Predictive Maintenance Solutions
How Neal Meets Your Resourcing Needs

**Talent Services**

**Right Resources, right now**

Our services include sourcing, paid advertising, screening, interviewing, and reference checking. We partner with our clients to understand their core business objectives so that we can align the right resource plan.

**Result:**
Best resource delivered on time in the right model.

**Time & Materials**

Hourly resources staffed to resolve a problem with a time commitment and hourly rate.

**Project-Based**

Fixed deliverable schedule with resourcing determined by Neal Analytics to best fit the project.

**Reserved Teams**

Retained team of dedicated size with flexible skills sets available to adjust to workstreams.

**Talent Focus**

**Technology Expertise**
- Azure Developers & Architects
- Azure Data Scientists & Quants
- Business Analysts & PMs
- App Dev/Test
- BI and Reporting
- Cloud Marketers
- Tech Recruiters
- UI / UX Designers
- Systems Admins / Infosec

**Non-Technology Expertise**
- Project and Program Managers
- Management Consulting
Value Chain for Delivering Analytics Insights and Automation

1. Opportunity Discovery
2. Data Pipeline Management
3. Model Creation
4. Reporting and Embedding
5. Operationalization
6. Evaluation, Decision & Action

- Business Analyst
- Cloud and Data Architect
- Project Manager
  - Database Administrator
  - Data Engineer
  - Database Developer
  - Data Scientist
- App Developer
- IT Systems Admin
- Platform Engineer

Customer business end-user
Customer Subject Matter Expert/End user
Data Estate Modernization

Assess

Business Scenarios & Platform Deployment
- Analyze Capabilities, Data/App Landscape
- Rationalize Sources, App Lifecycle, Tools
- Prioritize Enterprise Architecture, Initiatives
- Advise on Best Practices, Resources & Budgets

Implement

Develop Cloud App and Data Infrastructure
Deploy Sandboxes for quick win Use Cases
Implement Adjusted Workflows and Train
Iterate as new Insights Influence the Roadmap

Re-Architect

Elevate Services
- Rehost Workloads and Apps in the Cloud
- ReArchitect Services for Leaner Operation
- Deprecate defunct tools and processes
- Validate performance gains and test features

Operationalize

Leverage data models built with analytics and data science in mind
Enhance existing reporting capabilities
Manage enterprise grade analytics with the support of experts

Innovate

Apps, BI & AI
- Accelerate time to value with our leading analytics solutions
- Automate existing data flows with cognitive services and AI
- Differentiate from the competition

Enterprise Project Management Organization
Digital Transformation Management Consulting
Security and Data Governance Compliance
Developing A Data Estate Modernization Roadmap

**Assess**
- Application & Data Inventory
  - Assessment
    - Strategy
      - Workshop with key stakeholders
      - Application portfolio
      - Data landscape inventory
  - Analyze
    - Portfolio Prioritization
    - Financial Justification
    - Benchmarking & Testing
  - Prioritize
    - Remediation
    - Upgrade
    - Enhancement
  - Rationalize
    - Risk Identification
    - Operational Process Mapping
    - Technology & Architecture
  - Advise
    - Vendor Consolidation
    - Mergers & Acquisition
    - Outsourcing
    - Licensing

**Implement**
- Application & Data Inventory
  - Assessment
  - Analyze
  - Prioritize
  - Rationalize
  - Advise
  - Application portfolio analysis and cloud assessment
  - Rationalization of priorities
  - Leveled per app / data source assessment

**Re-Architect**
- Upgrade
- Migrate
- Enhance
- Consolidate
- Remediating
- Re-Architect
- Operationalize
- Decommission

**Operationalize**
- Architectural Recommendations
- Application & Data Service Roadmap V1
- Master Data Management, Data Governance, and Security Analysis
- On Prem.
- IaaS
- PaaS
- SaaS

**Innovate**
- Final roadmap & reference architecture
- Business case justification & ROI for Deployments

**Presentation**
- Business Case
- Deployment Roadmap
- Finance
- Sales
- Ops

**Activities**
- Application & Data Inventory
  - Assessment
    - Strategy
      - Workshop with key stakeholders
      - Application portfolio
      - Data landscape inventory
  - Analyze
  - Prioritize
  - Rationalize
  - Advise
  - Application portfolio analysis and cloud assessment
  - Rationalization of priorities
  - Leveled per app / data source assessment

**Deliverables**
- Architectural Recommendations
- Application & Data Service Roadmap V1
- Master Data Management, Data Governance, and Security Analysis
- On Prem.
- IaaS
- PaaS
- SaaS
Example PMO Assessment Deliverables

Onsite Workshop

Data Strategy Workshop

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Tuesday</td>
<td>Wednesday</td>
</tr>
<tr>
<td>Infrastructure Assessment</td>
<td>Project Kickoff, Introduction to infrastructure</td>
<td>Infrastructure Roadmap, Planning, and Development, Infrastructure Development, and sprint reviews</td>
</tr>
</tbody>
</table>

You need to bring:
- Business Stakeholders
- CIO Spenders
- VP & Director Roles

ET Leadership
- VP & Management
- Data Expert
- Application Expert

Data Security
- Data Governance

Infrastructure Development Roadmap

Development Timeline

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Initial Data Engineering &amp; Integration</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
</tr>
<tr>
<td>2. Data Management Strategy &amp; Roadmap</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
</tr>
<tr>
<td>3. Data Stewardship &amp; Governance</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
<td>[description]</td>
</tr>
</tbody>
</table>

Description:
- These deliverables are a combination of face to face consulting and completed business analysis and engagement design delivered in PowerPoint
- These deliverables are part of an overall framework but will vary from engagement to engagement depending on the needs of each customer

Sprint Plan

Reference Data Estate Modernization Assessment Sprints

Backlog Prioritization & Analysis

FP&A: Overall Opportunity Prioritization

Opportunities:
- Strategic Party Planning and Expectations Identification
- Service Planning and Costing
- Data Handling

Financial Opportunities:
- Financial Opportunities Identification
- Financial Opportunities Planning
- Financial Opportunities Prioritization
- Financial Opportunities Implementation
- Financial Opportunities Review
- Financial Opportunities Evaluation
- Financial Opportunities Feedback
- Financial Opportunities Improvement
- Financial Opportunities Optimization
Example Technical Assessment Deliverables

**Custom Designed Architectures**

**Azure Lambda Reference Architecture**

- **Capture**
  - **Data Ingestion**
    - **Database**
      - **Data Warehouse**
    - **Data Model**
    - **Data Lake**
    - **Data Governance**
    - **Data Quality**
  - **Analytics**
    - **Data Analytics**
    - **Predictive Analytics**
    - **Prescriptive Analytics**
  - **APIs**
  - **Integration**
  - **Security**
    - **Identity and Access Management**
    - **Security Policies**
    - **Compliance**

- **Process**
  - **Quality Management**
  - **Change Management**
  - **Configuration Management**
  - **Risk Management**
  - **Performance Management**

- **Visualize**
  - **Reporting**
  - **Dashboards**
  - **Self-Service Analytics**

**Scenario Canvas: Right Product Recommendations**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Business</th>
<th>Technology</th>
<th>Product</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Technical Development Plan**

**ML Models require an iterative development approach**

- **Iteration Through more data, advanced feature engineering, and algorithm tuning**

**Description**

- These deliverables are more involved and are developed following the workshop through collaboration with technical teams to analyze the deeper requirements of the business goals identified in the workshop.

- The result is the formulation of an actionable scope of work to begin modernization around top priority use cases.

- To summarize our technical approach in one sentence... we start by demonstrating the business value via a sandbox architecture which through iteration and expansion will serve as the foundation of the eventual production platform.
Reference Sprints for Assessment

Estimated Assessment Timeline

1. **Week 1**: Onsite workshop, backlog buildout, issue identification & planning
2. **Week 2**: Analyze Portfolio and build financial justification for further analytics
3. **Week 3**: Architecture remediation, process-side governance assessment, process changes & roll-out
4. **Week 4**: Make changes to hard governance (deploy solution template, make changes to current roll-out strategy, licensing)
5. **Week 5**: Data Governance, usage, modelling, Security, and CICD Analysis and Remediation
6. **Week 6**: Align BI team with roll-out, Agile, and management best practices
7. **Week 7**: Present Roadmap and Findings
8. **Week 8**: Next Phase
9. **Week 9**: Digital Consulting Activity
10. **Week N**: Data Modernization Activity

* Sprint length and arrangement are illustrative and are for informational purposes only. The actual sprint arrangement and length are functions of the Agile planning process and sprints will be planned 1-2 sprints ahead to remain agile. The overall timeline will vary depending on the effort required.
Predictive Maintenance Program Process

**Understand Failure Modes**
Identify common failure modes and impact on SLA metrics:
- Failure modes
- Frequency of failure
- Location of failures
- Impact on SLA

**Review Existing Models**
Evaluate existing predictive maintenance models and applicability:
- Evaluate Variables
- Identify Edge Cases
- Improve Model Performance

**Map to Sensors**
Identify potential sensor types for identifying pre-failure conditions on TVM devices.
(ex. Temperature, vibration, RPM)

**Recommendations**
Create recommendations for next steps based on discovery period:
- Data collection redesign
- Instrumentation approach
- Next best step to improve & iterate

---

Machine Learning Model

Temperature
Vibration
RPM

---

0% 20% 40% 60% 80% 100%

0 0.1 0.2 0.3 0.4 0.5 0.6

Temperature
RPM
Vibration
AI Enhanced Field Operations

Remote Diagnostics
Algorithms diagnose potential issues automatically
- Likelihood
- Severity
- Corrective actions

Advanced Resource Allocation
Technician Schedules are optimized based on SLA penalties.
- Identify and prioritize high-risk locations for penalties, account for travel time
- Combine scheduled and non-scheduled tasks

O’Hare Station
SLA Impact: High
Issue / Likelihood / Severity
- Alarm 226
  - Dirty BHU - 80%
  - Medium
- Alarm 345
  - Bill jam - 20%
  - Low
- Alarm 761
  - Card jam - 5%
  - Low

BHU Component History
Date
4/6/2017
7/8/2017
12/9/2018
Action
Module cleaned
Module sent in for repair
Module cleaned

Harlem Station
TVM Down: 1
Total TVMs: 2
TVM Online: 50%
SLA Impact: High

Technician 1 Schedule

<table>
<thead>
<tr>
<th>Priority</th>
<th>Station</th>
<th>TVM</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Harlem</td>
<td>1</td>
<td>Refurbish CHU</td>
</tr>
<tr>
<td></td>
<td>O’Hare</td>
<td>2</td>
<td>Refurbish BHU, Refill cards</td>
</tr>
</tbody>
</table>

Module Lifecycle Management
System tracks full lifecycle of modules
- Service history (time, transactions, where installed)
- Repairs

Advanced Planning
Service Regions drawn dynamically based on:
- Historical failures
- Repair times
- TVM location
- SLA penalty matrix

AI Enhanced Field Operations
Algorithms diagnose potential issues automatically
- Likelihood
- Severity
- Corrective actions

Module Lifecycle Management
System tracks full lifecycle of modules
- Service history (time, transactions, where installed)
- Repairs

Advanced Planning
Service Regions drawn dynamically based on:
- Historical failures
- Repair times
- TVM location
- SLA penalty matrix
AI Enhanced Condition Based Field Maintenance

Automated Condition Diagnostics
- Issue / Cause
- Likelihood

Impact Estimation
- SLA Impact
- Risk Adjusted Impact

Real Time Telemetry

Historical Telemetry

Maintenance Records

Service Region Optimization

Failure Frequency Forecasted Issues

Maintenance Evaluation
- Preventative & Scheduled Maintenance
  - Corrective
  - Predictive

Automated Task Scheduling
- People Assignments
  - Task Prioritization

Real Time Telemetry

Historical Telemetry

Maintenance Records

Impact Estimation

Automated Condition Diagnostics
- Issue / Cause
- Likelihood

Risk Adjusted Impact

SLA Impact

Service Region Optimization

Failure Frequency Forecasted Issues

Maintenance Evaluation
- Preventative & Scheduled Maintenance
  - Corrective
  - Predictive

Automated Task Scheduling
- People Assignments
  - Task Prioritization

Real Time Telemetry

Historical Telemetry

Maintenance Records

Impact Estimation

Automated Condition Diagnostics
- Issue / Cause
- Likelihood

Risk Adjusted Impact

SLA Impact

Service Region Optimization

Failure Frequency Forecasted Issues

Maintenance Evaluation
- Preventative & Scheduled Maintenance
  - Corrective
  - Predictive

Automated Task Scheduling
- People Assignments
  - Task Prioritization

Real Time Telemetry

Historical Telemetry

Maintenance Records

Impact Estimation

Automated Condition Diagnostics
- Issue / Cause
- Likelihood

Risk Adjusted Impact

SLA Impact

Service Region Optimization

Failure Frequency Forecasted Issues

Maintenance Evaluation
- Preventative & Scheduled Maintenance
  - Corrective
  - Predictive

Automated Task Scheduling
- People Assignments
  - Task Prioritization

Real Time Telemetry

Historical Telemetry

Maintenance Records

Impact Estimation
User Interface Desktop:
Real time incident response and location based technician dispatch

- Incident identification and tracking
  - Highlight basic failure and risk statistics for field equipment (TVMs)
  - Realtime monitoring of equipment conditions
  - Incident identification
  - System map

- Technician real-time status and communication
User Interface Mobile: Responsive UI for mobile technicians

- **Mobile based first response**
- **Real time technician assignments and dispatch communication**
- **Service history tracking and visualization**
- **Technician advanced field communications (location, notifications, messaging)**
- **Machine learning enhanced diagnostics based on event codes**
## Common Scenarios for Oil & Gas

### Scenarios

| Drilling Operations Planning | • Downhole Dynamometer Analysis  
| • Downhole Temperature Prediction  
| • Drilling optimization & automation |
| Production Forecasting & Optimization | • Hydraulic Fracturing Optimization  
| • Production Optimization  
| • Production Predictions |
| Predictive Maintenance & Risk Management | • Equipment Failure Prediction  
| • PDC Bit Wear Predictions  
| • Well-work Evaluation Tracking System  
| • Equipment Risk Assessments  
| • Frac-hit risk assessment |
Common Scenarios: Tank Level Forecasting

Machine Learning Can be Used to Forecast and Schedule Oil Tank Pickups

Multiple Algorithm Evaluation

Tank Forecast Development

- Machine learning used to forecast tank levels using onsite sensor reading and historical data
- Tank forecasts used to schedule tank pickups and minimize downtime at site
- Parallel model development in Azure ML allows for rapid solution testing and development
- Advanced machine learning algorithms (Neural Network Regression, Poisson Regression, Decision Forest Regression) enable accurate prediction

Forecast Horizons

<table>
<thead>
<tr>
<th>Forecast</th>
<th>Accuracy</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>High</td>
<td>Truck Route</td>
</tr>
<tr>
<td>1 day</td>
<td>High</td>
<td>Schedule</td>
</tr>
<tr>
<td>1 week</td>
<td>Medium</td>
<td>Schedule</td>
</tr>
</tbody>
</table>
Common Scenarios: Truck Optimization

Stochastic Optimization Used to Increase Return on Assets

- Right sizing fleet of trucks requires careful balance of risk and return on assets
- Stochastic optimization used to explore potential solutions and give optimized recommendation for truck scheduling
- Dynamic route optimization enabled by GPS and Bing Maps for in-route path and destination adjustments

Asset Optimization Development

Optimized Route Planning

Risk & Return on Assets
Successful Analytics Services are Agile

Our ample experience delivering data projects over the last several years has shown us that there is simply no way to fully spec out the required data, activities, and outcomes completely in the pre sales process to account for all changes and customer requests. Analytics maturity is an iterative journey which constantly evolves along with our customers.

Our Approach:

**Write the Business Story**
Work with Stakeholders to craft a roadmap to digital maturity
- Identify critical issues/needs
- Reconcile solution feasibility vs data
- Prioritize & scope efforts

**Iterative Development Sprints**
Build MVP solutions, evaluate, & improve until production ready
- Train models on immediately available data, adding more as it comes available
- Adjust development as needed to run at the pace of the business, instead of some arbitrary timeline

**Incremental Value Crafting**
Without a fixed endpoint, deliver value at each milestone
- Define objectives & key results for each sprint
- Measure progress and value with respect to the business need, not named performance thresholds
**Definitions**

**Program** - The master engagement model. AEs & DCs work with you on your long term roadmap.

**Initiatives** - Distinct efforts to drive a business outcome. One or many initiatives can be run at a time to tackle various IT, analysis, & business goals.

**Sprints** - 2-4 week short term task groupings to accomplish an initiative goal. Sprints are sequential and not concurrent.

**Roles** - Individual contributors are classified by their function on the delivery team and will vary in their permanence in the program.

---

**Agile Program Model Breakdown**

- **Program**
  - Master engagement model. AEs & DCs work with you on your long term roadmap.

- **Initiatives**
  - Distinct efforts to drive a business outcome. One or many initiatives can be run at a time to tackle various IT, analysis, & business goals.

- **Sprints**
  - 2-4 week short term task groupings to accomplish an initiative goal. Sprints are sequential and not concurrent.

- **Roles**
  - Individual contributors are classified by their function on the delivery team and will vary in their permanence in the program.

---

**Agile Program Model**

- **Digital Consultant**
  - Project Manager
  - Architect
  - Data Engineer
  - UX/UI
  - SDE
  - Sprint 1
  - Sprint 2
  - Sprints 3, 4, 5...
  - Roles vary per sprint needs

- **Account Executive**
  - Project Manager
  - Data Scientist
  - Data Engineer
  - Sprint 1
  - Sprint 2
  - Sprint 3
  - New initiatives can start whenever blockers are removed and the business is ready

- **Initiative A (Tech)**
  - Digital Consultant
  - Account Executive

- **Initiative B (AI)**
  - Digital Consultant
  - Account Executive

- **Initiative C (BI)**
  - Digital Consultant
  - Account Executive

---

**Initiative A (Tech)**

- Project Manager
- Architect
- Data Engineer
- UX/UI
- SDE

**Initiative B (AI)**

- Project Manager
- Data Scientist
- Data Scientist
- Data Engineer

**Initiative C (BI)**

- BI Analyst

---

**Initiative A (Tech) - Initiative B (AI)**

- Roles vary per sprint needs

---

**Initiative B (AI) - Initiative C (BI)**

- Some initiatives may be short or only require few resources, sharing a PM from another initiative

---

**Initiative C (BI)**

- BI Analyst

---

**Definitions**

**Program** - The master engagement model. AEs & DCs work with you on your long term roadmap.

**Initiatives** - Distinct efforts to drive a business outcome. One or many initiatives can be run at a time to tackle various IT, analysis, & business goals.

**Sprints** - 2-4 week short term task groupings to accomplish an initiative goal. Sprints are sequential and not concurrent.

**Roles** - Individual contributors are classified by their function on the delivery team and will vary in their permanence in the program.
Leverages Agile Methodology

Adjustable Team Size (Scale Up/Down)

Balanced Team with multiple skills:
- MC, PM, DS, DE, Arch, PBI, etc.

Flexibility to pivot as workstream demands

Phased, stage-gate delivery approach

Establish a foundation for repeatable analytics

*Estimates are subject to change based on gained realities and engagement’s evolution over time
TRANSFORMING YOUR BUSINESS WITH DATA

nealanalytics.com