Predictive Maintenance for Effective Asset Management

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FAQs

- Is this session being recorded? Yes
- Can I get a copy of the slides? Yes, we'll email a PDF copy to you after the session has ended.
- Can we arrange a re-run for colleagues? Yes, just ask us.
- How can I ask questions? All lines are muted so please use the chat facility – if we run out of time we will follow up with you.

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Predictive Analytics for Smarter Business

Premier Business Partner IBM

- Premium, accredited partner to IBM specialising in the SPSS Advanced Analytics suite.
- Team each has 15 to 20 years of experience working in the predictive analytic space - specifically as senior members of the heritage SPSS team

What do we mean by ‘Predictive Analytics’?

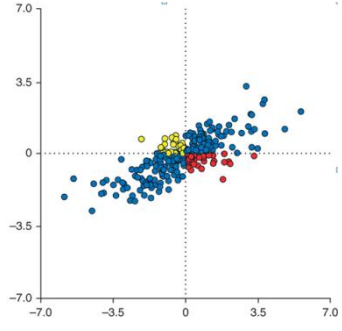
Predictive analytics encompasses a variety of techniques from statistics and data mining that analyze current and historical data to make predictions about future events

IBM

Analysis of structured and unstructured information with mining, predictive modeling, and 'what-if' scenario analysis.

What do we mean by ‘Predictive Analytics’?

- It’s different from Business Intelligence or MI reporting
- Actually, it’s not *always* about prediction
- However, Predictive Analytics *does* creates important new data
- These data take the form of estimates, probabilities, forecasts, recommendations, propensity scores, classifications or likelihood values
- Which in turn can be incorporated into key operational and/or insight systems



Predictive Analytics applied to Asset Management

- Core Capability of Predictive Asset Maintenance Programmes
- Used in multiple industries to reduce costs and maintain uptime
- A strongly *data-driven* approach

Effective Predictive Maintenance Applications…

Environmental

- Weather Conditions
- Ambient Temperature

Interaction

- Maintenance History
- Notes from inspection
- Customer Feedback

Assets

- Machine
- Material
- Age

Behavioural

- Telemetry
- Alarms
- Events (Failure ,Faults)

Utilise historical data from multiple sources…

Effective Predictive Maintenance Applications…

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- Age

Behavioural

- Telemetry
- Alarms
- Events (Failure ,Faults)

…to build accurate, testable predictive models…

Effective Predictive Maintenance Applications…

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- Weather Conditions
- Ambient Temperature

Interaction

- Maintenance History
- Notes from inspection
- Customer Feedback

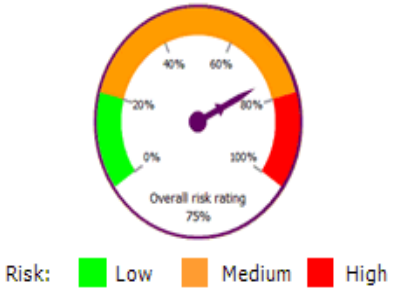
Assets

- Machine
- Material
- Age

Behavioural

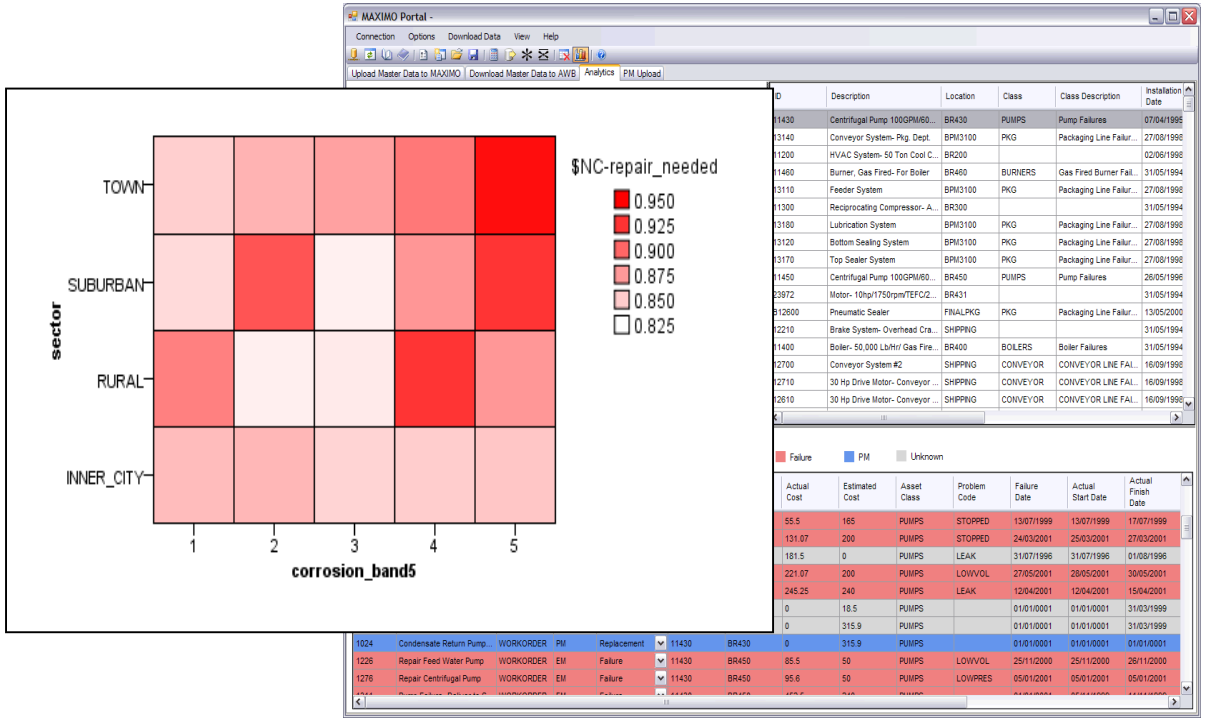
- Telemetry
- Alarms
- Events (Failure ,Faults)

…to generate predictions and risk scores ….



Effective Predictive Maintenance Applications…

…to deploy these scores into operational systems and other insight/reporting platforms



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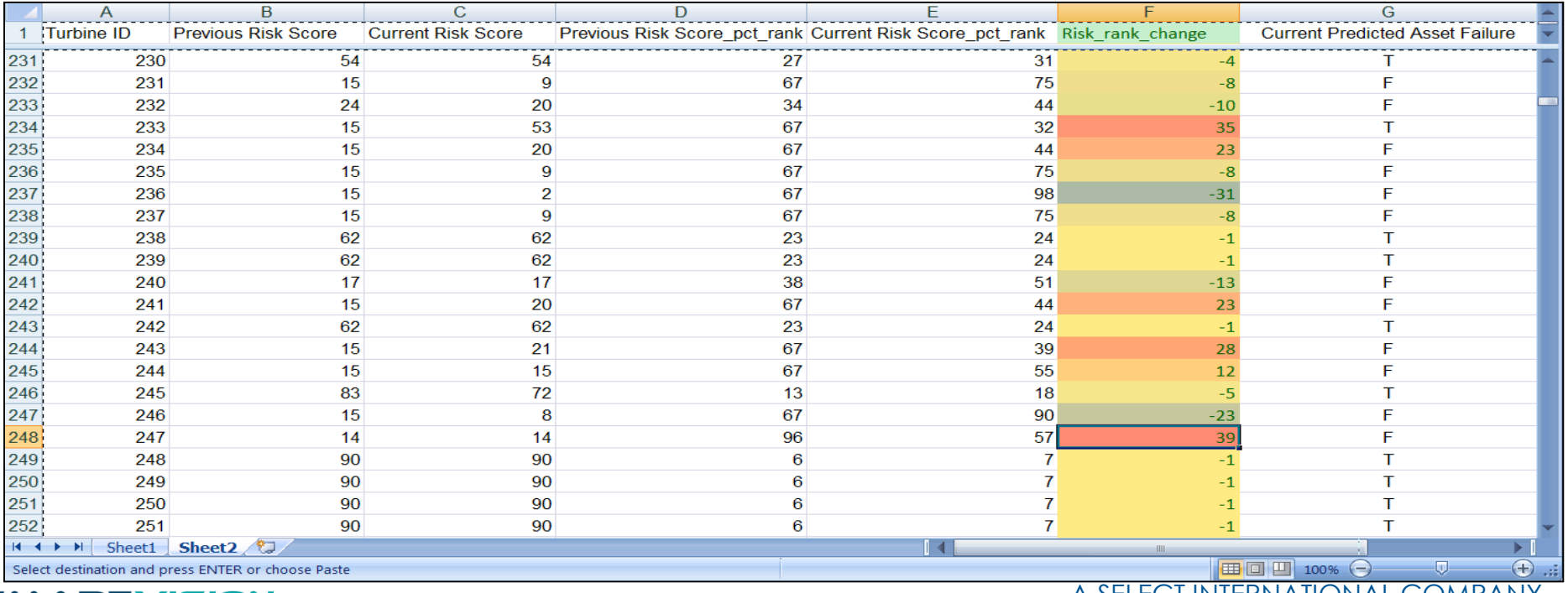
Effective Predictive Maintenance Applications…

…to make smarter asset management decisions



	A	B	C	D	E	F	G
1	Turbine ID	Previous Risk Score	Current Risk Score	Previous Risk Score_pct_rank	Current Risk Score_pct_rank	Risk_rank_change	Current Predicted Asset Failure
231	230	54	54	27	31	-4	T
232	231	15	9	67	75	-8	F
233	232	24	20	34	44	-10	F
234	233	15	53	67	32	35	T
235	234	15	20	67	44	23	F
236	235	15	9	67	75	-8	F
237	236	15	2	67	98	-31	F
238	237	15	9	67	75	-8	F
239	238	62	62	23	24	-1	T
240	239	62	62	23	24	-1	T
241	240	17	17	38	51	-13	F
242	241	15	20	67	44	23	F
243	242	62	62	23	24	-1	T
244	243	15	21	67	39	28	F
245	244	15	15	67	55	12	F
246	245	83	72	13	18	-5	T
247	246	15	8	67	90	-23	F
248	247	14	14	96	57	39	F
249	248	90	90	6	7	-1	T
250	249	90	90	6	7	-1	T
251	250	90	90	6	7	-1	T
252	251	90	90	6	7	-1	T

Israel Electric Corporation

- **Using advanced modelling techniques to identify root causes and predict failures before they happen.**
- Israel Electric Corporation (IEC) generates 95 % of Israel's electricity. IEC uses SPSS Predictive Maintenance to model the behaviour of its turbines and monitor their performance
- Estimated to reduce costs by up to 20 % by avoiding the need to restart turbines after an outage – an expensive process.
- Saved approximately $75,000 in fuel costs per turbine by identifying inefficient fuel usage.
- Increased the efficiency of maintenance schedules, costs and resources, resulting in fewer outages and higher customer satisfaction.
- Provides *early warning of certain types of failure* up to 30 hours before they occur.

DC water

- **Using advanced modelling techniques to identify root causes and predict failures before they happen.**
- 36 % reduction in customer calls through increased preventive maintenance and implementation of automated meter readings
- Increased % of emergency investigations dispatched within 10 minutes from 49% to 93 %
- Ability to generate reports for regulatory compliance and management review in seconds versus days
- Significant reduction in asset downtime

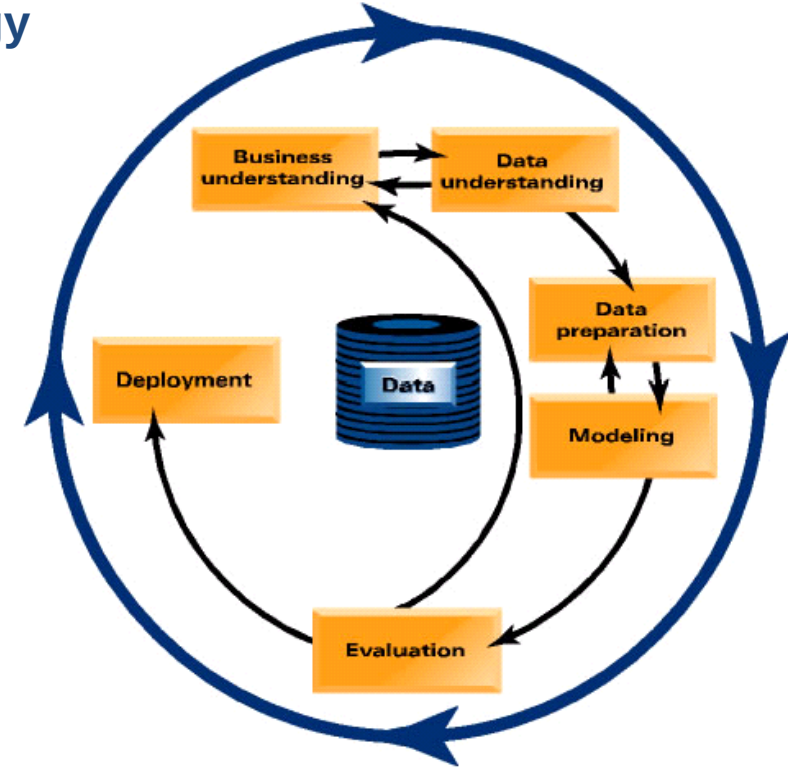
aqualia

- **Aqualia needed to accurately forecast water consumption for its agricultural, industrial and consumer customers in more than 450 municipalities across Spain at regional and national levels.**
- **Existing processes lacked the capability to provide insight into common usage patterns and causes for fluctuations in consumption**
- Improved water distribution for 450 municipalities by 100 %
- Reduced the prediction error for future water consumption to around 4 to 5 % through precise analytical modelling
- Accelerates the process for predicting national water consumption by 99 %—from a month to 30 minutes—by automating data aggregation and implementing sophisticated modelling

What are the common ingredients of successful applications?

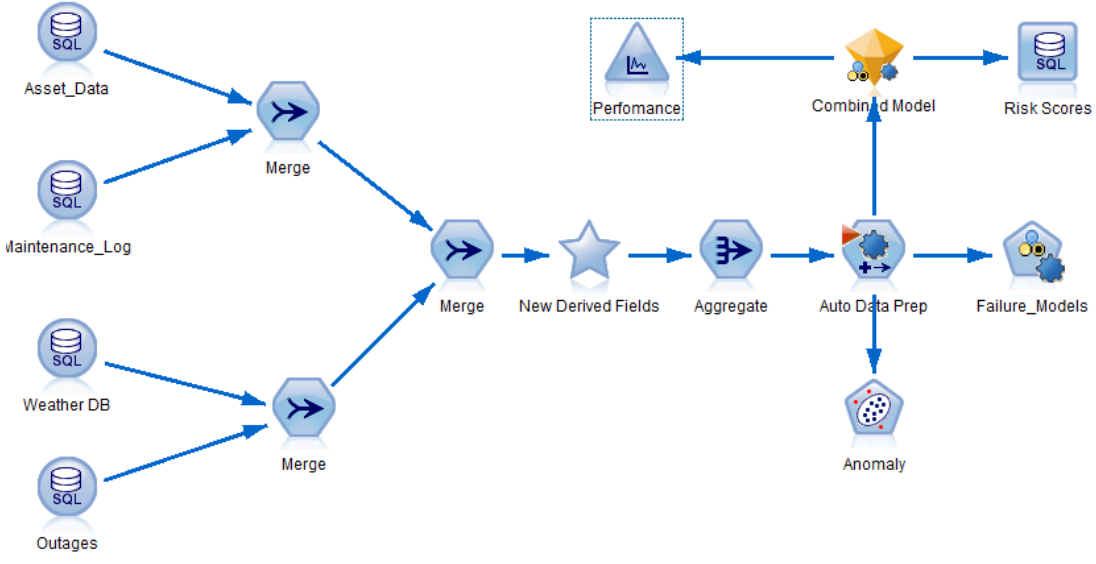
Utilising a powerful, proven methodology

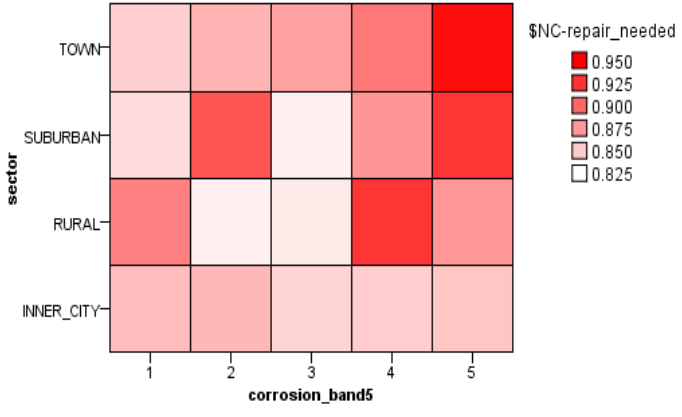
- CRISP-DM: Cross Industry Standard Process for Data Mining



What are the common ingredients of successful applications?

Using powerful, intuitive advanced analytics technology





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What are the common ingredients of successful applications?

Integrating the resultant insight with existing systems

Cognos. software

infosphere™

WebSphere

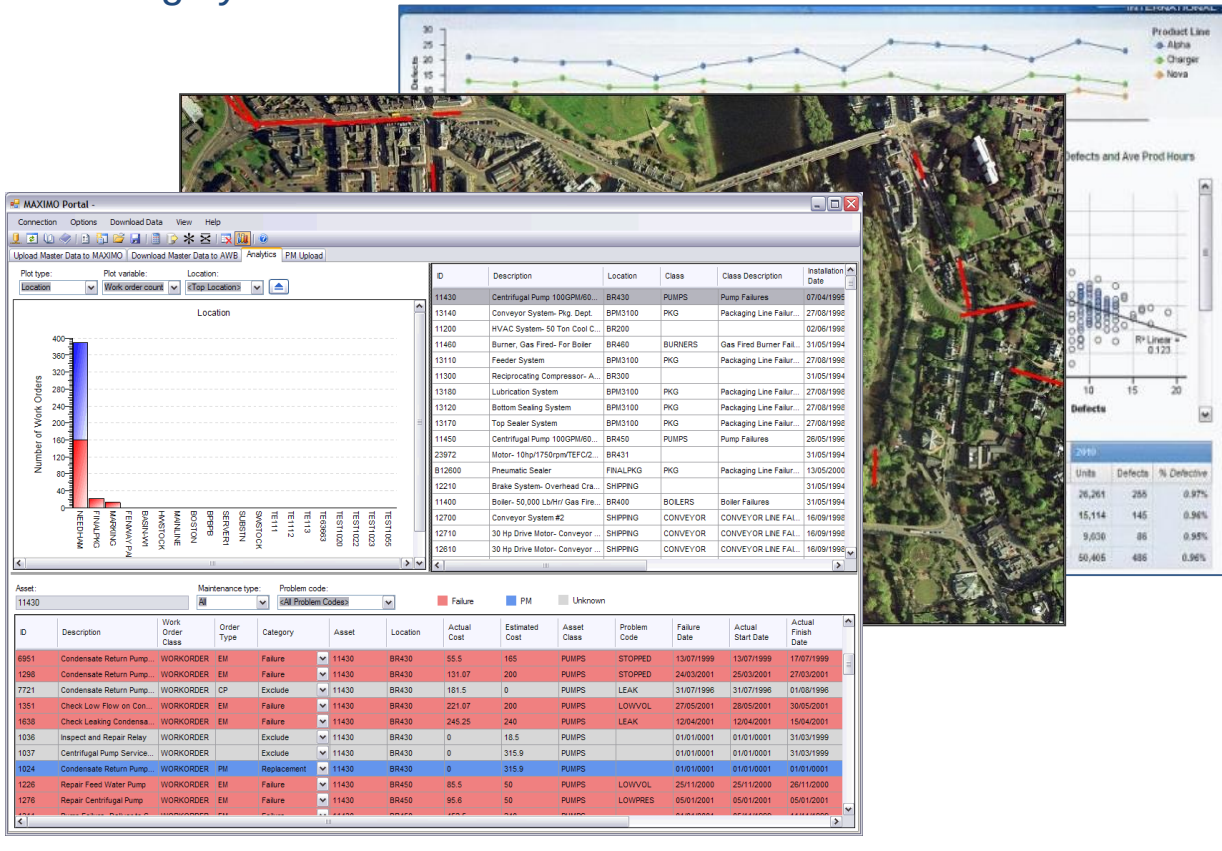
SPSS

NETEZZA

ILOG
Changing the rules of business®

maximo

COREMETRICS



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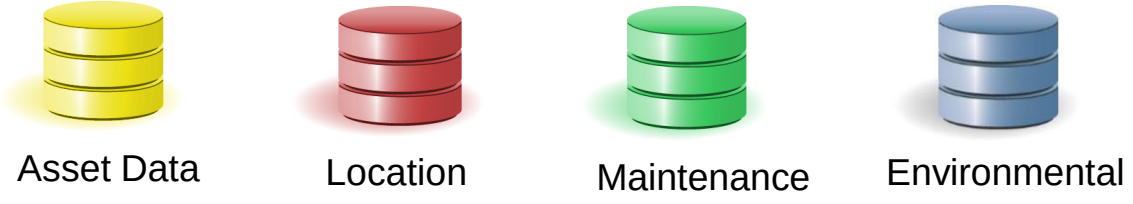
What are the common ingredients of successful applications?

Exploiting *multiple* data sources

- Fixed attributes
  - Asset Data
  - Location data
  - Age
  - Specification
- Dynamic attributes
  - Maintenance History
  - Inspection History
  - Asset replacements
  - Maintenance reports (free text)
  - Recent Weather



Consolidate the data that seems most relevant to the application

Asset Register

Meteorological/Location Data

Maintenance History

Load/Monitoring Data

Field	Sample Graph	Measurement	Min	Max	Mean	Std. Dev	Skewness	Unique	Valid
Month recorded		Nominal	--	--	--	--	--	12	3660
Section		Continuous	2.000	4866.000	2433.925	1420.193	-0.002	--	3660
Zone		Nominal	--	--	--	--	--	4	3660
Previous Over current Trips		Continuous	0.000	13.000	0.725	1.484	3.131	--	3660
Lubrication Type		Continuous	0.000	21.000	0.238	1.120	8.734	--	3660
New Seal		Continuous	0.000	15.000	0.841	1.358	2.658	--	3660
Planned shutdowns		Continuous	0.000	30.000	2.069	2.910	2.476	--	3660
Average RPM		Continuous	0.000	20195.000	3815.406	2397.339	0.815	--	3660
Asset Age Score		Continuous	0.000	1458.000	170.622	224.106	2.138	--	3660
Average Vibration Score		Continuous	0.000	1613.000	359.111	293.049	1.019	--	3660
Torque_rating		Continuous	0.000	73.000	3.451	5.020	3.046	--	3660
Bearing Weight Score		Continuous	0.000	653.000	53.145	81.452	3.097	--	3660
Insulation Rating		Continuous	0.000	327.000	65.013	46.979	0.909	--	3660
Fatigue Score		Continuous	0.000	35.114	4.797	7.747	1.657	--	3660
Asset Failure		Flag	--	--	--	--	--	2	3660
Temperature_Class_One_Week_Before		Nominal	--	--	--	--	--	4	3660
Average Pressure Score		Continuous	5.615	42.692	17.248	6.957	0.686	--	3660

¹ Indicates a multimode result ² Indicates a sampled result

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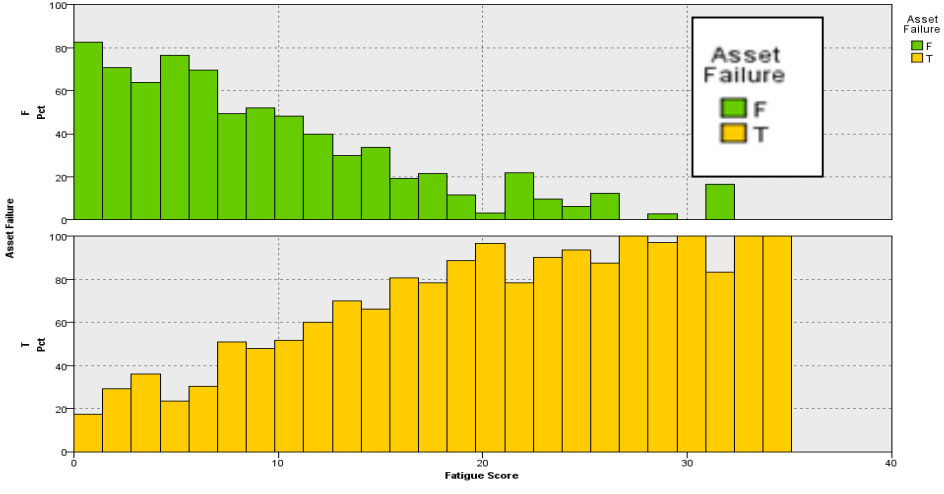
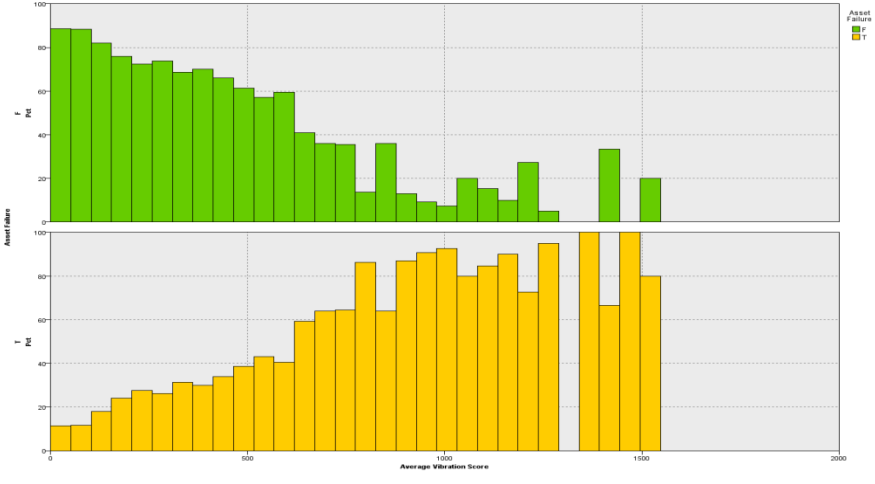
Visualise the data and identify potential predictive indicators

- **Corrosion/Fatigue Score**
- Higher the degree of corrosion
- Higher the risk of asset failure



- **Average Gas Pressure Score**
- Lower the sustained pressure score
- Higher the risk of failure/discharge



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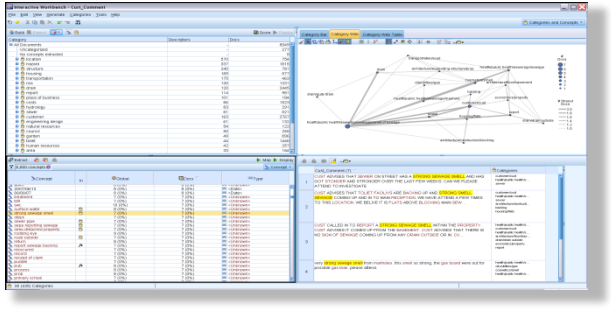
Don't ignore unstructured data

Text mining produces *structured data from unstructured:*

example from Water Industry



- "Tried to clear but they reckon its on the main sewer line - causing backup inside toilet - neighbour across the back has been having similar problems and we found a blockage on the main - can we check?"

Text mining gives

- Main sewer
- Backup
- Blockage

- "Possible discharge of cooking fat from lateral into main sewer as there is a block outside the takeaway."

Text mining gives

- Fat problem
- Lateral sewer
- Property type

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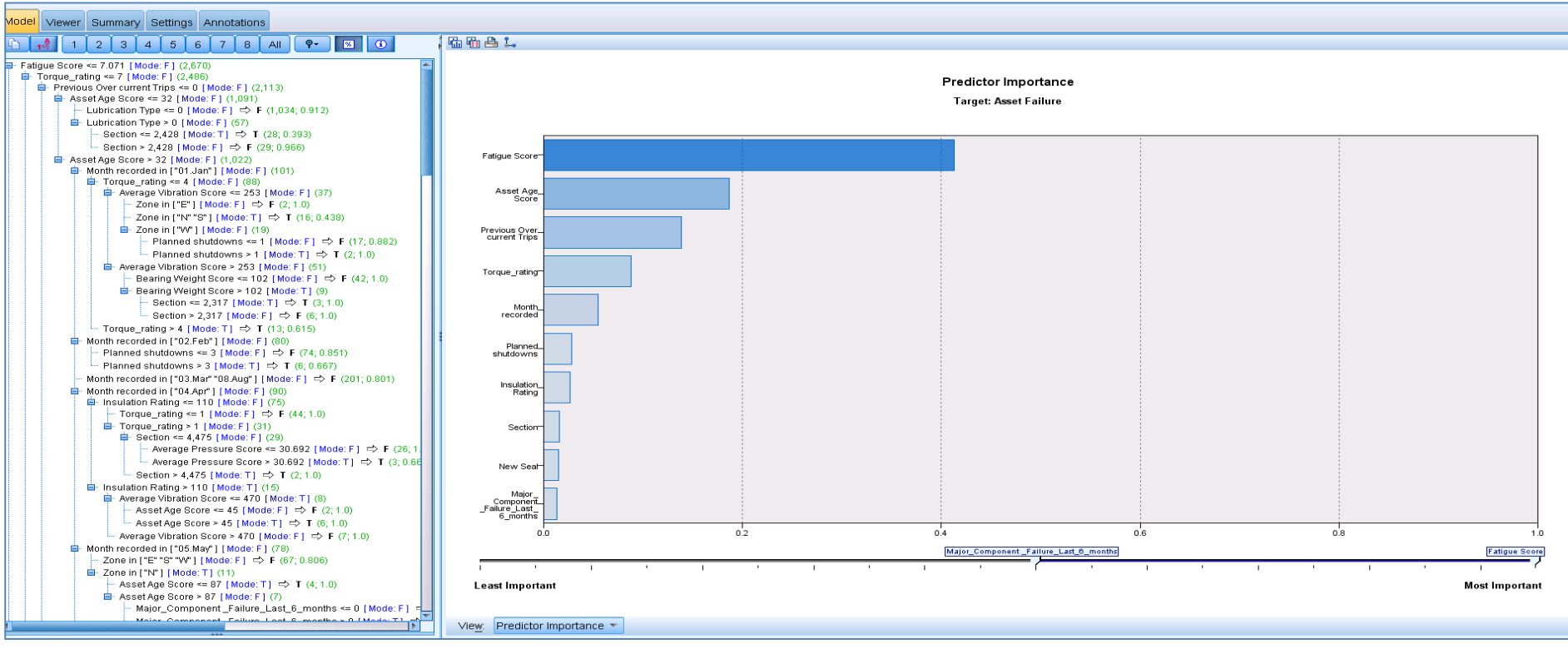
Make sure the model makes sense



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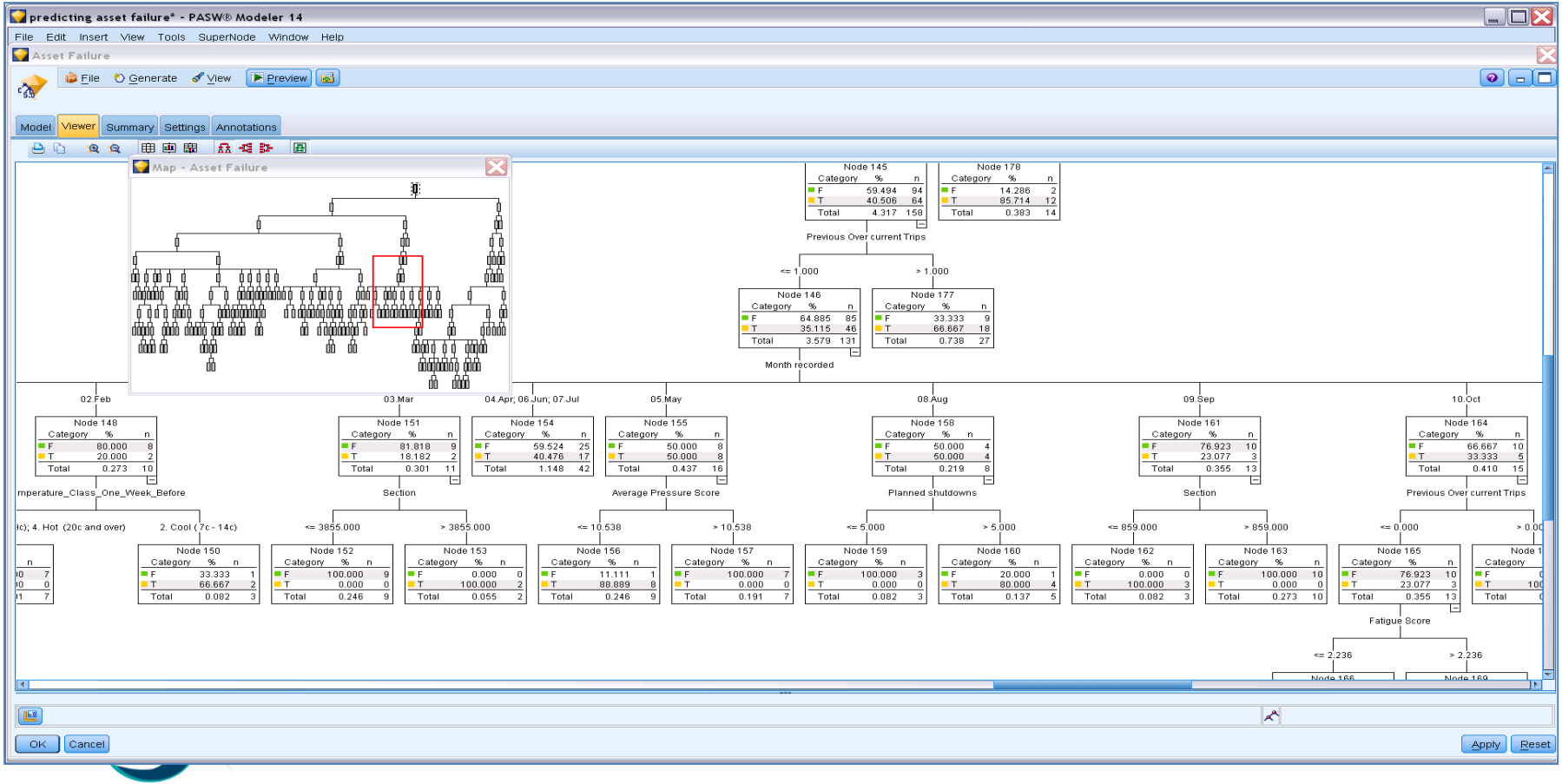
Example of an actual reusable predictive model



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Model Evaluation: what does 'success' look like?

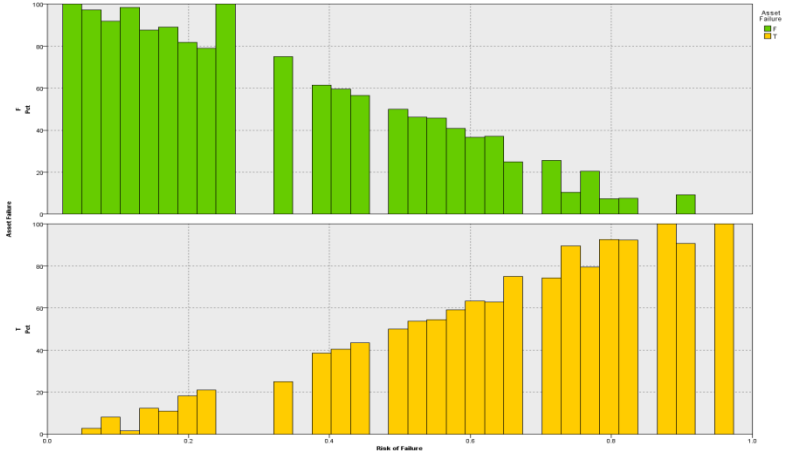
Results for output field Asset Failure

Comparing $C-Asset Failure with Asset Failure

Correct	3,079	84.13%
Wrong	581	15.87%
Total	3,660	

Coincidence Matrix for $C-Asset Failure (rows show actuals)

	F	T
F	2,067	363
T	218	1,012



Model Classification

- 84% accuracy in predicting asset failure
- Chart shows strong correlation between estimated risk of failure and actual failures

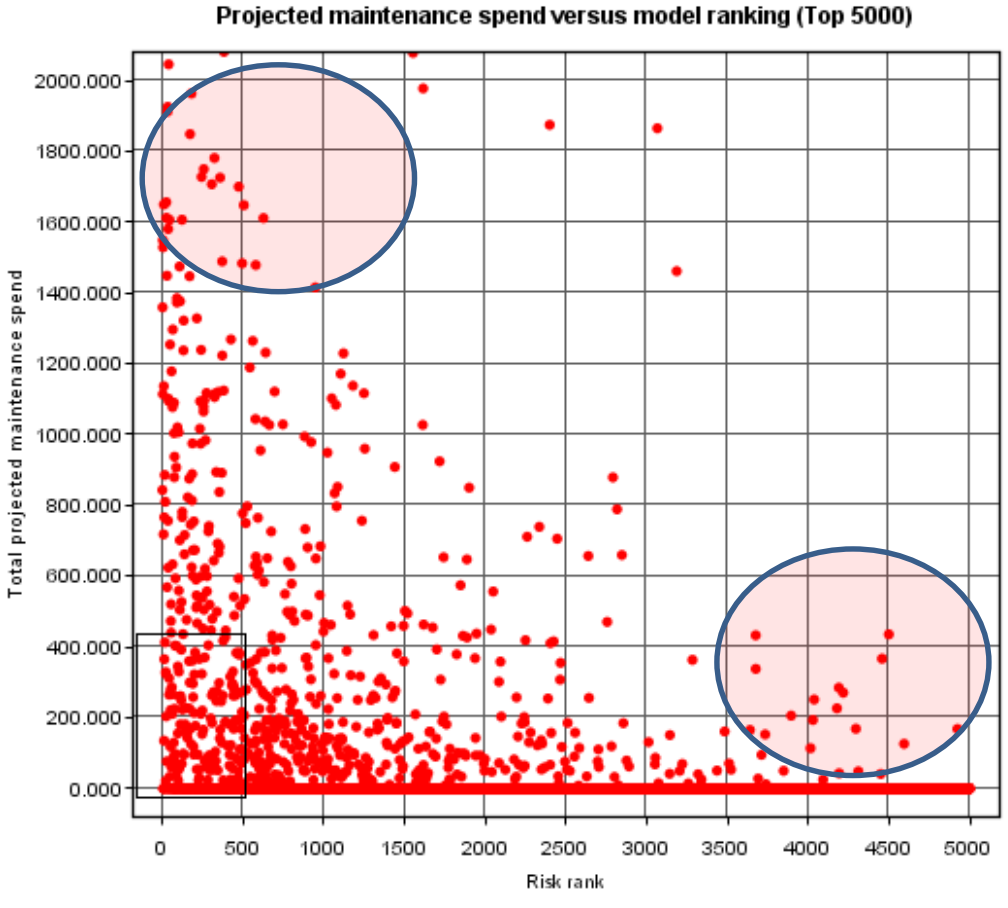
What does 'Deployment' look like?

- Assets in red have a high risk profile but no previous issues

Ranking	Asset information		Prioritisation of siltation			History of incidents				Recency		
Ranking	Asset id	Type of asset	Likelihood of siltation	Consequence	Total Risk - Siltation	Pollution Count	Internal Count	External Count	Back Up Count	Last reported siltation issue	Estimated siltation frequency (months)	Number of historic reported issues
1	43723952	Main	0.64	107.1	**68.8**	0	21	2	0	17/12/2007	4	8
2	101405798	Main	0.99	56.3	**55.7**	0	11	0	0	13/12/2006	8	2
3	78583469	Main	0.97	55.1	**53.5**	0	11	0	0	06/02/2007	8	3
4	43804534	Main	0.80	55.1	**44.0**	0	11	0	0	22/04/2006	8	3
5	APKUHQ8H5CL44HU083_lat	Public lateral	0.65	66.0	**43.1**	2	11	1	0	22/01/2005		1
6	43724270	Main	0.74	58.1	**42.9**	0	11	3	0			0
7	AP203W8M5Y153GCGNM_lat	Public lateral	0.78	55.0	**42.7**	7	9	1	0	12/09/2007	32	2
8	APPMB88Q5MP44WU02H_lat	Public lateral	0.45	94.0	**42.5**	0	18	0	0	09/08/2007	1	7
9	APE4AA8W5Y442TW075_lat	Public lateral	0.77	54.0	**41.7**	0	10	0	0	20/08/2006	12	3
10	APF4E98W5R044KTGLR_lat	Public lateral	0.74	55.0	**40.9**	1	10	1	0			0
11	43724570	Main	0.96	41.1	**39.6**	0	8	1	0			0
12	APM1HT8H53E43GU0Q0_lat	Public lateral	0.79	50.0	**39.3**	0	9	1	0			0
13	AP58F18C5B955LE0WX_lat	Public lateral	0.41	94.0	**38.4**	0	18	0	0	23/02/2007	4	6
14	APXR988M5Y8420T0GM_lat	Public lateral	0.77	49.0	**37.8**	0	9	0	0	02/11/2006	10	3
15	APJVEC8R5L04YCUGYH_drain	Private drain	0.80	46.0	**37.0**	0	6	0	6			0
16	43723196	Main	0.71	50.1	**35.4**	0	10	0	0			0
17	APNV9L8M5TL427T0YM_lat	Public lateral	0.39	90.0	**35.3**	0	17	1	0	08/05/2007	1	7
18	AP7VG38R6R14A6W0NG_lat	Public lateral	0.79	44.0	**34.6**	0	8	0	0			0
19	44051115	Main	0.76	45.1	**34.4**	0	9	0	0	05/11/2007	10	4
20	APKQEV8R56K437TGQH_lat	Public lateral	0.79	42.9	**33.7**	1	7	0	0	06/08/2007	11	4

Model Scores Open New Doors of Insight

- Risk becomes a new *dynamic* metric
- Risk can be viewed in terms of –
  - Projected Spend
  - Asset Value
  - Failure Consequence
  - Maintenance Cost



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Quick Demo?

What does good practice look like?

1. Make explicit use of an established methodology (e.g. CRISP-DM)
2. Focus on specific issues/failures with specific asset types
3. Work with subject-matter experts to identify useful data sources (e.g. telemetry, maintenance history, inspection reports, meteorological)
4. Leave plenty of time for data consolidation and preparation
5. Evaluate the resultant models in terms of predetermined success criteria
6. Focus on the most effective methods of deployment (asset management platform, live telemetry, workforce management systems, GIS, MI/BI platforms)
7. Always quantify the benefits.

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- We are a support providing partner so if you already have SPSS you can source your technical support directly from us (identical costs to IBM)
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