Fix it before its broken

**Condition Based Maintenance**

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Research and Development Partnering: the role of UCL in the supply chain

- Why UCL?
- What is Research & Development?
- With Whom do we work?
- How do we work

- What does it all cost?
Why UCL?
A Brief History of UCL Time (and space)

An Invitation to the foundation ceremony for the college on 30 April 1827.

A view of UCL from Gower Street in 1880.

Wartime bomb damage to UCL, viewed from the south east.
Jeremy Bentham our spiritual father

- 38,000 undergraduate, postgraduates & PhD students in total
- 8,000 research and academic staff
- students from 150 countries studying at UCL (one third of student intake)
- 29 Nobel Prize Winners
- QS World Ranking 7th in 2018
Research Feeds into our:

**MSc Digital Innovation in Built Asset Management**

Modules: Principles of FM; Service Operations; Principles of BIM; Space and Workplace; Digital Innovation Practice; Spatial Databases; Management Concepts; Quality and Project Management

Full Time 1 year / **Part Time 2 years**

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What is UCL Research and Development?

- It is business focused
- Only value adding projects
- Project based
- Continuous improvement
- Process development
- Innovation
With Whom do we work?

- Amey
- Modus
- HCP
- Bouygues
- UCLH
- Barts Hospital
- CHL
How do we work?

• Often described as outsourced innovation management

• Project based R & D Partnerships
  – A clearly defined project plan
  – A clearly identified value add
  – A dedicated project manager
  – Often the PM is undertaking a PhD
  – UCL engagement, management and oversight
  – Regular project boards
  – Working with clients
What does it all cost?

• In our Department we don’t do projects with clients that don’t have a commercial basis. So the numbers have to stack up for us too.

• Cost depends on the nature of the project but a project requiring little investment in technology could be as little as £50k per annum.

• Projects are usually 2-3 years in duration
Dr Ruhul Amin

- Ruhul gained his Engineering Doctorate through developing the condition based monitoring system which he will now run through in depth
**Aim:** Identify and implement cost effective, innovative techniques to optimise maintenance.

99% of equipment evidence some sort of indications prior to a fault developing.

Examining and understanding these signs can enable proactive actions before failure, therefore:

- Increase asset life
- Maximise efficiency of assets
- Reduce risk of unexpected failures
- Reduce energy usage

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**Case study**
How failure occurs

- Age related failures: 8-23%
- Random failures account for 77-92% of total failures.
CBM in use
Monitoring Techniques

Point where failure starts to occur

P = Potential failure

Changes in vibration P-F interval 1-9 months

Wear debris in oil P-F interval 1-6 months

IR thermography in oil P-F interval 3-12 weeks

Quantitative PM P-F interval 5-8 weeks

Audible noise P-F interval 1-4 weeks

Heat by touch P-F interval 1-5 days

F = Failure
Project overview

Locations and assets

- Plantroom chiller
  - 16 x Pumps
  - 11 x Motors
  - [54 x Sensors]

- Plantroom B
  - 4 x Pumps
  - 4 x Motors
  - [16 x Sensors]

- Plantroom A
  - 4 x Pumps
  - 4 x Motors
  - [16 x Sensors]

- Cooling Tower Base Build
  - 8 x Pumps
  - 8 x Motors
  - [32 x Sensors]

- Cooling Tower IT
  - 4 x Pumps
  - 4 x Motors
  - [16 x Sensors]

- Main AHU
  - 4 x Supply fan
  - 4 Extract fan
  - 8 x Motors
  - [32 x Sensors]

Real time asset condition monitoring

- Temperature and humidity sensors
- Vibration sensors

BMS operation and energy data
Vibration Analysis Example

Faulty bearing vibration

Healthy bearing vibration
Data integration into BMS and CAFM
The most significant opportunities

- **Reduce lifecycle expenditure** – The solution reduced lifecycle expenditure in the region of £250,000 (2015)

- **Optimisation of bearing life** – Reducing lifecycle expenditure

- **Provide evidential condition of assets for hand-back compliance** – mitigating cost risk to shareholders

- **Reduction of risk** – Improved management of risk relating to unplanned failure
  – Zero Failures

- **PPM to Proactive CBM** – Foundation for transition to proactive CBM

- **Operational savings** – Optimised maintenance through enhanced workforce utilisation and motivation

- **Energy savings** – Maximising asset efficiency reduces energy consumption
Paradigm shift

- **Innocence**: Repair as good as before
- **Developing**: Reactive – fix it when it breaks
  - Struggling with management systems
  - Proactive, preventive maintenance
- **Competence**: A “paradigm shift” in attitude from “cost focus” to “business focus”
  - Systems are a valuable tool – information is an asset
- **Knowledge Based**: Integrated organization, systems & processes
  - Proactive predictive maintenance
- **Excellence**: Optimized planning & decision making
  - Outsourced contracts to deliver value & cost savings
  - Sound knowledge of cost, performance & risk relationships

- **Performance & Reliability**
- **Maintenance & Renewal Spend**

**Learning → Applying → Embedding → Integrating → Optimizing**

**Maintenance is a expense** → **Maintenance is an investment**
Continuing the journey

Low cost MEMS microphones

Knowles SPW2430
MEMS microphone
Bandwidth: 100 – 10,000 Hz
Analogue output

Knowles SPH0641
MEMS ultrasonic microphone
Bandwidth: 100 – 80,000 Hz
PDM output requires specialist CODEC chipset
New technologies: Motion Amplification
Collaborations

Innovate UK

bre

LoRa Alliance

UCL

BSRIA
Thank you for listening

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