

Made Smarter Innovation

An overview of our investments in Maintenance Innovations

MADE Smarter Chris Needham Innovation Lead



Funding innovation

We're investing £147 million to develop digital manufacturing ideas more quickly.



How it works

Made Smarter Innovation connects leading UK manufacturers, technology developers, start-ups and research institutions so they can prove and scale their idea.

New core technology development

Development of Standards

Embedding research into adoption



Exploitation (and then adoption)

Shaping the future

Our goal is to be world-leading in digital manufacturing by...



Boosting productivity



Accelerating the race to net zero



Creating highly-skilled jobs





Design, Make and Test Adaptable, Flexible Manufacturing

Smart Factories Connected Supply Chain

How we are having an impact...

Virtual product and process design – making new drugs, foods and products faster.

> Machine Learning and Predictive Maintenance for zero defect digital welding.

Smart Connected Factories – transforming production in live manufacturing environments.

<u>(</u>

15% per year growth through 3D design and manufacture of blast furnace castings.

Intelligent biopharma manufacturing to meet the demand for vaccines.



Meet Katerina...

Team: ATS Global, BMW, Laing O'Rourke Subsea 7, TWI, Lancaster University.

Prove quality, accuracy, precision and cost.

Machine Learning and Predictive Maintenance for zero defect digital welding.

Can be applied to other manufacturing processes.

Increase productivity by 40% while reducing waste and and improving safety.



Drilldown: Welding tips & maximizing life

Spot welding tips have hard and limited life.

Require periodic 'dressing' and then replacement - expensive.

Uneven wear leads to variable weld quality.

Data analysis to monitor power profile v's time – to predict optimum time to re dress.

Significant reduction in variability, improved weld confidence and cost savings.



Meet David...

Team: GKN Aero, Rolls-Royce, BAE Systems, Atec, Airbus, Meggitt, GSK and Nissan

Locations and equipment that are hard to connect.

Common data standards for existing equipment

Site-specific blend of technologies.

Merging IT and OT to make UK manufacturing more resilient.



Select Time Frame Last V 1 Weeks (Calendar) 15/05/2022 - 21/05/2022 Total Duration (Hours)

168.00

	Specific Status	Duration (Hours) ▼
/cinnii	Inspection by CMM	104.26
	Off-shift	29.75
	Inspection/Replacement of Cutting Tools	23.16
Î	Normal Cycle	7.54
chipid	Unknown Downtime	3.27
	No Personnel Available	0.02

Mazak I500V-1 (663653) 🗡

In Cycle Duration Regression Model

Correlations	
In Cycle 1 Planned	0.95
In Cycle [®] Unplannec	-0.54
In Cycle [*] Unknown	0.65

SUMMARY OUTPUT (In Cycle[®] Planned + Unplanned + Unkown)

			Adjusted R	value st.	ates how muc	h of the data can be		
Regression 3	Ratistics		explained in the model.					
Multiple R 0.975081814			1					
RSquare	0.950784544		This measu	res "The (Goodness of f	it"		
Adjusted R Square	82.87%							
Standard Error	83.41508424		The higher the R2 value, the more reliable the model is.					
Observations	12		82.87%					
ANOVA	1.000		Anything al	oove 65%	is considered	l acceptable for forecasting.		
	đť	55	MS	F	philicance F	5		
Regression	3	1E+06	403265	57.956	9E-06			
Residual	9	62623	6958.1					
Total	12	1E+06	81545-4585895					

	Coefficients	andard Er.	t Stat	F-sake	ower 35%	lpper 95%.	nver 35.03	
Intercept	C	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Planned Downtime	0.378501443	0.0584	6.4846	0.01%	0.2465	0.5105	0.2465	0.5105
Unplanned Downtim	-0.444781417	0.1005	-4.4271	0.17%	-0.6721	-0.2175	-0.6721	-0.2175
Unknown Downtime	0.034845473	0.1206	0.2888	77.92%	-0.2381	0.3078	-0.2381	0.3078
	19 19 19 19 19 19 19 19 19 19 19 19 19 1					S		

Planned & Unplanned downtimes P-values fall below the 5% significance level, indicating

Drilldown: Condition Monitoring & Maintenance

New facility – mix of state-of-the art, legacy & custom built equipment.

Machine utilisation > Condition monitoring.

Data used to predict availability (80% confidence)

Extend sensor use for preventative maintenance, usage, wear, temperature etc.

Outcome: predictive regression modelling - in scalable system incl. condition monitoring

BAE...Benefits of Artificial Intelligence / Machine Learning within manufacturing

Why Leverage AI/ML in Manufacturing?

- It's all about harnessing and exploiting manufacturing data- which can be easily accessed
- It can empower those on the shop floor by getting the right information to them
- Once AI driven data is trusted **workforces naturally upskill** as they understand the benefits (push becomes pull)
- Leveraging the same or similar data with AI can often help companies move towards their Net Zero Targets via efficiency improvements Examples

What can AI in Manufacturing Improve?	How?				
Increase 'right first time' process outcomes & Catching manufacturing issues at their origin	Enhanced ML driven process and part inspection				
Reduce material use & wastage	AI driven design simulation & design-for-manufacture methods				
Maximise machinery up-time and mitigate lost time from unrequired maintenance	Implement closer-loop system monitoring and predictive maintenance capabilities				
Optimise use of existing manufacturing resources	Deploy AI driven dynamic scheduling				
Connect and integrate supply chains so they are part of the full manufacturing execution process	Apply DLT and blockchain technology to distribute dynamic scheduling beyond company walls				
Manufacturing process carbon emissions and overall REEE values	Creating high efficiency Green Al's that still improve all aspects of the manufacturing process				



Examples of Current BAE Initiatives

- BAE is **collaborating cross-industry** in AI technology development as a member of high value collaborative technology programs
- Novel visual inspection method implemented for an existing manual XRAY image classification process at our Samlesbury site
- In-house engineered predictive maintenance and descriptive analytics for future robotic manufacturing capabilities
- Use of **ML to detect** personnel incorrectly entering restricted manufacturing areas
- Use of body tracking to promote correct posture for specific tasks

Meet Tribosonics...

Tribosonics - Sheffield based scale-up.

Sensing Technology to tackle wear, friction, lubrication challenges

Partnered with ENGEL (plastic processing machines) to monitor wear on plasticising feedscrew

Outcome: Ultrasonic high temperature transducer for real-time monitoring in high temperature environment

Time to check for wear reduced from 2 days to just 1 hour, reduced friction and energy consumption (est 3%)





LAING O'ROURKE

"The Made Smarter Innovation programme connected us with world-leading experts, cross-sector learnings and industrial partners, speeding up the development and adoption of Industrial Digital Technologies."





subsea7

AIRBUS









Senseye Made Smarter Innovation: Impact from our investments

in Maintenance Innovations







Introduction – Rob Russell

- Chief Technical Officer and Co-Founder
- Educated in Mechanical Systems Engineering
- Over 20 years experience in designing and deploying complex condition monitoring and prognostics solutions across the aerospace, defense and transport sectors globally.
- Responsible for technical direction in research, product development and delivery. With a focus on maintaining the vision of Senseye.













What is Predictive Maintenance (PdM)?

CONDITION MONITORING

- An engineering discipline to support maintenance decision-making
- Uses sensor data to measure the condition of a machine

CONDITION-BASED MAINTENANCE

- Replaces planned maintenance
- Uses evidence from condition monitoring rather than traditional route-based manual readings



What is Predictive Maintenance (PdM)?

PREDICTIVE MAINTENANCE

- Uses on-line monitoring to establish the condition of machines
- Predicts failure by using *previous* failure *patterns* and maintenance *actions*
- Sources data during normal operations
- Minimizes disruption to operations for sampling or measuring
- Enables a proactive maintenance strategy of 1000s of machines





Senseye PdM Key Benefits

40% 50% 85% 55% Lower <u>maintenance</u> Increased maintainer Reduction Increase in downtime productivity in downtime costs forecasting accuracy



About Senseye



Senseye delivers Scalable & sustainable asset performance, guaranteed.



Global Industry Footprint







MANUFACTURING



HEAVY INDUSTRY

Deployed across **6 industries & 3 continents** (Europe, Asia Pacific, Americas)



FMCG



CPG



OIL & GAS



What was the Vision?





Asset Failure



How do you predict asset failures for thousands of machines on your site?



Asset Failure



SITE 1



SITE 2



SITE 3

How do you predict asset failure across all your sites?



SITE 4

• • •



SITE 19







The Proven Cases





Nissan

CHALLENGE

Nissan embarked on a global Condition Based Maintenance programme to help to avoid unplanned downtime on the production line, to reduce it by 50% across thousands of diverse assets. The scalable Machine Learning based solution from Senseye was chosen to help them achieve this.



RESULTS

Senseye PdM integrates maintenance and asset data, across multiple geographies, allowing engineering staff to zero-in on assets that will cause issues and maintain them before they do.

- Several \$m of unplanned downtime saved to date at each site
- Used across over 10,000+ assets in 8 factories
- ROI in <3 months

Senseye has helped us lower overall downtime and increase OEE.

Damian Wheeler, Nissan UK Engineering Director



2016

NISSAN has saved millions

GLOBALLY

Senseye has worked with Nissan since 2016, scaling from 30 assets in 2016 to 2500+ at the end of that year, to over 10,000 assets by February 2019 across 8 factories around the world.



January – First meeting

2017 January – Site expansion

400 assets being monitored

2018

Global expansion started. Europe, Japan and North America

2019

9 factories across the world, 10,000+ assets in one account with 450+ concurrent users



Senseye Nissan project team: 2016: 3 people / 2020: 3 people

Technology empowered the Nissan maintenance teams



Asset types: 100+



Unplanned downtime avoided: \$\$m++ ROI achieved in <3 months







Case Study: ALCOA

CHALLENGE

Alcoa operates plants worldwide, with a large number of diverse assets of differing ages and capabilities. Having made significant investments in data collection capabilities, a flexible and scalable Predictive Maintenance solution was needed to integrate with and leverage these existing systems.



RESULTS

Senseye PdM was chosen as an automated, intelligent system that could work with existing systems and not require a significant increase in workload – learning instead from actions taken by maintenance teams. Being fully integrated with OSI PI and Oracle EAM, the system is 'closed loop', allowing work-orders to be created automatically based on identified machine issues.

- Expansion in progress across multiple production funcitons
- Automated closed-loop system
- ROI in <3 months

Our team's decision was unanimous that Senseye was the best choice. Senseye offered a rare combination of a highly advanced back end data engine married to a front-end user interface that was intuitive and user-friendly.



ALCOA achieved ROI in 3 months

Senseye has worked with Alcoa since winning a thorough competitive tender process in 2018 against 12 competitive solutions.

100s highly complex assets are being monitored, using process data already captured.



Alcoa # FTEs hired for the deployment: 0 Wanted PdM as a managed product. Efficient implementation enabled quick results.



Additional sensors installed: O Leveraging existing machine & maintenance data feeds Able to easily add more assets as Alcoa scales.



ROI in 2019: 10x Achieved initial ROI in 3 months. Reduced unplanned downtime by 20% - significant improvements in OEE

2018 Competitive tender

Senseye won against 12 competitors including industry standards and newcomers

2019 Fjar∂aál - Iceland

50 assets initially brought in. ROI achieved in 3 months

2022

100s assets covered. Expansion in progress to over 1000



The Proven Cases



- ROI in < 3 months
- On target for 50% reduction in downtime
- Several \$m downtime avoided to date at a single site
- Global deployment



- ROI in < 3 months
- Automated work-order creation based on generated cases
- Fully integrated with existing data collection & work order systems
- Expanding to global deployment





THANK YOU

We run monthly webinars on predictive maintenance topics, these can be found at <u>www.senseye.io/events</u>







Innovating together

Our digital innovation ecosystem helps solve the challenges UK manufacturers face, with less of the risk.



We are a digital innovation ecosystem transforming UK manufacturing.

We're investing £147 million to develop digital manufacturing ideas more quickly.



	RESEARCH	COLLABORATIVE F	R&D INNOVATION HUBS	NOVATION HUBS			
	Research	£60m Collaborative		DIGITAL ACCELERATORS		NOVAL	
Addressing interoperability challenges through standardisation	 Programme 5 Multidisciplinary centres launched looking at digital innovations Further programme shaping future of digital manufacturing using economic and social science 	 Industry Lead consortia 1 - Fast Start (£20M) nearing completion 2 - Digital Supply Chain (£20M) 3 - Smart Factory (opens in Nov) 	£30m Innovation Hubs • Digital Supply Chain hub lead by Digital Catapult launched • Smart Factory Hub competition ongoing • will launch Jan 2022	 £6m Investment Tech Start-up/SME focussed £1M programme nearing completion £5M to be launched early 2022 	GLOBAL £10m Investment • First programme launched in Taiwan • Work ongoing with focus on Singapore and India	MADE SMARTER INIT	
		الأدية	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				



Hot off the press... Recently launched "Smart Manufacturing Data Hub"

• An initiative delivering bold technology leadership & radical innovation via 6 Key Elements



NNOVATION DATA HUB

Be part of our digital innovation ecosystem

Visit our webpages to see the support and investment you need to disrupt the competition.

Search UKRI Made Smarter Innovation Visit www.madesmarter.uk/#innovation-newsletter To keep informed of developments, sign-up for the newsletter





Thank you Questions

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Made Smarter Innovation.

Faster, Better or Cheaper. Digital doesn't have to choose.





@MadeSmarterUK