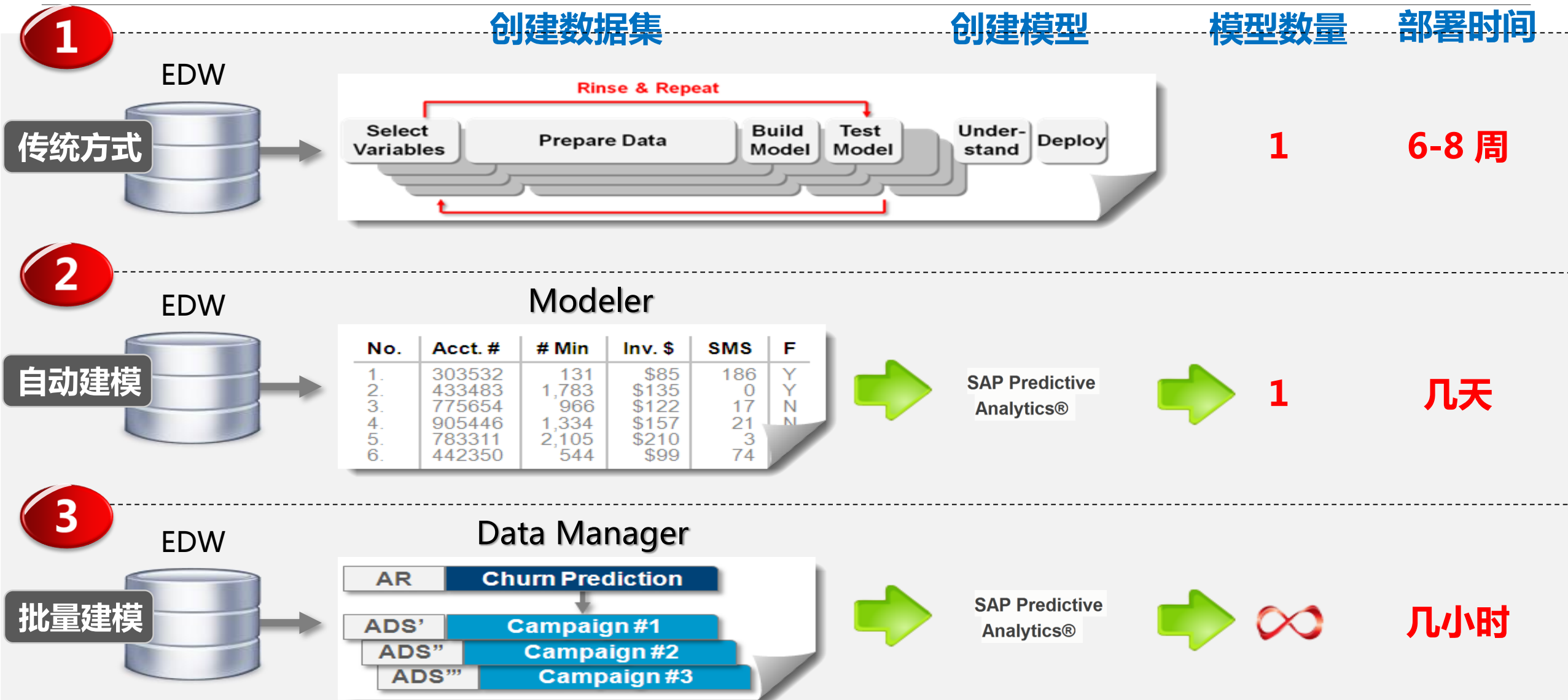
降低维护成本

报警和故障更快反应

更高故障之间的平均时间

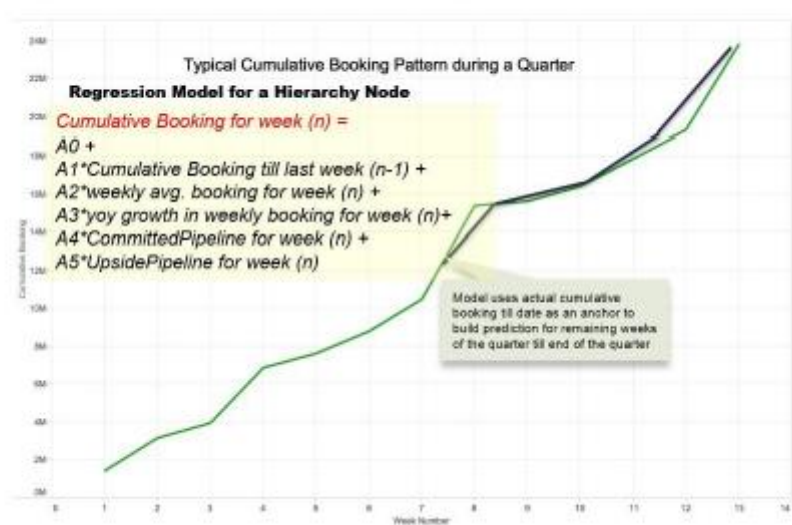
较低的平均修复时间

预测模型产能指数级上升



模型生产力提升Demo

Modeling Cumulative Booking



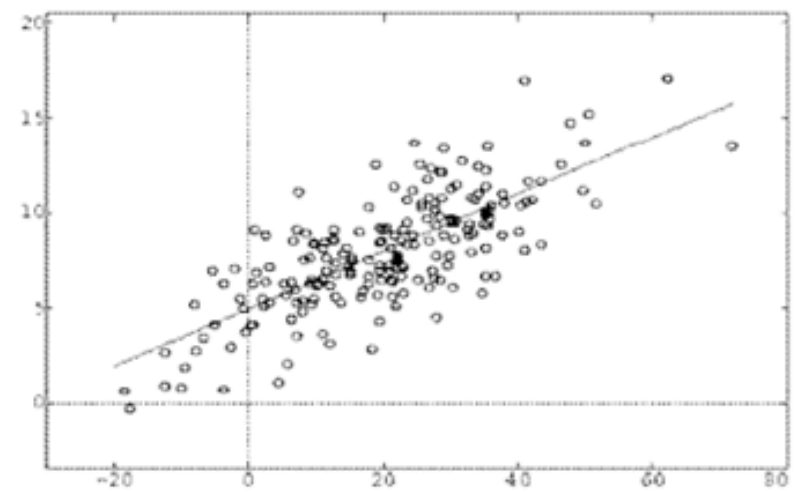
某集团大数据科学家团队基于历史订单数据，使用R语言创建回归模型预测季末销量，协助销售经理及时调整销售策略

模型准确率应保证在90%-95%

面临挑战：

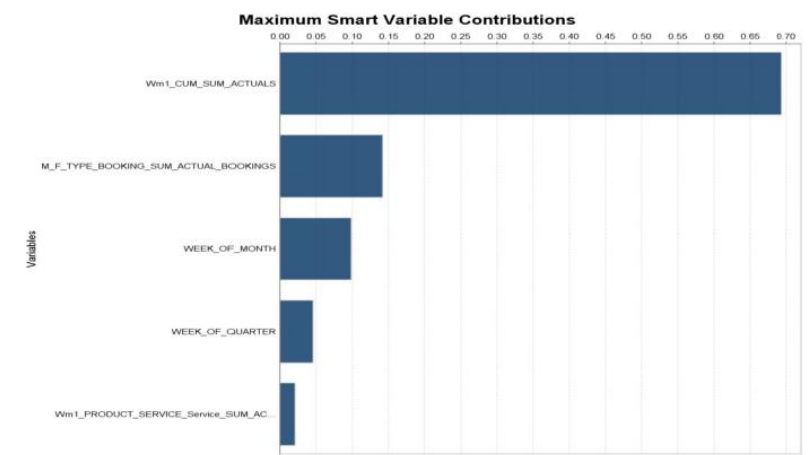
1. 相关课题按品类需要创建几百个模型
2. SAP PA自动建模，模型管理是否可以帮助到大数据科学家？
3. SAP只有5天时间去证明！

里程碑1：回归模型



数据学习范围：
2011-07-31/2014-03-15
数据校验范围：
2014-03-16/2015-01-25

- 1. 模型在203个变量中
自动保留5个变量
- 2. 发现大数据科学家团队
原模型中包含两个可疑变量



里程碑1：测试数据预测结果（回归模型）

Date	Actual bookings	Predicted bookings	Error
01/02/2015	\$4 604 890	\$4 541 869	1.4%
08/02/2015	\$5 955 017	\$6 435 891	8.1%
15/02/2015	\$8 488 014	\$8 703 424	2.5%
22/02/2015	\$9 872 040	\$9 024 080	8.6%
01/03/2015	\$10 717 554	\$11 647 288	8.7%
08/03/2015	\$13 251 671	\$13 055 998	1.5%
15/03/2015	\$15 602 478	\$15 434 458	1.1%
22/03/2015	\$17 409 491	\$18 139 533	4.2%
29/03/2015	\$21 362 385	\$20 589 214	3.6%
05/04/2015	\$24 417 945	\$24 588 620	0.7%
12/04/2015	\$27 049 804	\$26 687 122	1.3%
19/04/2015	\$33 049 468	\$31 608 909	4.4%

平均误差 3.8%
中位数误差 3.1%

里程碑2：自动创建400+模型

几乎不用任何额外工作即创建并部署400+模型

1. 导出模型脚本



2. 调整参数生成模型

```
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="AU_COM_NSW_PL_TAM_TM" -DMODELNAME="AU_COM_NSW_PL_TAM_TM"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="MM CENTRAL PLAINS TERRITORY PL" -DMODELNAME="MM CENTRAL PLAINS TERRITORY PL"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="Carolinas Select 6" -DMODELNAME="Carolinas Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="SLED-SoCal Named Reg" -DMODELNAME="SLED-SoCal Named Reg"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="Peach State Select 6" -DMODELNAME="Peach State Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="Florida Select 6" -DMODELNAME="Florida Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="TN Select 6" -DMODELNAME="TN Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="PL_S_CH_S_SZ_TM" -DMODELNAME="PL_S_CH_S_SZ_TM"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="MM South Pacific Territory PL" -DMODELNAME="MM South Pacific Territory PL"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="Atlanta Select 6" -DMODELNAME="Atlanta Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="PA Select 6" -DMODELNAME="PA Select 6"
ion\Scripts\RegressionScript_AA.kxs -DMODELPROMPT="SLED-NYC Region" -DMODELNAME="SLED-NYC Region"
```

里程碑3：模型管理器自动管理400+模型

LEVEL6FORECASTS > IMPORT MODELS

Source Name: TSMocks

Name Pattern: *
All
All Versions

Select Unselect

Selected models: 69 / 69

Previous Next

	Model Name	Model Type	Creator	Version	Version Count	Creation Date	Description
<input checked="" type="checkbox"/>	ATT EDGE	Kien.TimeSeries		1	1	2015-06-17 22:31:39	The model ATT EDGE has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	AU_COM_NSW_PL_TAM_TM	Kien.TimeSeries		1	2	2015-06-17 19:51:33	The model AU_COM_NSW_PL_TAM_TM has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	AU_COM_NSW_PL_TAM_TM	Kien.TimeSeries		2	2	2015-06-17 20:01:01	The model AU_COM_NSW_PL_TAM_TM has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	AU_P9_VIC_STATE_GOV_TM	Kien.TimeSeries		1	1	2015-06-17 21:55:48	The model AU_P9_VIC_STATE_GOV_TM has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	AU_TELSTRA_TM	Kien.TimeSeries		1	1	2015-06-17 20:38:41	The model AU_TELSTRA_TM has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	Alaska PS Northwest Select 6	Kien.TimeSeries		1	1	2015-06-17 21:44:37	The model Alaska PS Northwest Select 6 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	Atlanta Select 6	Kien.TimeSeries		1	1	2015-08-17 20:21:51	The model Atlanta Select 6 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	BAKER HUGHES	Kien.TimeSeries		1	1	2015-08-17 22:29:58	The model BAKER HUGHES has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	BER-KY PL NO NAMED	Kien.TimeSeries		1	1	2015-08-17 22:21:19	The model BER-KY PL NO NAMED has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	CAN CENTRAL PS NORTH	Kien.TimeSeries		1	1	2015-08-17 22:18:46	The model CAN CENTRAL PS NORTH has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	CAN MANAGED SERVICE POOL	Kien.TimeSeries		1	1	2015-08-17 23:05:33	The model CAN MANAGED SERVICE POOL has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	CGAR 1	Kien.TimeSeries		1	1	2015-08-17 22:28:00	The model CGAR 1 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	COL-ENT ENERGY MATERIAL	Kien.TimeSeries		1	1	2015-08-17 21:52:16	The model COL-ENT ENERGY MATERIAL has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	CROATIA_COM_PL	Kien.TimeSeries		1	1	2015-08-17 21:27:41	The model CROATIA_COM_PL has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	CBC2_	Kien.TimeSeries		1	1	2015-08-17 21:29:35	The model CBC2_ has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	Carolinus Select 6	Kien.TimeSeries		1	1	2015-08-17 20:06:42	The model Carolinus Select 6 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	Charter Region	Kien.TimeSeries		1	1	2015-08-17 20:43:48	The model Charter Region has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	EC PL NO NAMED	Kien.TimeSeries		1	1	2015-08-17 21:12:14	The model EC PL NO NAMED has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	ENT-GER-SOUTH-1-WINBACK	Kien.TimeSeries		1	1	2015-08-17 21:26:19	The model ENT-GER-SOUTH-1-WINBACK has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	FED-DEFENSE AGENCIES REG	Kien.TimeSeries		1	1	2015-08-17 20:41:44	The model FED-DEFENSE AGENCIES REG has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	Florida Select 6	Kien.TimeSeries		1	1	2015-08-17 20:15:26	The model Florida Select 6 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	GER-T1-SA-VW	Kien.TimeSeries		1	1	2015-08-17 22:14:15	The model GER-T1-SA-VW has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	GER_CENTRAL_CL1	Kien.TimeSeries		1	1	2015-08-17 20:55:48	The model GER_CENTRAL_CL1 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	GER_SOUTH_CL3	Kien.TimeSeries		1	1	2015-08-17 21:07:02	The model GER_SOUTH_CL3 has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]
<input checked="" type="checkbox"/>	GREECE-PL-CL	Kien.TimeSeries		1	1	2015-08-17 21:39:41	The model GREECE-PL-CL has been saved [E:\iscs\Production\Scripts\TimeSeriesTraining_AA.ios]

Previous Next

依据新数据是否存在偏差
设置模型应用规则

Define when the Task must be Executed

☒ Notify me when the task has executed

☐ Execute Once

☐ Execute n Times

☐ Execute n Times with User Defined Reference Dates
This schedule cannot be used when generation mode is: Generate a Single Table and apply out over

☐ Execute on Predefined Schedule

☐ Execute after Another Task

☒ Execute after an Event

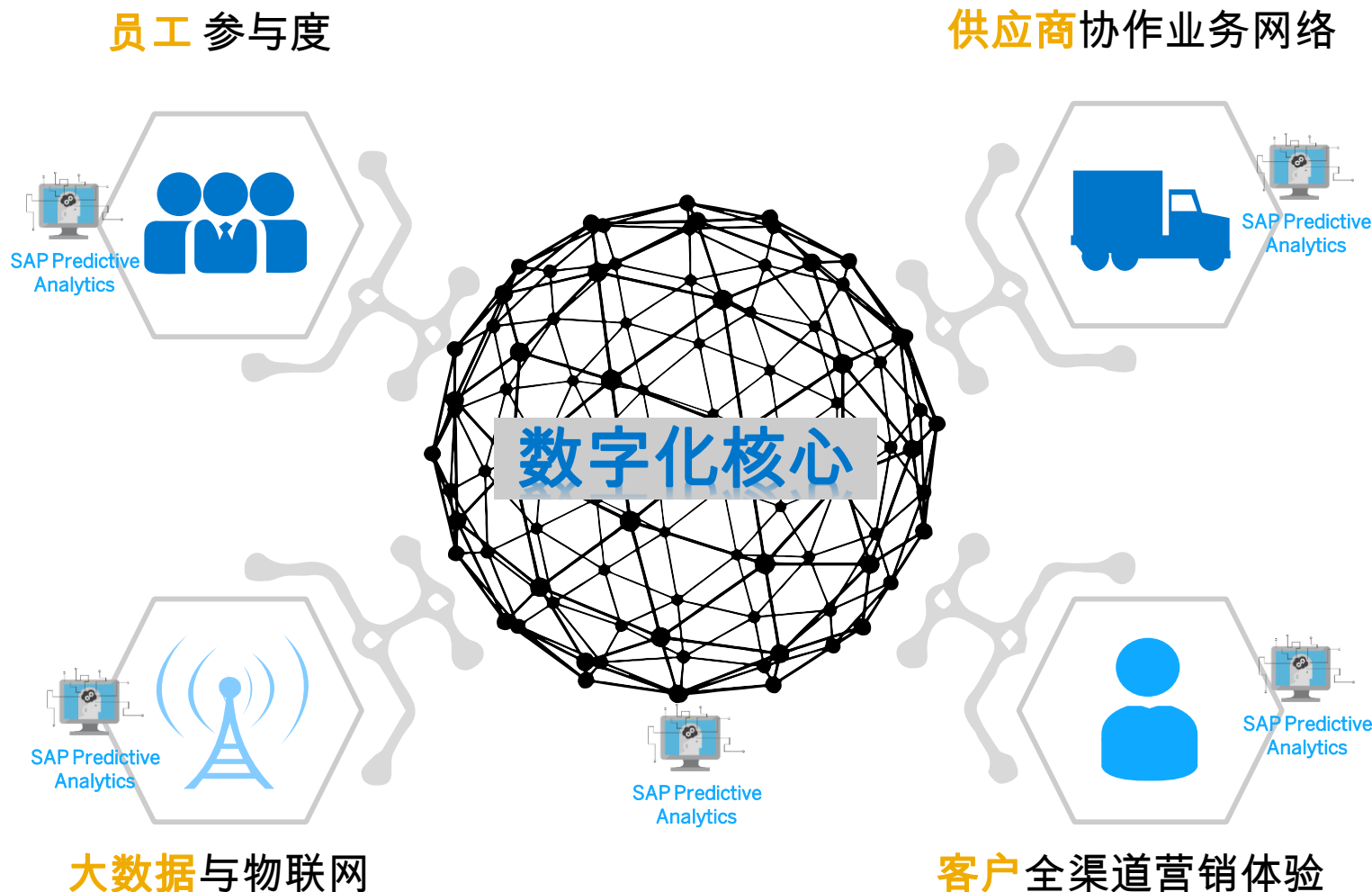
Event: No Deviation Task Name: PRDG-REB-SWEDEN-PS Deviation

SAP 预测分析 全程参与 企业数字化转型

在数字化核心的基础上将整个价值链数字化作为业务创新与最佳化平台

数字化企业连接各个价值链以实时推动和预测业务成果

各行业中的企业都可通过完全重构商业模式、业务流程与工作引领数字化转型。





企业数字化转型，从预测分析开始！





Thank you

Contact information:

F name L name

Title

Address

Phone number

F name L name

Title

Address

Phone number