HVAC Maintenance Solution











Different way of managing maintenance contracts



CHANGE THE WAY YOU LOOK AT THINGS

AND THE THINGS YOU LOOK AT CHANGE



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WASNEDNER.

Nelson Mandela







Why the change









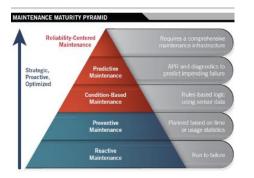


CM Costs increasing

Contractor Performance

Poor accountability

Assets under management



Little asset performance



Many contractors



Task based work







What we saw coming



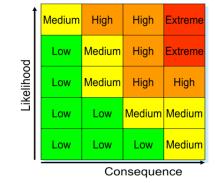


Rising Utility prices



Figure 1: PAM decision-making methodology phases

Need for prioritise assets



Need to understand risks



Reducing budget



Ageing Facilities



Student Experience



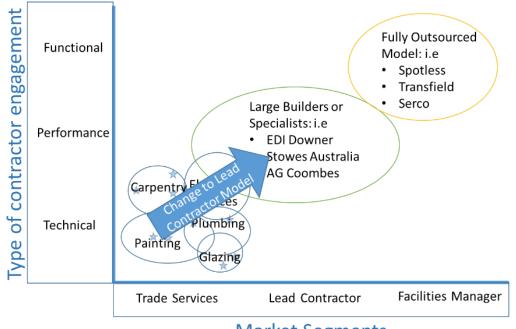




Objectives



- Holistic asset management
- Focus on asset performance
 - Reliability Centred Maintenance Strategies
 - Predictive Maintenance Strategies
 - Risk Based Strategies
- Incorporate Life Cycle programs
- Focus on collaboration
- Establish Lead contracts



Market Segments







Process



- Engaged consultant to manage process
 - Contract documents and Legal
- Expression of Interest
 - Asset List and scope based on DA19
 - Q Tender
 - Undertook a mandatory briefing
 - Review EIO via evaluation criteria
 - Short list
 - Interviewed
 - Financial viability check
- Request for Tender
 - 5 year + 2
- Year 1 Transition year
 - Condition assessment and Asset priority
- Year 2 and onwards Performance based







The Deliverables - Year 1

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- Asset audit & Verification (first 90 days)
 - Barcoding of all assets
 - Asset data structures, hierarchies, & definitions
 - Asset condition assessment
 - Identified critical assets & associated risks
- Development of 10 Year Asset Lifecycle Plan
- Delivery of performance based preventive maintenance plan
- Corrective maintenance reduction plan.







University of Queensland



Campuses

- 1. St Lucia campus
- 2. Gatton campus
- 3. Herston campus

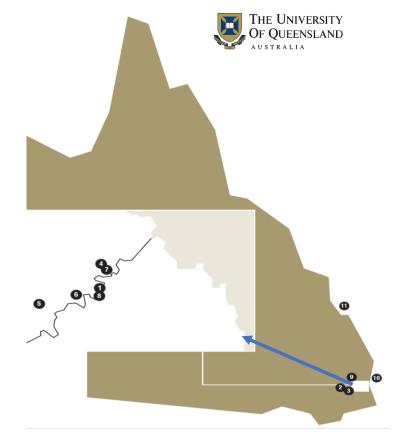


20 Other Locations including:

- Pinjarra Hills
- Long Pocket
- University Mine, Indooroopilly
- School of Dentistry, City
- Pharmacy Australia Centre of Excellence, Woolloongabba
- Veterinary Teaching Clinic, Dayboro

Marine Research Stations

- Dunwich, Stradbroke Island
- Heron Island









University of Queensland



- Over 50,000 students
- 6703 staff
- 551 buildings
- 24% UFA Service & Equipment Intensive (SEI) buildings
- 782,216 m2 (gross floor area)
- Asset Replacement Value of \$3.74 Billion
- 454 general teaching rooms and 1318 laboratories
- 1670 hectares











A.G. Coombs Journey



A.G Coombs awarded contract - Commenced 1 August 2015

Performance based contract using the combined expertise of A.G. Coombs Service and A.G. Coombs Advisory expertise to develop and implement a tailored HVAC Maintenance Solution.







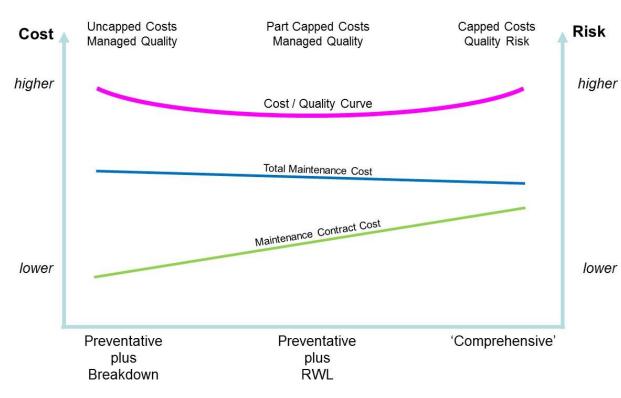


The old industry maintenance paradigms and the shortcomings





Current Paradigms



- Task based and founded on regulatory compliance
- Assets generally maintained as individual parts demarcation between asset systems and in turn Service Providers
- Relatively short term focus, driven by budget constraints for the NOW
- Defined frequencies & tasks Prescribed and generally not engaging of maintenance provider capabilities
- Largely reactive, not driven by longer term strategic objectives improve quality of outcomes (asset life and condition) whilst reducing costs, mitigating risk and maintaining regulatory compliance

therefore.







The old industry maintenance paradigms and the shortcomings



Uncapped Costs Part Capped Costs Capped Costs Risk Cost Managed Quality Managed Quality Quality Risk higher higher Cost / Quality Curve Total Maintenance Cost Maintenance Contract Cost lower lower Preventative 'Comprehensive' Preventative plus plus RWL Breakdown

Current Paradigms

..... generally

- No relation to facility outcomes ٠
- No relation to the nature or condition of plant ٠
- No direct correlation to risk *cause and consequence* ٠
- Total costs not attributed to the asset little correlation to ٠ corporate commercial outcomes – budget/total cost of ownership
- Limited consideration to energy efficiency and sustainability • outcomes
- Limited deployment of 'maintenance engineering principles' ٠
- The ability to make decisions driven by both historical and ٠ forecast asset information "useful data"







How we transitioned to the new paradigm

Year 1 Maintenance Plan – Six (6) key elements

1. Mobilisation

- Asset stock take
- Asset data structures, hierarchies and definitions
- Asset condition assessment & Barcoding

2. Review of Operation of Mechanical Systems

- Review and reassign BMCS maintenance tasks
- Assess trending, alarming and reporting functionality of the BMCS
- Review Break down and repair maintenance historical data.

3. Mechanical Systems Fault / Repair Diagnosis

- Analysis of the historic failures and review / assess likely anomalies
- Identify any underlying factors requiring attention
- Delivery of a corrective maintenance reduction plan



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How we transitioned to the new paradigm

4. Monitoring & Assessment of System Operation

- When should a system operate at given parameters?
- Have these parameters existed over the previous reporting period?
- How did the system perform against know parameters?

5. Systems and Plant Engineering Assessment & Planning

- Development of 10 year asset life cycle plan
- Implementation of maintenance and reporting systems
- KPI development plan Lead and lag indicators

6. Implementation to Performance Base Maintenance Strategies

• Year 2 - Agreed planning and contract framework



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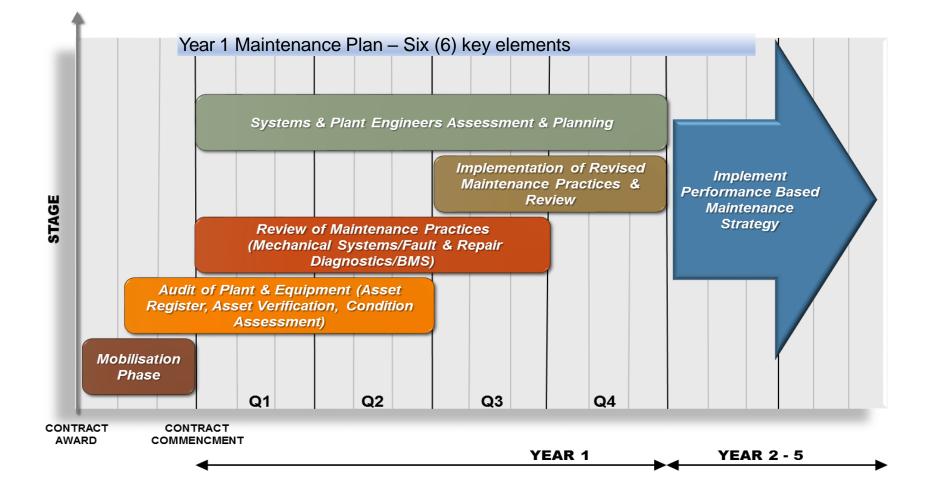
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How we transitioned to the new paradigm









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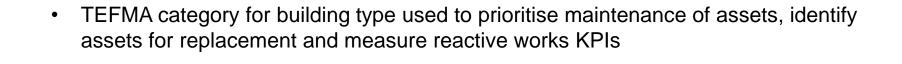
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ensure these systems integrate in the best possible way.

- Improved integration between electronic systems BMS and DV15 co-ordination improved –reporting and messaging on essential alarms
- Engineering assessments of critical equipment Eg: Industry best practise Cooling tower risk management plans.
- ALL assets tracked in a asset lifecycle plan which includes a detailed lifecycle analytic program



 $(t)e=mc^{2017}$

How we transitioned to the new paradigm (cont.)

Adopted a systems-based approach to maintenance, as opposed to looking at individual assets

Maintenance methodologies considered each component as a part of a larger system to

How we transitioned to the new paradigm (cont.)

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The buildings were divided into 5 priority categories each with its own maintenance regime.

- Category 5 Above normal maintenance to ensure reliability
- Category 4 Normal maintenance
- Category 3 Essential Services Maintenance
- Category 2 No maintenance reactive service calls only. (Building earmarked for redevelopment or under warranty)
- Category 1 Run to fail Building to be demolished / removed in the future.





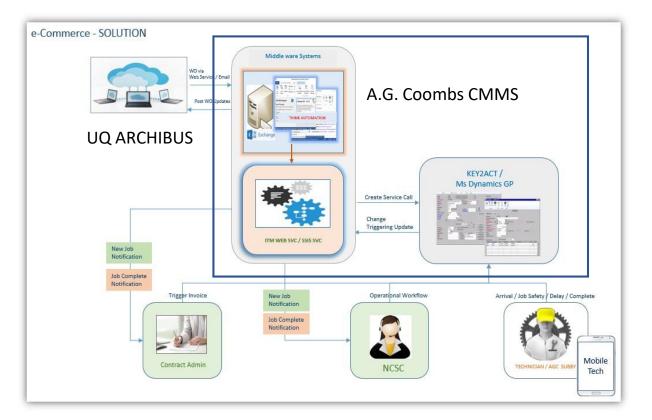


How we transitioned to the new paradigm (cont.)

Management Information Systems

ARCHIBUS - "SINGLE POINT of TRUTH"

Think Automation - extracts information from inbound messages received from UQ including (emails and SMS)









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Performance Based (Proactive) Maintenance Regime



Asset based analytics:

- Utilises physical asset information
- Factors in many attributes of the asset and its installation
- Considers maintenance, breakdown and repair history
- Life cycle, redundancy and obsolescence issues

Operational focused analytics:

- Applies rules to identify issues
- Uses operational data from building management and control systems
- Identifies poor equipment performance and energy efficiency
- Use technology tools to assist Movus vibration analysis
 - Instant alarms
 - Data incorporated into lifecycle assessment

Movus Vibration Monitoring







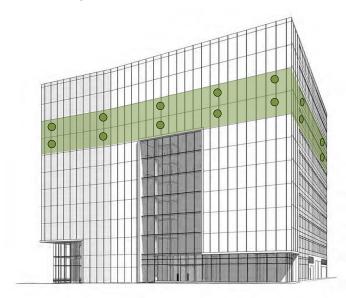


Performance Based (Proactive) Maintenance Regime

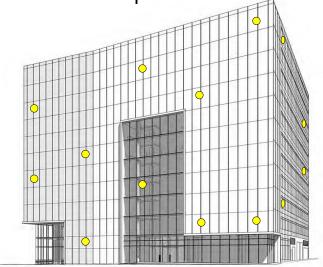


Exception Based or Targeted Maintenance

<u>Scheduled</u> based maintenance indicates 14 VAV boxes on levels 8 and 9 and due for servicing based on date



<u>**Pro-Active</u>** based maintenance indicates these 14 VAV boxes require servicing based on performance - all items serviced over a 12 month period</u>

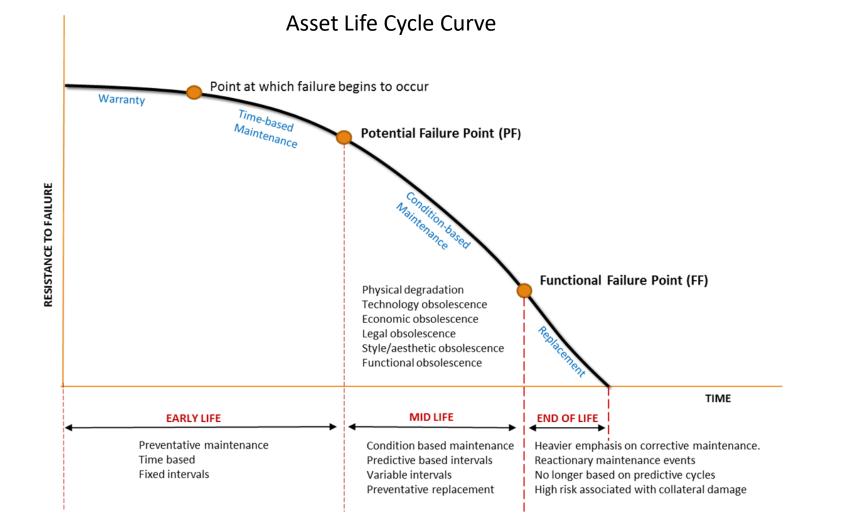








Performance Based (Proactive) Maintenance Regime









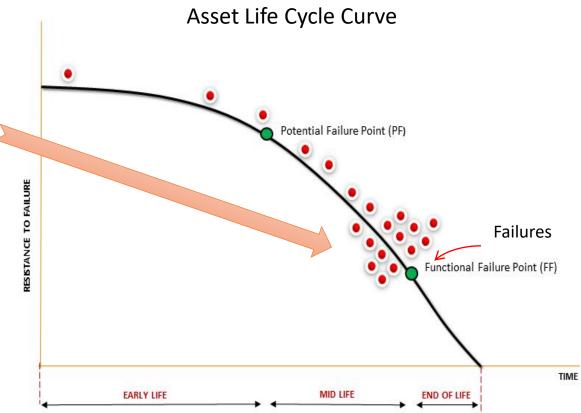
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What are we looking for?

Performance Based (Proactive) Maintenance Regime

- We looking to predict replacement before it fails
- Record maintenance & breakdown against the assets
- Analyse the data
- Project routine & replacement expenditure
- Identify trend abnormalities
 - Energy
 - Breakdown
 - Conditions
 - Replacement









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First Year - Lifecycle Plan

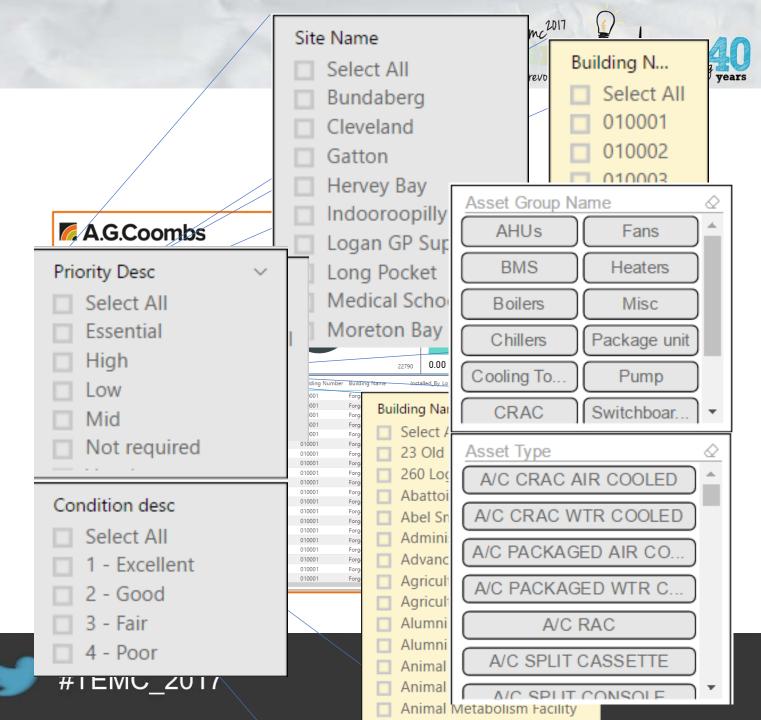
- Development of a computerised model to manage all asset life cycle costs
- Ability to filter based on campus or building
- Ability to filter based on Asset types
- Ability to filter based on Building use (benchmarking similar facilities)

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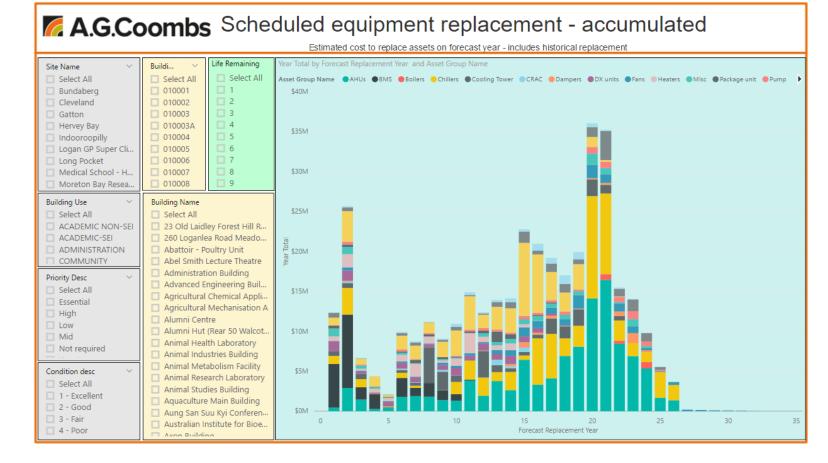
 Ability to filter based on Condition and/or priority



First Year - Lifecycle Plan



- Good understanding of total asset replacement costs
- 25 year replacement program down to component level
- Enabled a prioritised asset replacement program











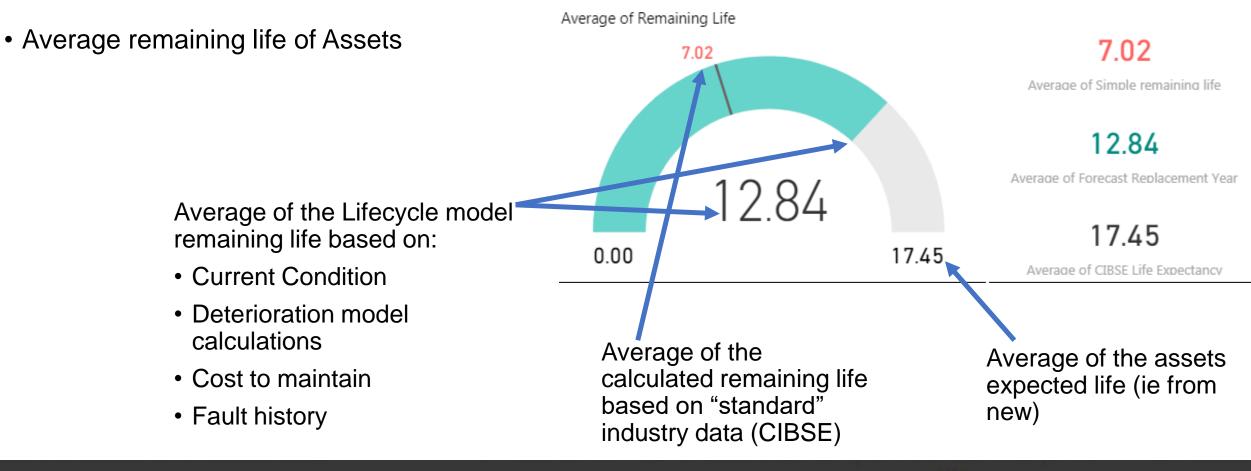
- Asset lists updated and refined
 - More data = better resolution of reports
 - Improved accuracy
- Metrics were refined to include
 - Building benchmarking (size / use / location)
 - Incorporated corrective maintenance faults down the square metre
- Provided the ability to tune the model into "what-if" scenarios













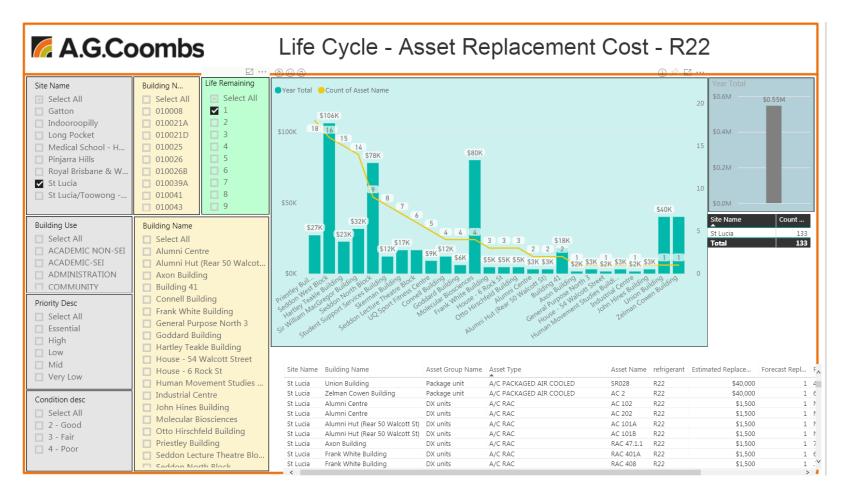






R22 – phasing out

Strategy to stockpile gas from large central plant to support smaller equipment replacement program

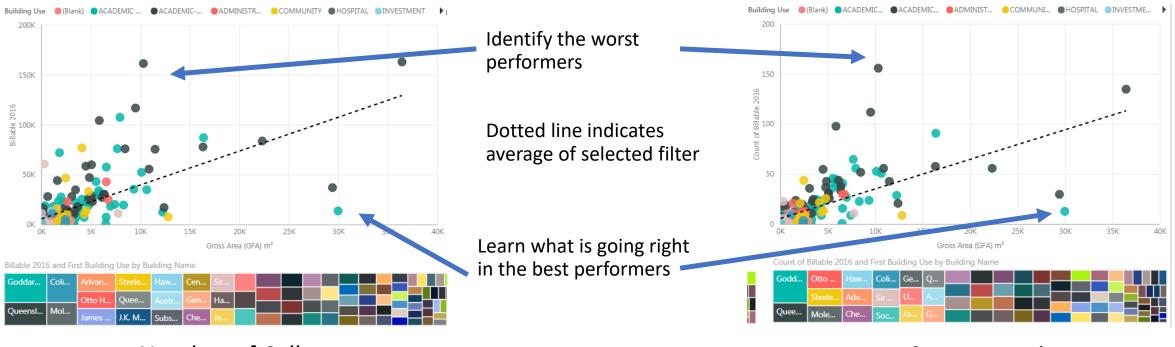








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Number of Calls

Cost to repair





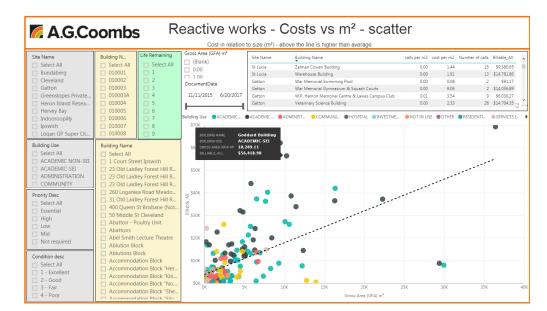




Analysis down to the square metre for benchmarking on similar space

		Life Remaining	Gross Area (GFA) m ²	[-
Site Name	building is		(Blank)	Site Name	Building Name		calls per m2	cost per m2	Number of calls	Billable_All	
Select All	Select All	Select All	0.00	St Lucia	Zelman Cowen Building		0.00	1.44	15	\$9,380.65	
Bundaberg	010001		1.00	St Lucia	Warehouse Building		0.00	1.91	13	\$14,781.86	
Cleveland	010002	2	DocumentDate	Gatton	War Memorial Swimmin		0.00	0.08	2		
Gatton	010003	3		Gatton	War Memorial Gymnasi		0.00	9.06		\$14,036.89	
Greenslopes Private	010003A	4	11/11/2015 6/20/2017	Gatton		Centre & Lawes Campus Club	0.01	3.54		\$6,030.27	
Heron Island Resea	010004	5		Gatton	Veterinary Science Build	ling	0.00	2.33	26	\$14,704.35	2
 Hervey Bay 	010005	6	Building Use ACADEMIC			HOSPITAL INVESTME	ANOT IN U.C.			SERVICES I.	-
Indooroopilly	010006	7		ALADEMIC	DMINIST COMMUNI	HUSPITAL INVESTME		OTHER	RESIDENTI	SERVICES I.	
Ipswich	010007	8	160							•	
Logan GP Super Cli	010008		BUILDING NAME God	dard Building							
Building Use	Building Name		140 BUILDING USE ACA	DEMIC-SEI							
Select All	Select All		GRDSS AREA (GFA) M ² 10,2 NUMBER OF CALLS 126	89.11							
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ADMINISTRATION	23 Old Laidle	ey Forest Hill R		•							
COMMUNITY	23 Old Laidle	ey Forest Hill R	100		•						
Priority Desc	🔲 260 Loganle	a Road Meado	calls								
Select All	🔲 31 Old Laidle	ey Forest Hill R	d .								
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High	50 Middle St	t Cleveland	Z		•						
Low	🔲 Abattoir - Po	oultry Unit	60		•						
Mid	Abattoirs		•								
Not required	🔲 Abel Smith L										
	Ablution Blo		40	7							
Condition desc	Ablutions Bl				8						
Select All	🔲 Accommoda	ation Block	20					•			
1 - Excellent		ation Block "Her		• •							
2 - Good	Accommoda				•						
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4 - Poor	🔲 Accommoda	ation Block "She	V6 36	10/	136	Gross Area (GFA) m ²	e J M	JUK	33%		-
		tion Block "Silv									

Number of Calls



Cost to repair









Site Name	Building N	e Remaining	Gross Area (GFA) m ²	Site Name	Building Name				Number of calls		
 Select All Bundaberg Cleveland Gatton Greenslopes Private Heron Island Resea Hervey Bay 	Select All 010001 010002 010003 010003A 010004 010004	Select All 1 2 3 4 5 6	(Blank) 0.00 1.00 DocumentDate 11/11/2015 6/20/2017 Building Use ACADEMIC	Logan GP Super Cl Gatton St Lucia St Lucia Gatton St Lucia	260 Loganlea Road Meadou Abattoir - Poultry Unit Abel Smith Lecture Theatre Advanced Engineering Built Agricultural Chemical Appli Alumni Centre	ding	0.01 0.00 0.00 0.00 0.00 0.01	5.82 3.19 1.93 1.67 0.00 1.61	9 1 2	\$5,955.21 \$802.32 \$1,030 \$37,242.13 \$0 \$759.42	
 Indooroopilly Ipswich Logan GP Super Cli 	010007	7 8 9	160	Building		HOSPITAL UNVESTINE.		OTHER	RESIDENTIAL	SERVICES	› L
Building Use Select All ACADEMIC NON-SEI ACADEMIC-SEI ADMINISTRATION COMMUNITY	Building Name Select All 1 Court Street I 23 Old Laidley F 23 Old Laidley F 23 Old Laidley F	orest Hill R orest Hill R	BUILDING VISAL COOLEN BUILDING USE ACADEM AVERAGE OF AGE 11.11 NUMBER OF CALLS 126								
Priority Desc Select All Essential High Low Mid	260 Loganlea R 31 Old Laidley F 400 Queen St B 50 Middle St Cl Abattoir - Poult Abattoirs Abel Smith Lect	oad Meado orest Hill R risbane (Not eveland ry Unit	Number of calls	• • •	•						
Condition desc Select All	Abler Smith Lect Ablution Block Ablutions Block Accommodation Accommodation	n Block	40			•	• •				









 Ability to identify the priority of asset replacement according to available budget

🜠 A.G.Co	ombs	Life Cycl	Revised budget \$14.08M					
Site Name Buildi Life Remaining Select All Select All Select All Gatton 010001 1 Indooroopilly 010002 2 Logan GP Super Cli 010003 3 Long Pocket 010004 4 Medical School - H 010005 5 P.A.C.E. Site - Wooll 010005 5		Forecast Replacement Ye Lifecycle Rank - Higher rank number means repl Asset Group @ Name 1 5 19860.1 23408.0 Asset Group @ Name Install Date Priority Desc @ Chillers Chillers 1958 2017 Essential High Mid Cooling To			AHUS BMS Chillers	Asset Type A/C PACKAGED AIR C A/C RAC A/C SPLIT CASSETTE A/C SPLIT CONSOLE A/C SPLIT DUCTED		
 Pinjarra Hills Royal Brisbane & W St Lucia 	010007 010008 010011	Revised budget	Low Very Lov	V Not required	DX units	Year Total		
Building Use Select All ACADEMIC NON-SEI ACADEMIC-SEI ADMINISTRATION COMMUNITY Priority Desc Select All Essential High Low Mid Not required	Building Name Building Name Select All 260 Loganlea Road Meado Administration Building Agricultural Chemical Appli Agricultural Mechanisation A Alumni Centre Alumni Hut (Rear 50 Walcot. Animal Industries Building Animal Studies Building Aung San Suu Kyi Conferen Axon Building Biological Sciences Library	\$4.69K Good \$438.55K Fair \$3.19M Poor \$9.40M Unserviceable	1858 Excellent Good 145 Fair 388 Poor 1218 Unserviceable 105	St Lucia Goddard Building BMS DX FEC TC VAV VSD IOM DX units A/C RAC Fans FAN TOILET EXHAUST Social Sciences Building Cooling Tower COOLING TOWER BMS		\$9,441,239.20 \$818,161.55 \$797,014.00 \$469,680.00 \$247,200.00 \$9,270.00 \$1,854.00 \$1,030.00 \$1,584.05 \$15,843.05 \$5,304.50		
Condition desc Select All 2 - Good 3 - Fair 4 - Poor	Block 6 Bookshop Building 240 Building 33 Building 407 Building 41	Condition desc	5000 • 3 - Fair • 4 - Poor •	DX FEC TC VFDs VARIABLE SPEED DRIV DX units Total	/e non essent	\$170,375,00 \$135,960,00 \$44,975,00 \$49,440,00 \$8,240,00 \$8,240,00 \$3,279,61 \$14,078,470,02		







Future work



- Operational stress
 - Short cycling BMS integration
 - Undersized equipment performance data (BMS or other)
 - Vibration monitoring rate of degradation
 - Runtime, hours of operation per week Movus integration and BMS integration underway
 - Costs of each asset compared to purchase price







Learnings



- Q tender
- Corporate scorecard
- All work co-ordinated through one point of contact
- Capabilities to do large urgent work
- DA 19 basis for contract basis
 - Need to be clear about items that could be preventative or corrective maintenance eg. belts and filters





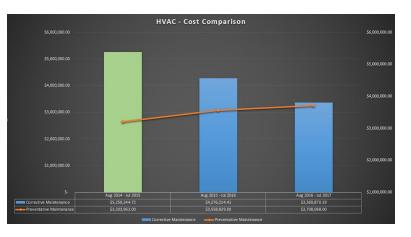


Overall Benefits

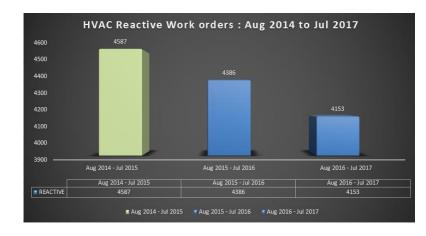


- Reduction in corrective maintenance costs
- Reduction in corrective work orders
- Reduction in invoice transactions

Preventative and Corrective Costs



Corrective maintenance Work Orders

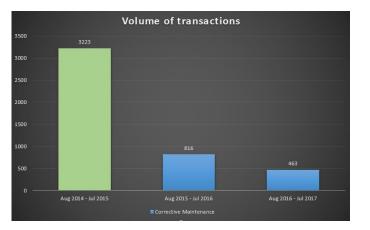


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Invoice volume



Overall Benefits

- Holistic asset management
- Robust information on asset life cycle
- Better understanding of asset performance
- Better method of prioritising asset replacement based on risk
- Single accountability for asset performance
- Good service performance which is regularly monitored











The collaborative journey between UQ and A.G. Coombs has required an ideological shift to performance based maintenance strategies

Delivered through a staged approach

A shared commitment and effort from both organisations to ensure the processes match to the outcomes









Questions





