Predictive Machine Maintenance Project (systemRx)

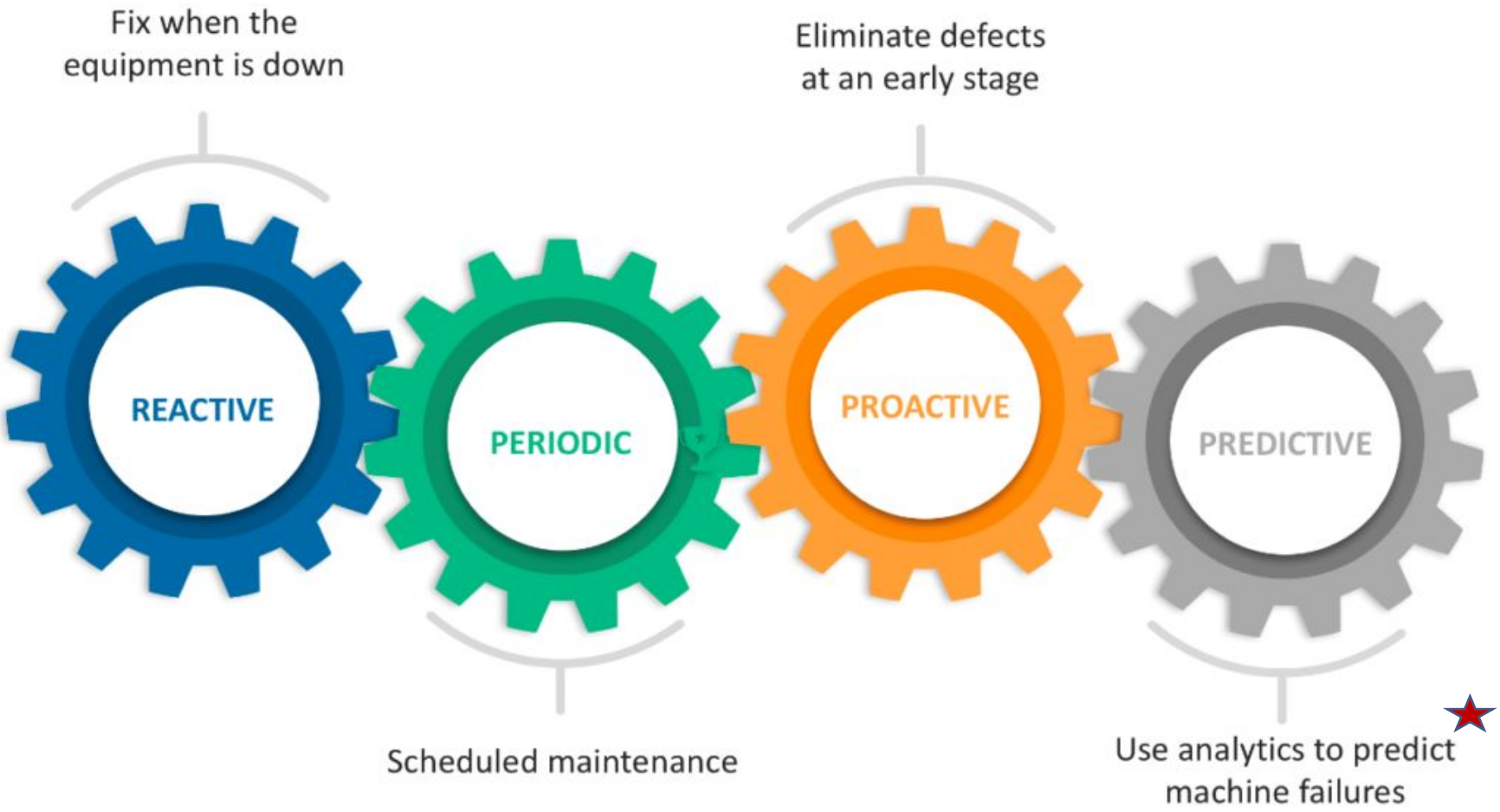

Image Source: digitaldoughnut.com

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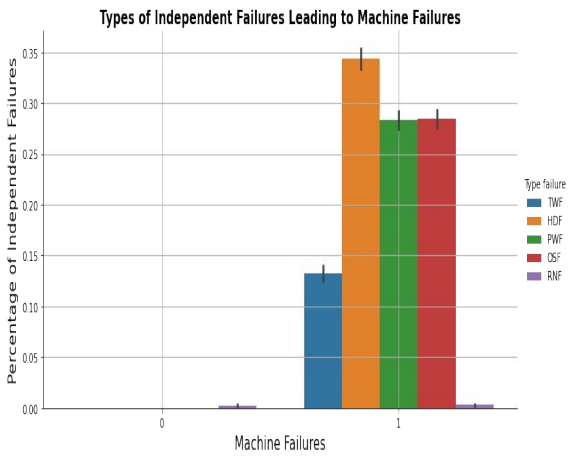
June 2022

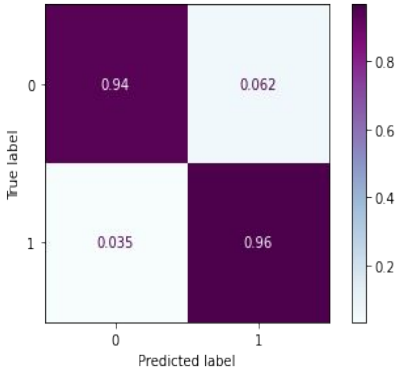
Predictive Machine Maintenance Project (systemRx)

Objective

- Develop a modeling tool that accurately predicts the percent likelihood of machine failure. If possible, identify common contributors to machine failure to minimize equipment downtime and maintenance costs.
- Prediction performance goals: >90% correct positive predictions, < 5% for false negative predictions
- Technology & tools: predictive maintenance (pDm) dataset (synthetic) of 10K rows, data analytics

Visualizations





Model 'Problem-Solving' Value

Strengths:

- Potential increase in Mean Time Between Failure
- Potential decrease in maintenance & labor costs
- Potential reduction in single point of failure leveraging digital monitoring / sensor data collection

Limitations:

- Limited public availability for predictive maintenance data to re-train model
- Must delete independent failure features/columns to focus on ONE target prediction, machine failure
- Must correct imbalance datasets to ensure quality model performance (e.g., balanced dataset improved performance by **31%!!**)

Recommendations

1) Focus initial maintenance tasks on highest percentage causes for machine failures

2) Migrate from scheduled maintenance culture to formal condition monitoring program

- Identify & collect machine data on critical assets (e.g., safety and revenue loss focus)
- Determine what typically goes wrong on machines that cause failures (e.g., 34% heat dissipation (HDF), 28% power failures (PWF) for this dataset)
- Consider altering testing frequency between degraded machine operation and breakdown

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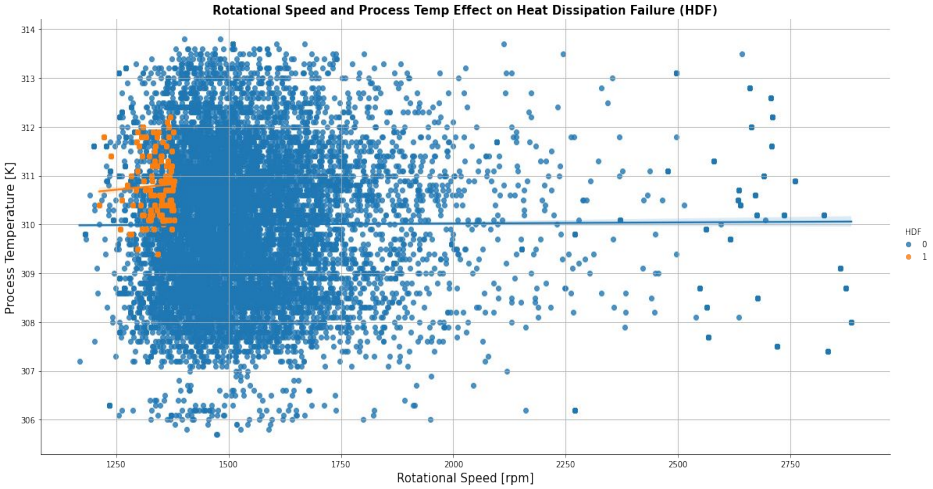
Backup - More systemRx Visualizations

Classification Metrics for Confusion Matrix (Slide 2)

Classification Reporting for Test Set (XGB):

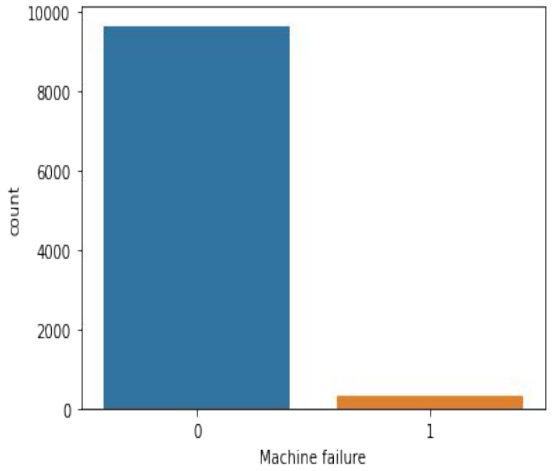
	precision	recall	f1-score	support
0	0.96	0.94	0.95	2405
1	0.94	0.96	0.95	2426
accuracy			0.95	4831
macro avg	0.95	0.95	0.95	4831
weighted avg	0.95	0.95	0.95	4831

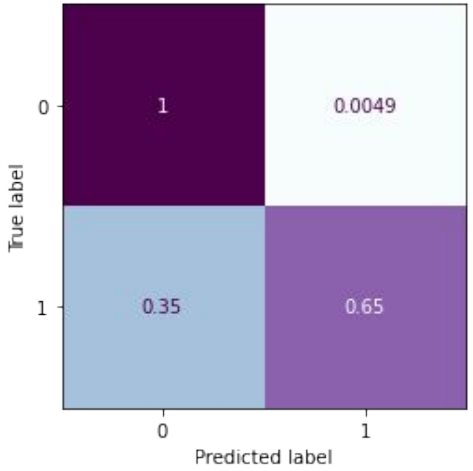
Heat Dissipation Failure - Feature Analysis



Imbalanced Data & Model Performance

Imbalanced datasets cause model predictions to be *skewed* in favor of the majority class versus the minority class (target). The prediction accuracy is 99% but of ZERO analysis value! You MUST correct the data imbalance and re-train the model to improve performance quality and ensure its value to stakeholders.





Classification Reporting for Test Set (XGB):

	precision	recall	f1-score	support
0	0.99	1.00	0.99	2428
1	0.80	0.65	0.72	72
accuracy			0.99	2500
macro avg	0.89	0.82	0.85	2500
weighted avg	0.98	0.99	0.98	2500

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