THE SALVO PROJECT

STRATEGIC ASSETS: LIFE-CYCLE VALUE OPTIMISATION

Optimizing the management of aging* assets

**This includes 'prematurely' aging assets, obsolescence etc!*

Jack Huggett
Principal Consultant
TWPL

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Project Summary

3-year R&D project to produce:

- Best practice definition
- Process & methods guidance
- Decision-support tools
- Case studies & templates

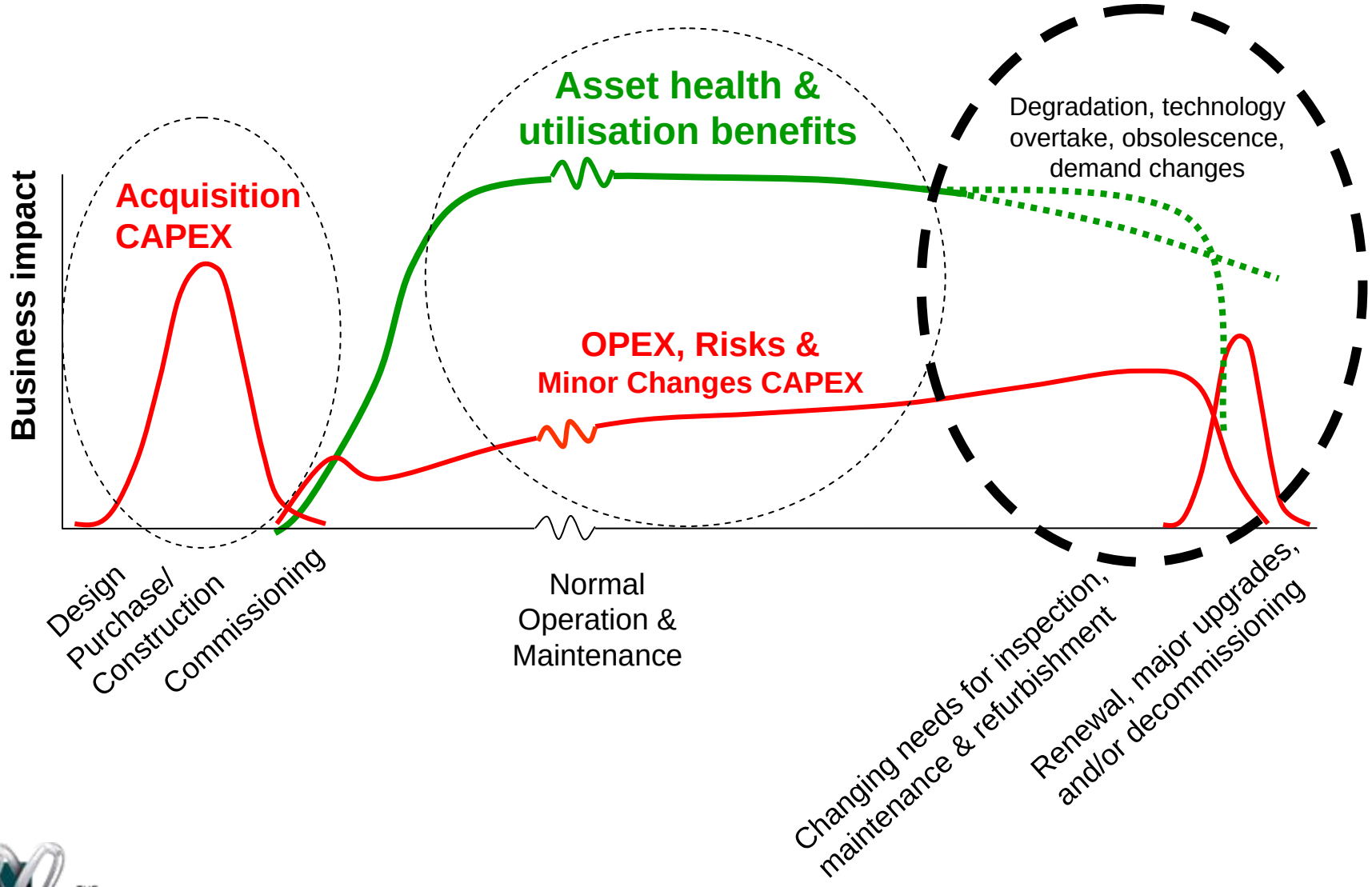
Started Sept 2009
Completion due 2012

Scope: *identification of optimal strategies and decisions for managing asset aging & degradation, obsolescence, renewals, refurbishments and changing inspection & maintenance requirements.*

First deliverables imminent:

- optimisation of *individual* assets renewal timing & cost/risk justification

Phases needing a Life Cycle view



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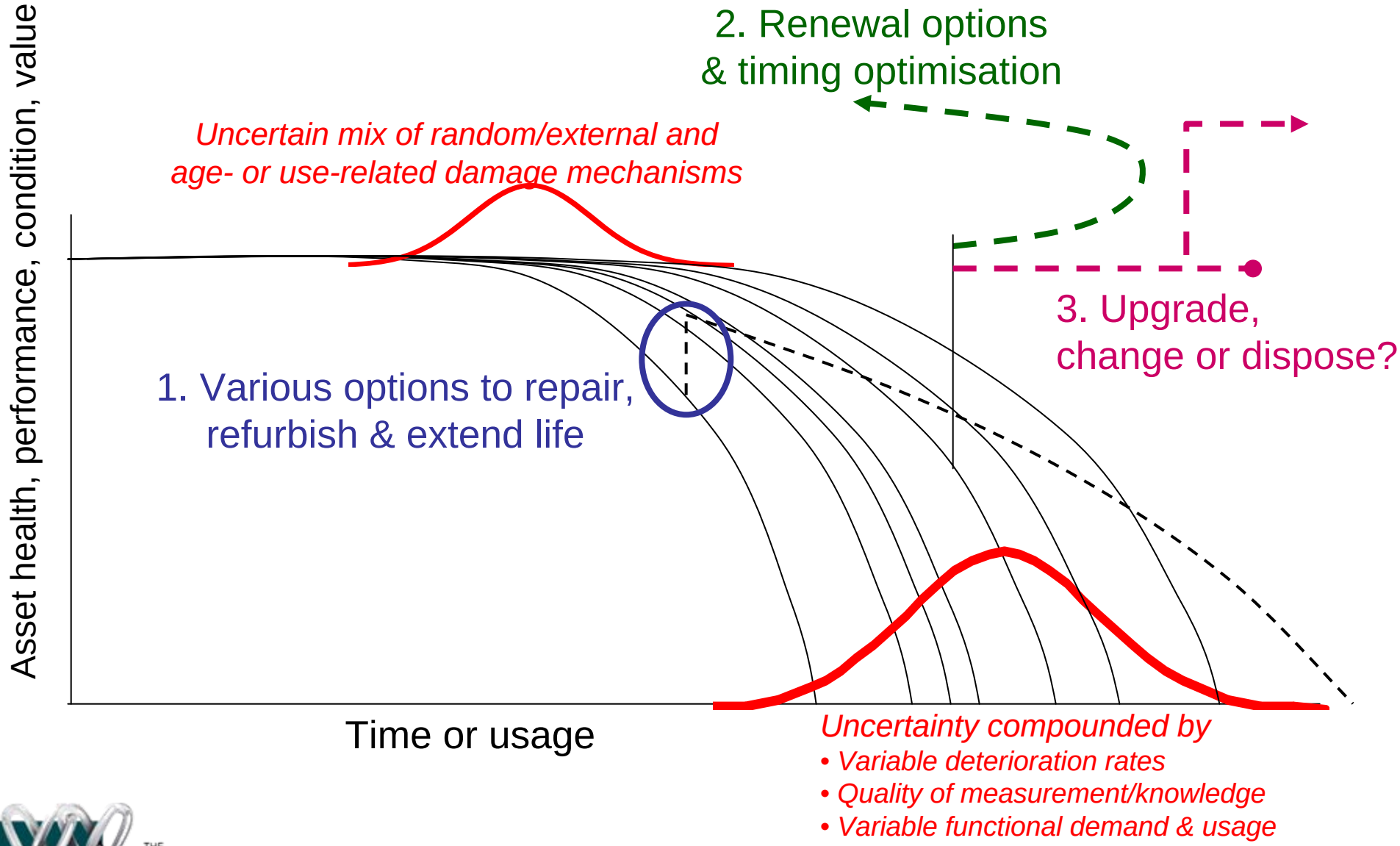
End of useful economic life is inherently 'fuzzy'



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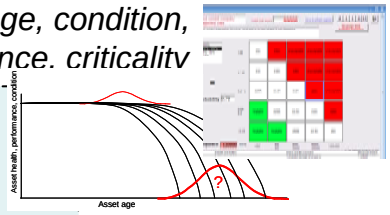
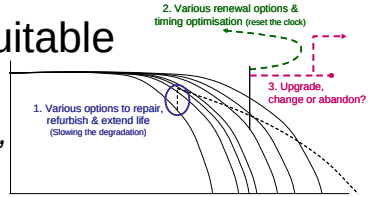
SALVO: top-down targeting & bottom up optimisation

Hard data + tacit knowledge

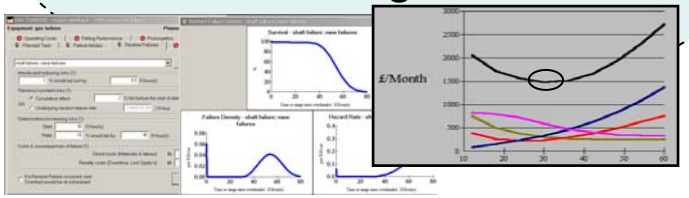
1. **Asset population** & systems **segmentation**:
e.g. Types, age, condition, performance. criticality



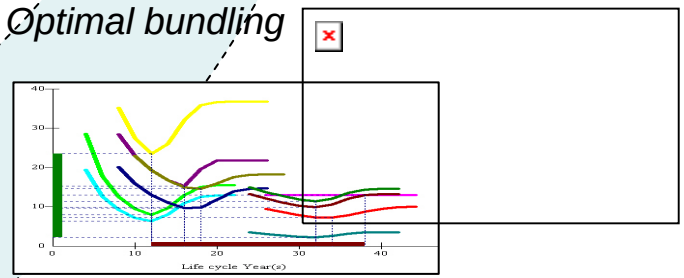
2. **Identification of** suitable actions & **options**
e.g. Inspection, maintenance, modification, renewal



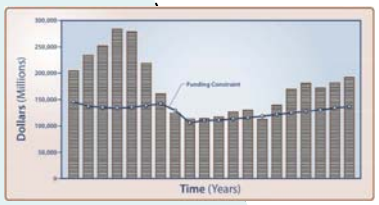
3. Optimisation of **individual interventions** and action **timing**.



4. **Work programme** integration and optimisation
a) Optimal blending
b) Optimal bundling



5. **Whole portfolio** needs, costs & risks **forecasting**
e.g. Capital investment plans, resourcing needs, risk & cost forecasts



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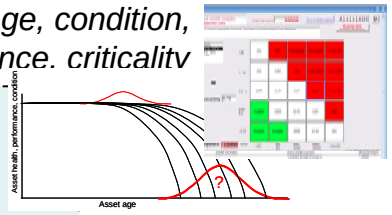

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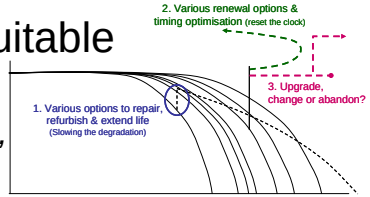

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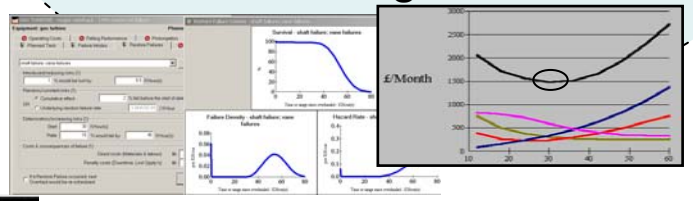

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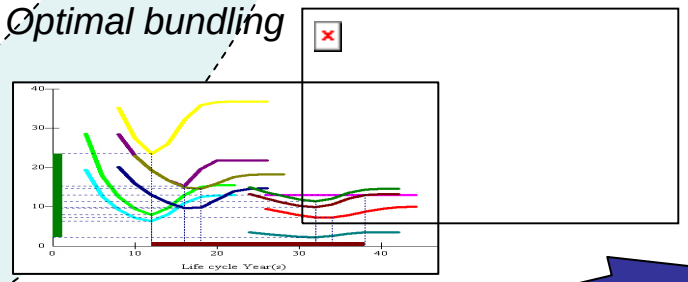

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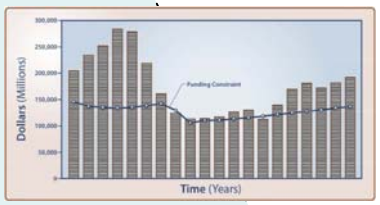

EAM work management & budgeting

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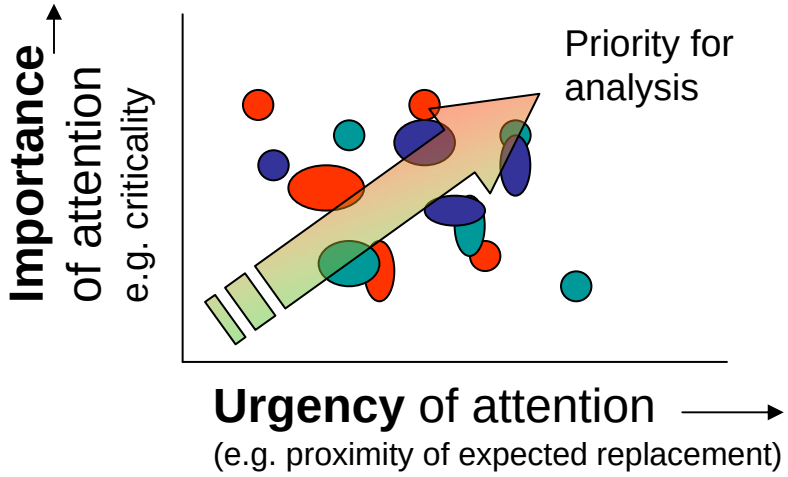
Step 1: *what assets are worthy of attention, and how can we group them for common needs, urgency etc?*

Mapping c. 40 possible decision 'triggers' & clustering criteria, including:

- Asset types, modularity, reparability, replace-ability
- Demand and utilization forecasts
- Asset ages, usage, performance *history* (including trends & forecasts)
- Asset 'health' (*current* condition, performance etc)
- Asset criticality/value
- Technology overtake/obsolescence
- Legislation & standards changes
- etc.



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Step 2: Intervention options to consider

Intervention Type
Alternative Finance/Servi
Comptetency Manageme
Decomission
Invest in Contingency
Manage Stakeholder Exp
Modify
Modify Asset/System Ca
Modify Asset/System Op
Monitoring/Inspection
Planned Maintenance
Quality Control System
Re engineer
Replace
Sampling (1 off information capture)

Alternative Finance/Service Provision	Insure
Alternative Finance/Service Provision	Purchase asset function instead
Alternative Finance/Service Provision	Re value (change priority)
Competency Management	Gap Analysis
Competency Management	Retirement and succession planning
Competency Management	Training
Decommission	Dispose
Decommission	Mothball
Decommission	Scrap for spares
Invest in Contingency	Buy a spare
Invest in Contingency	Competency
Invest in Contingency	Contingency planning
Invest in Contingency	Increase buffer stock/capacity
Invest in Contingency	Supply chain deal

54 possibilities identified so far!

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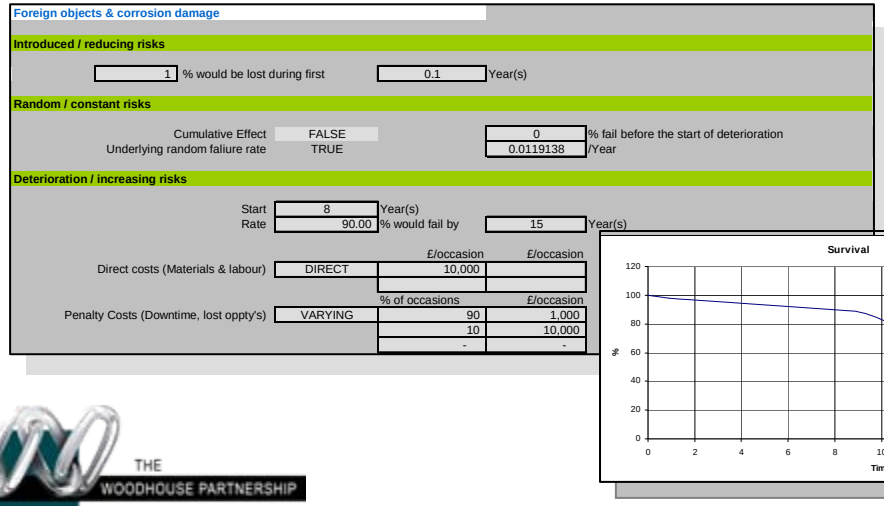
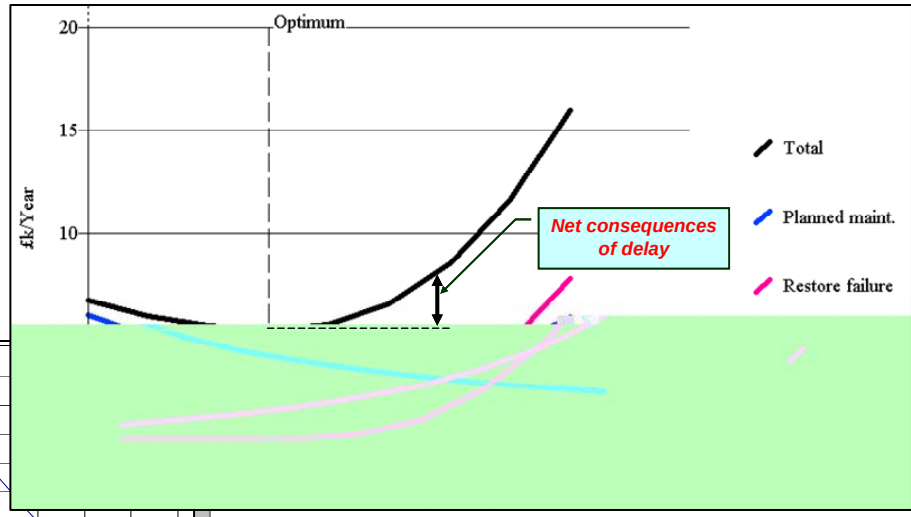
Step 3: *Individual* task evaluations

- Individual asset **replacements (justification & optimal timing):** *in field trials right now*
- 1-off interventions (e.g. **refurbishments or modifications**): *in definition stage*
- Enhanced **inspection, condition monitoring & maintenance**: *in process mapping stage*

*Structured capture of **tacit knowledge** plus **hard data** correct usage (where available)*





Field trials are already showing

1. Business case justification for **like-for-like renewal** has been badly handled historically (versus Capex for new demands/technology)
2. Big LCC impact, therefore, for better case-by-case evaluation & optimized timing for renewals
3. Diverse asset types *can* be modelled with a generic approach (don't need asset-specific models)
4. **Data quality is not the limiting factor** - structured presentation of the right questions, asked of the right people, is more important (plus correct calculation & interpretation of the answers!)

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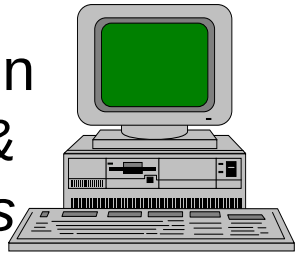
Optimisation
modelling & calculations



How we interpret and use the data

Sophisticated analysis focus: ***G.I.G.O.***

Better Decisions

Iterative, "what if?" analysis: find ***which assumptions really matter*** *& what data is therefore* ***worth collecting***

"Get better data first" usually ***fails*** *(****what*** *data,* ***when****,* ***how good?****)*

Subjective judgement

Bad Decisions

Quality of Data

2 to 3 (-ish)

2.79

'Guesstimates'

Measurement

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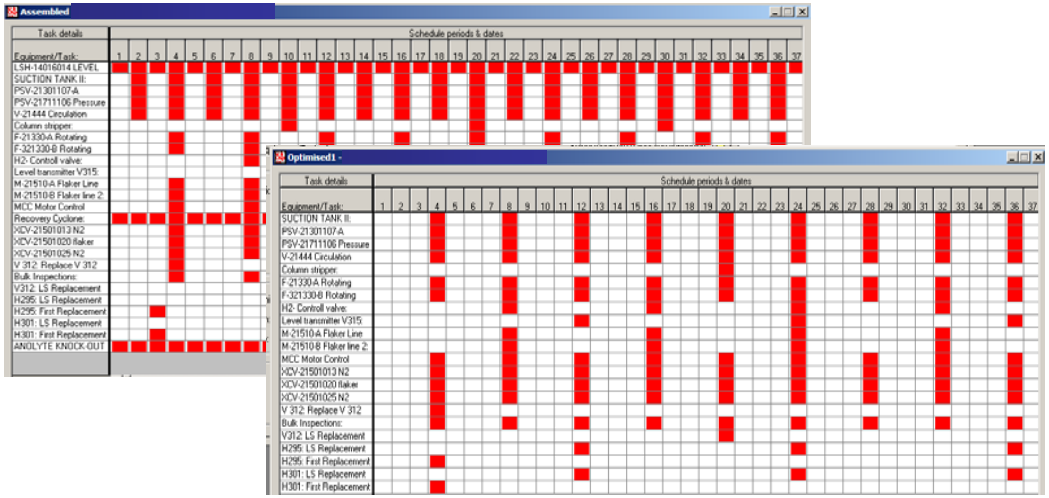
Step 4 - optimal task bundling

- Only early trials so far
- Re-mixing minor and major shutdowns & work alignments: scope for further large savings (esp. in planned downtime)



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Next on the cards

- Refining the individual asset renewals justification process, tools, guidance etc.
- Broadening the scope of different intervention types *and combinations*
- Extending the *programme aggregation* up to full population implications (without ‘double-counting’)
- Developing suite of guidance notes, case studies & templates

- Next update - mid 2011….

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Draft SALVO field case studies:

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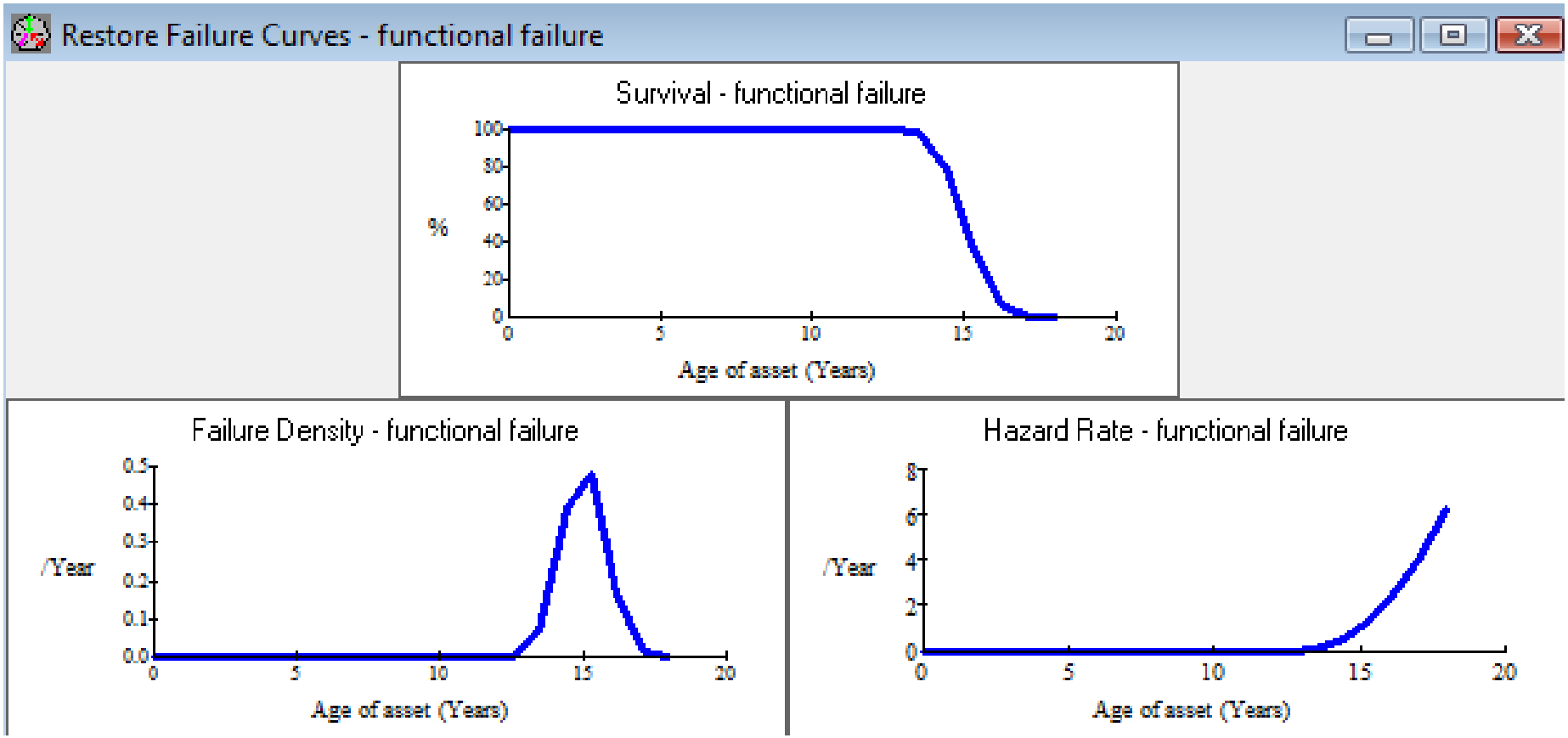
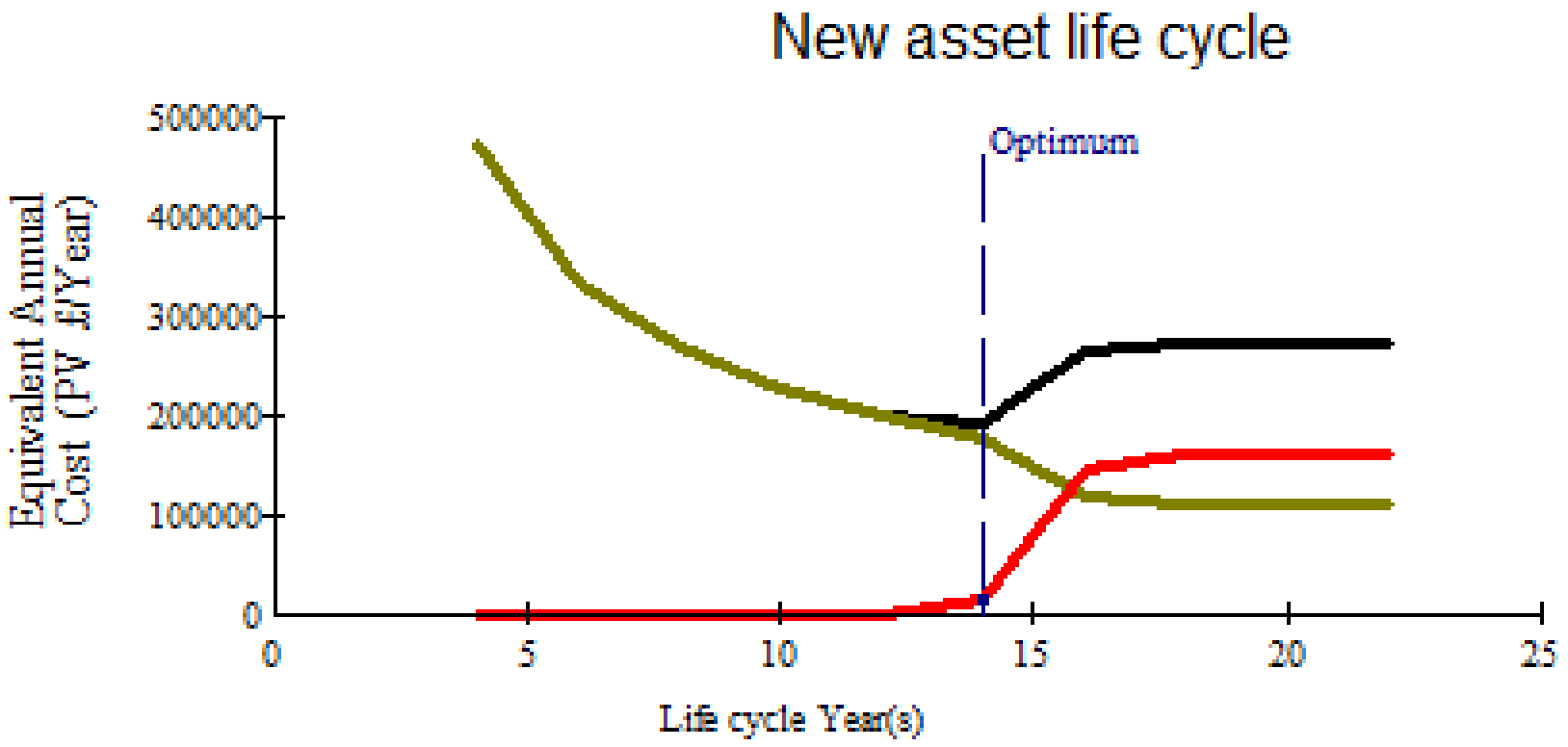
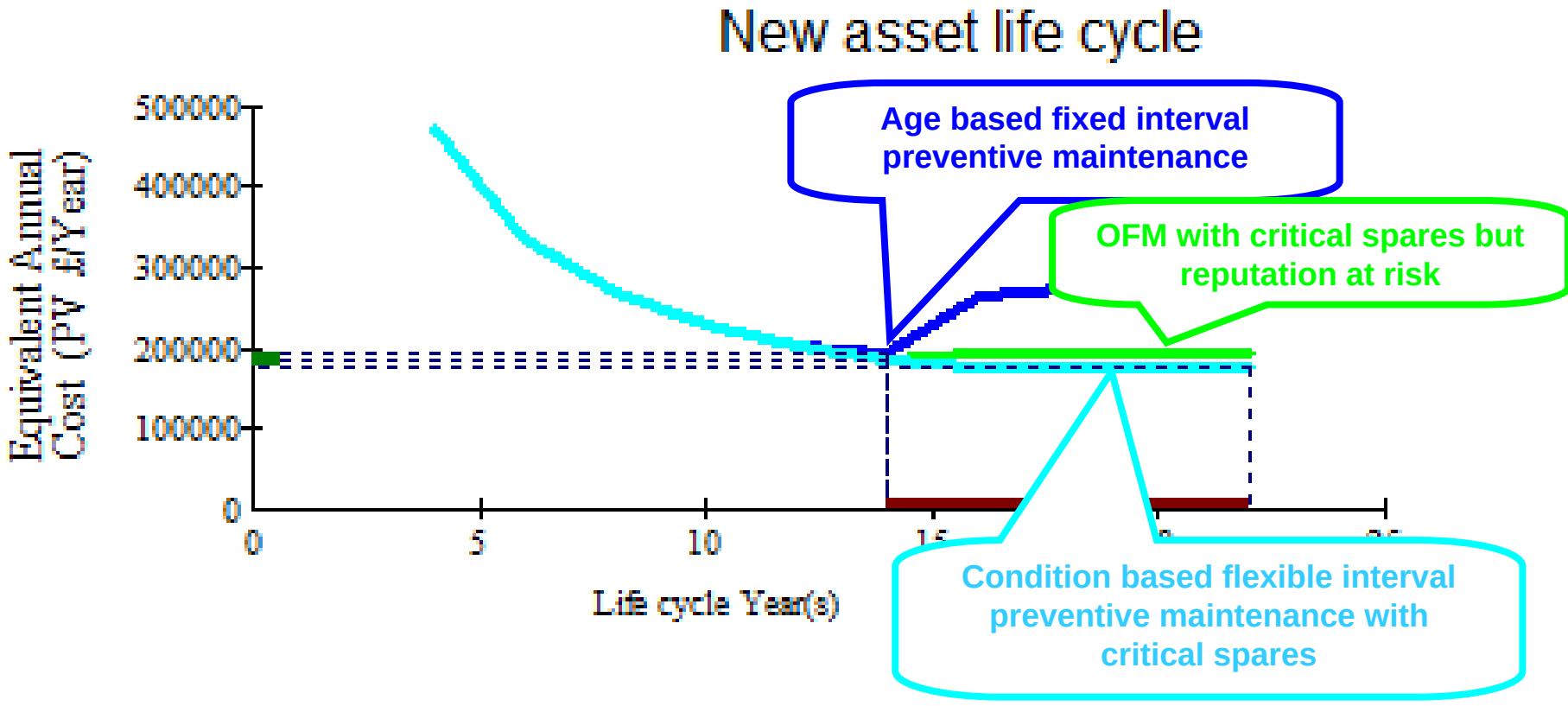
Case 1: Escalators
Estimated life cycle of the step chain type A:



Optimal replacement interval of this step chain:



Comparing 3 maintenance strategies:



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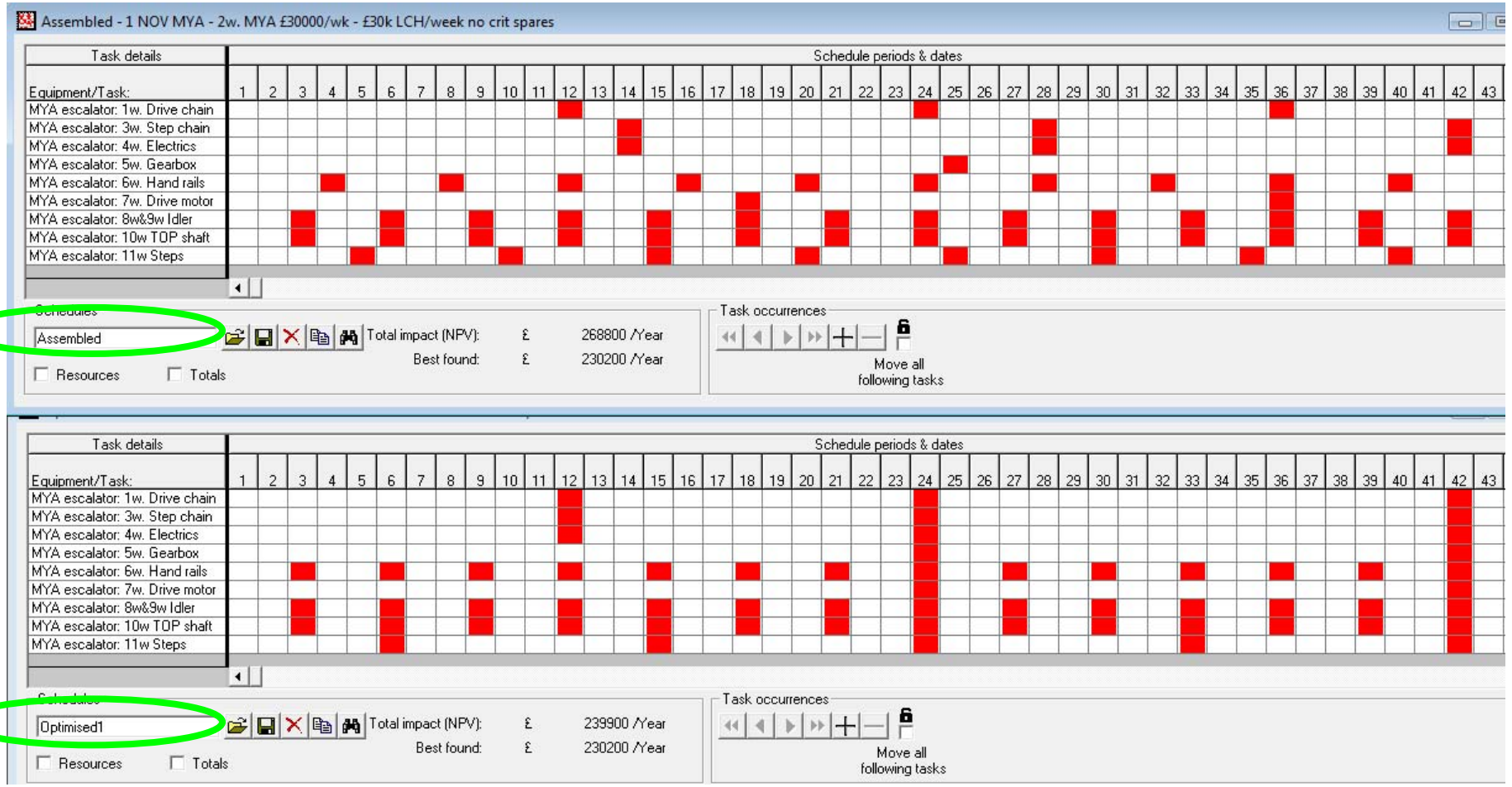
A escalators with £30000/wk downtime penalty:



Criticality summary:

Metronet escalators:					
Escalator type:		Red 54000 to >5000/wk	Orange 5000 to 1000	Green <1000/wk to 50	Total
HD	B	7	11	17	35
	C		4		4
LHDM		5	8	13	26
M	H			2	2
	HA	7	7	5	19
	B			2	2
M	Y			3	3
	YA	14	21	2	37
P	H		6		6
	S		1	7	8
	S-X			2	2
	SX-98	1	2	3	6
RAC			2	3	5
RTHD	M4	4	2	4	10
	LUL2	2		3	5
RTP	1		2		2
	2	2	2	8	12
	Totals	42	68	74	184

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A escalators with £70/wk downtime penalty:

Draft conclusions:

- High criticality escalators
  - Age based fixed interval planned preventive refurbishments and replacements (long term planning)
- Low criticality escalators
  - Comprehensive condition monitoring & inspections
  - Condition based flexible interval planned preventive refurbishments (short to medium term planning)
- The combination of long & short term planning needs to produce a constant work load to enable optimised resource levelling & constant work loads for contractors.

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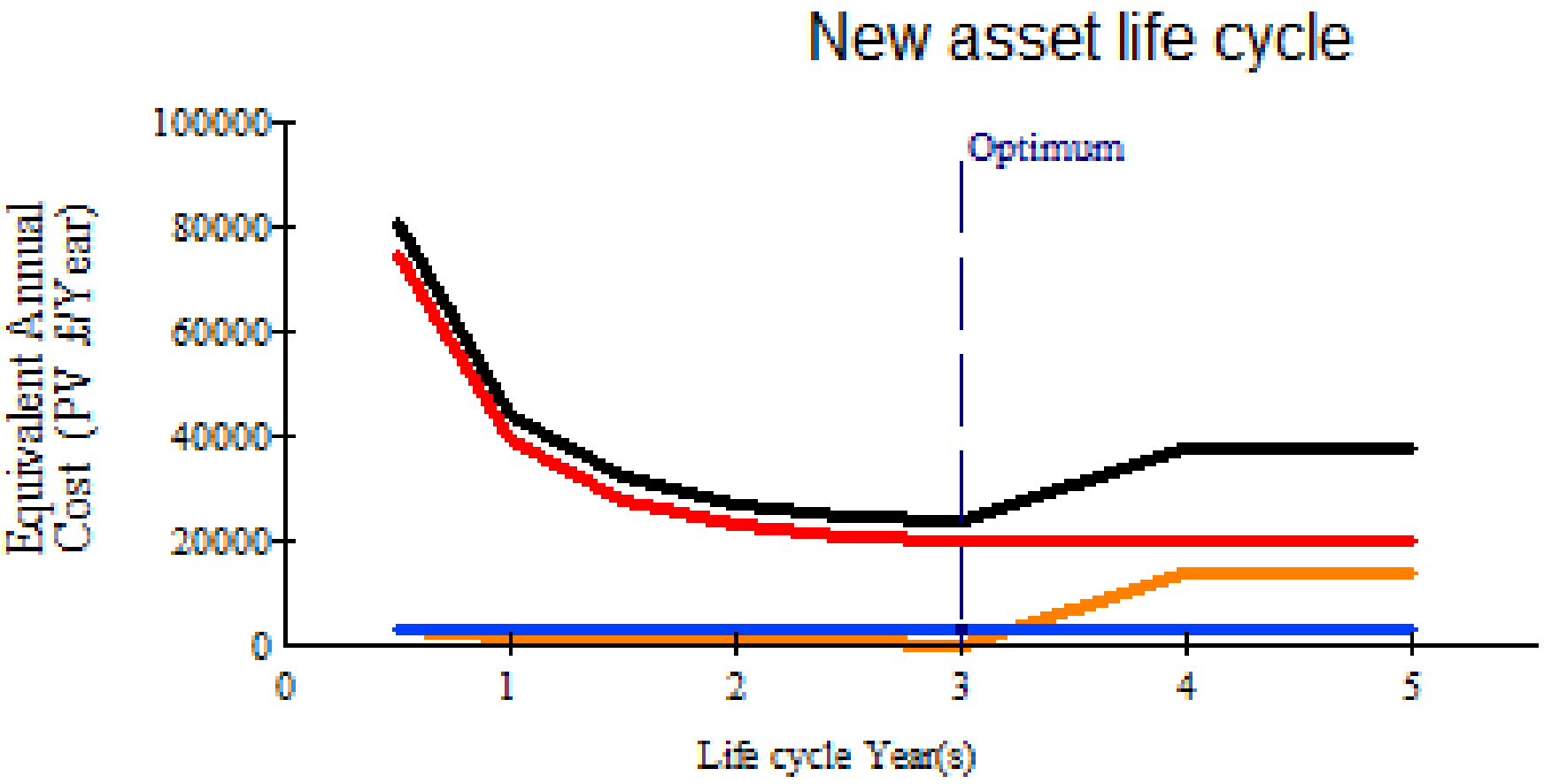
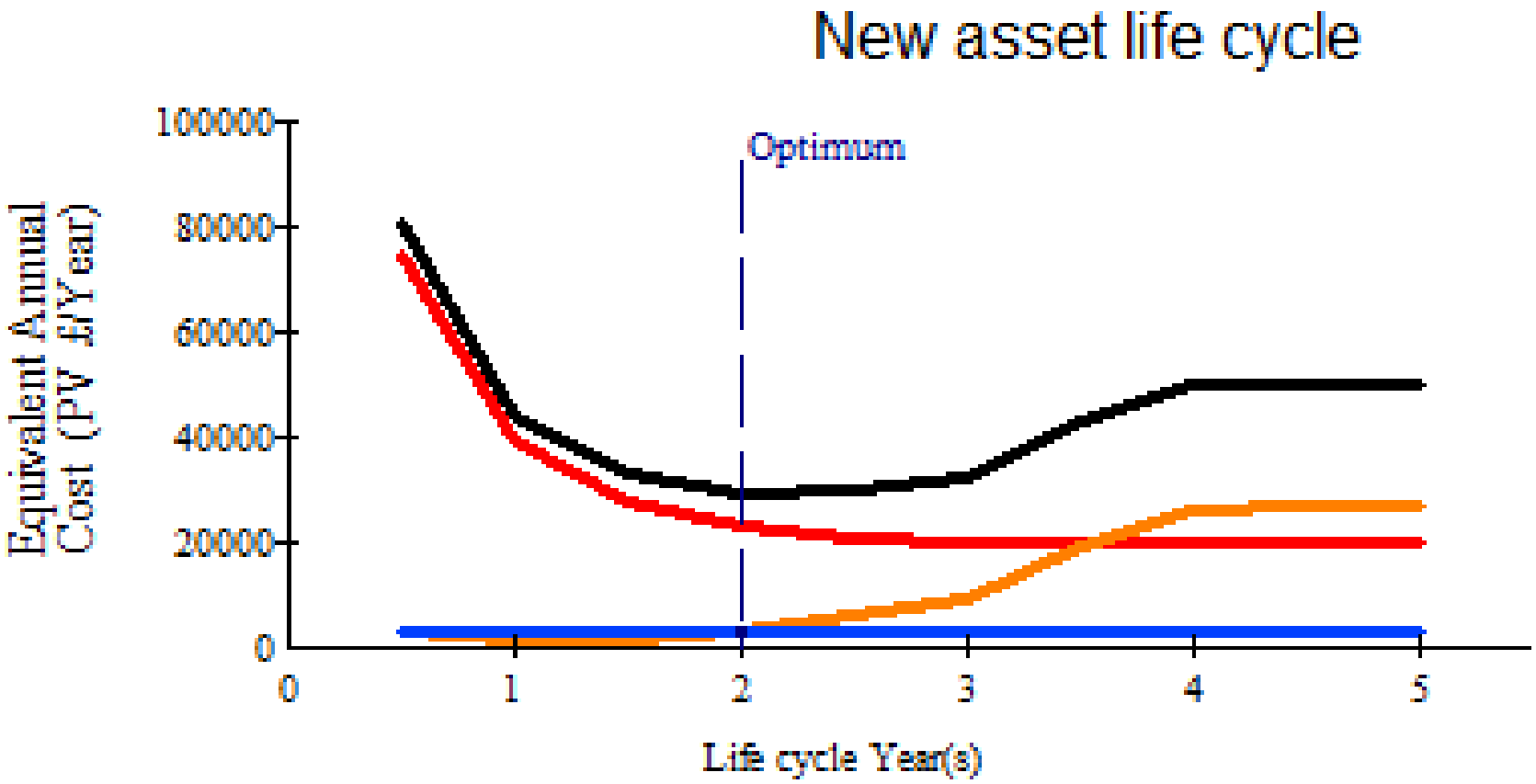
Case 2: Membranes for water purification: (big plants in cities)



Small water purification plants:
(Each membrane cleaning requires water importing)



Draft conclusion:

- Membranes cannot be kept in stock as they deteriorate quickly
- The deterioration of membranes in service will enable functional failure to be predicted and replacement planned for with some certainty
- Condition based preventive replacement of membranes will produce considerable benefits
- Smaller plants need to consider replacing membranes at shorter intervals that larger plants, due to the increasing cost of importing water to make up for the loss of production output due to chemical cleaning. (Larger plants can accommodate this loss of output and without inconveniencing customers)

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Case 3:
1807 PMs for work bundling

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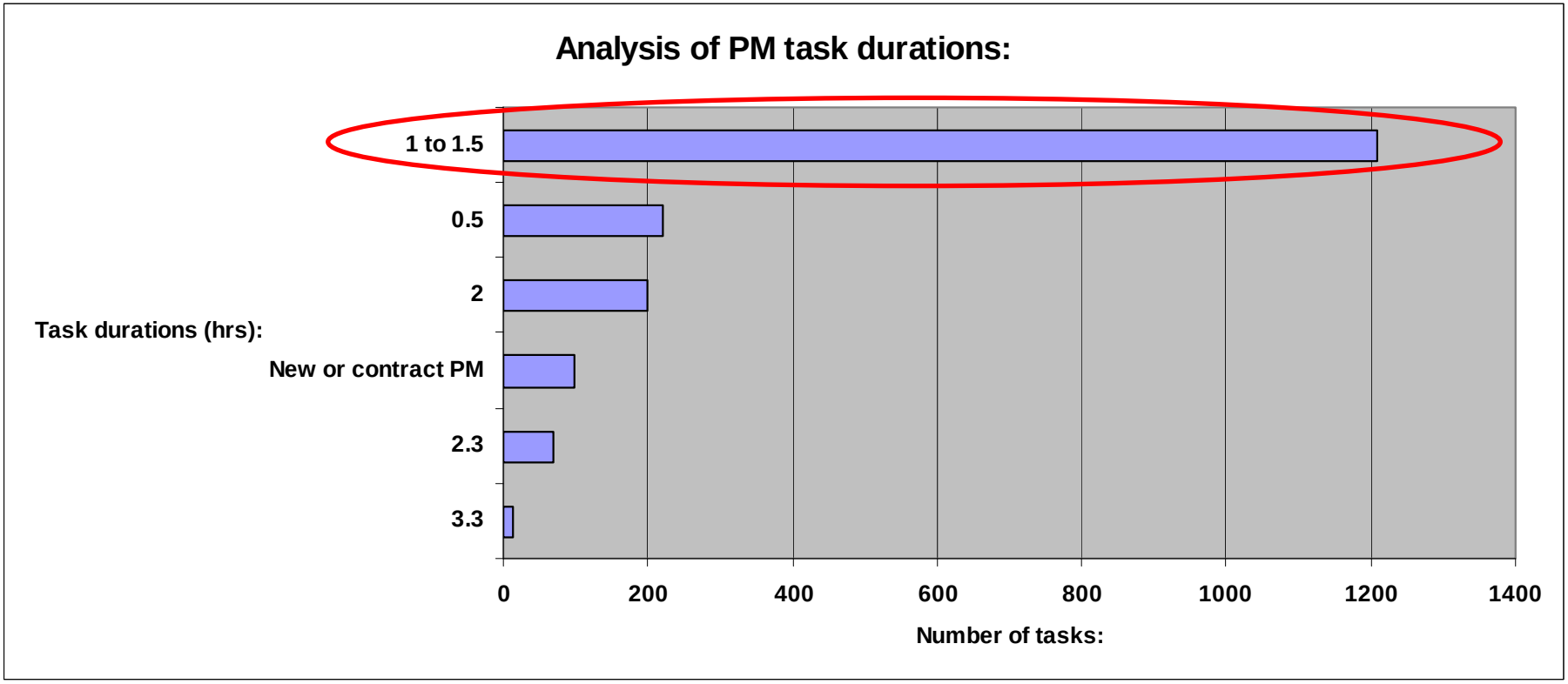
PM task durations:



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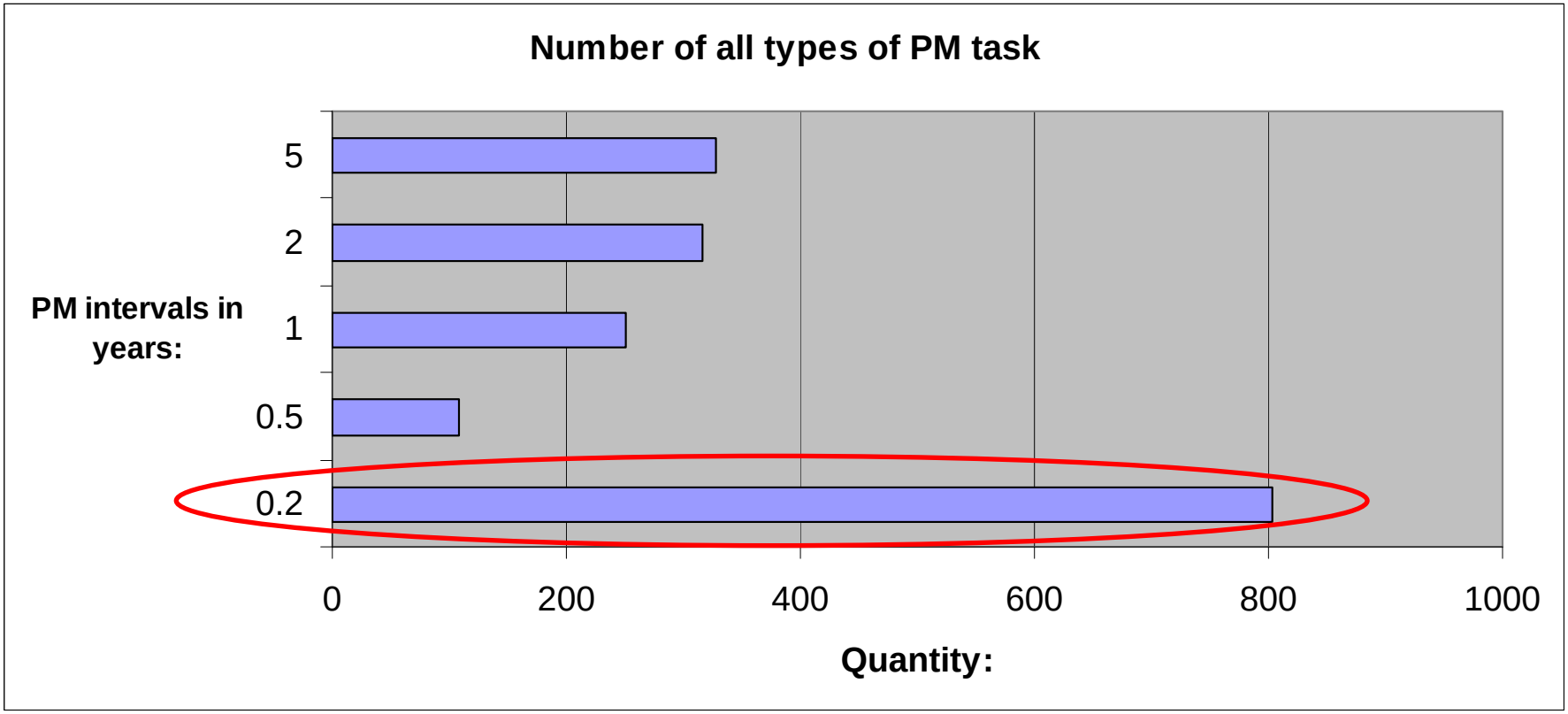
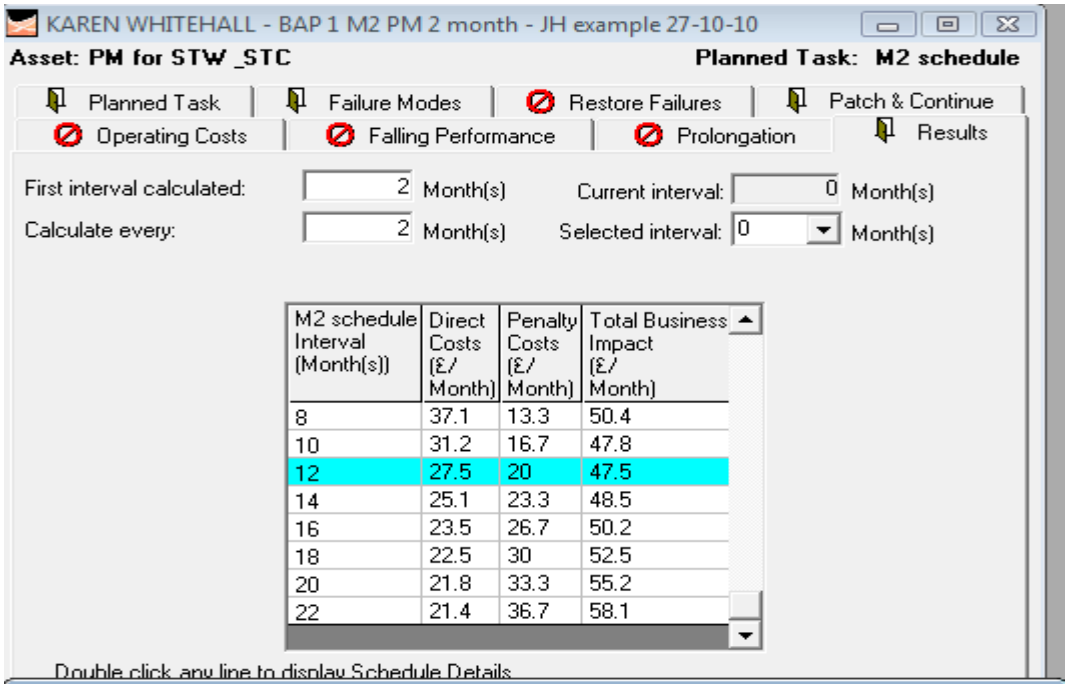
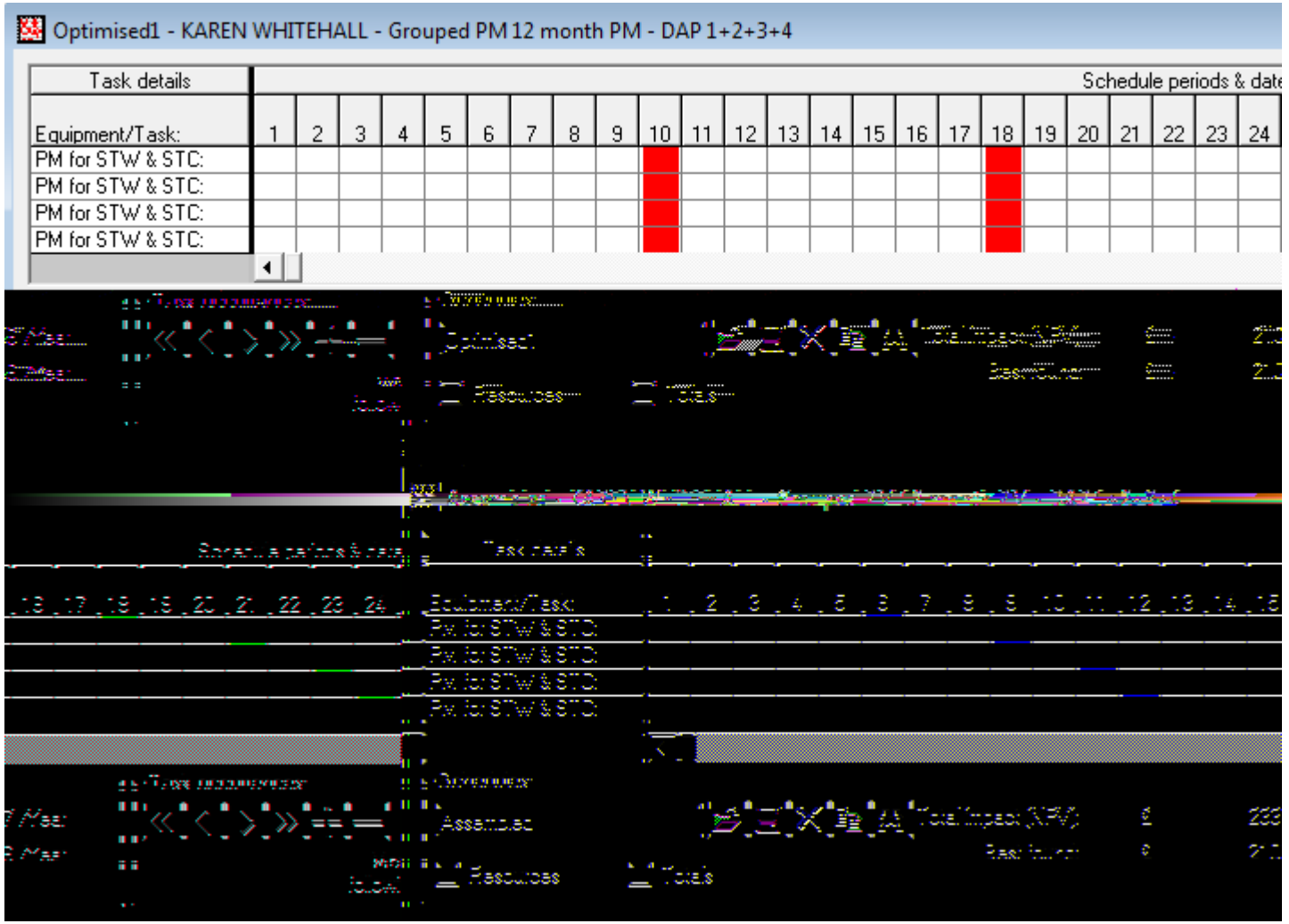
PM task intervals:



First task (reverse) optimised in APT-MAINTENANCE to get 1yr interval:



APT-SCHEDULE analysis of the four 12 monthly PM tasks:



First task (reverse) optimised in APT-MAINTENANCE to get 3yr interval:

KAREN WHITEHALL - BAP 1 M2 PM 36 months 6mth - JH example 27-10-10

Asset: PM for STW _STC **Planned Task: M2 schedule**

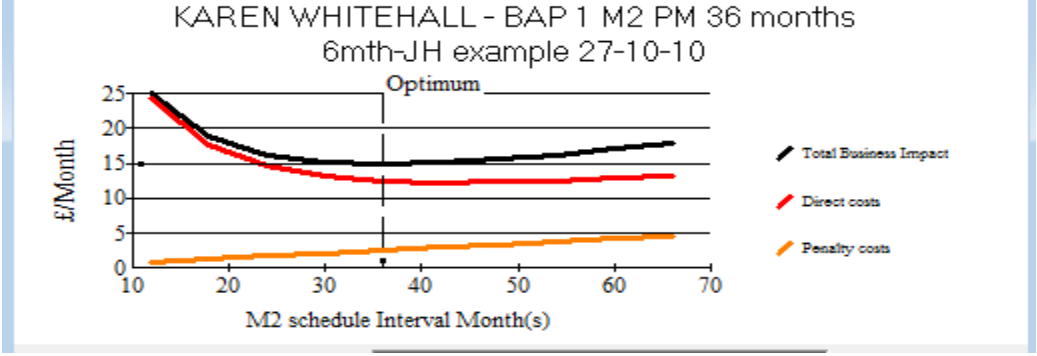
Planned Task | Failure Modes | Restore Failures | Patch & Continue | Operating Costs | Falling Performance | Prolongation | Results

First interval calculated: 12 Month(s) Current interval: 0 Month(s)

Calculate every: 6 Month(s) Selected interval: 0 Month(s)

M2 schedule Interval (Month(s))	Direct Costs (£/ Month)	Penalty Costs (£/ Month)	Total Business Impact (£/ Month)
24	14.6	1.67	16.3
30	13.2	2.08	15.3
36	12.5	2.5	15
42	12.3	2.92	15.2
48	12.3	3.33	15.6
54	12.5	3.75	16.3
60	12.8	4.17	17
66	13.3	4.58	17.8

KAREN WHITEHALL - BAP 1 M2 PM 36 months 6mth - JH example 27-10...



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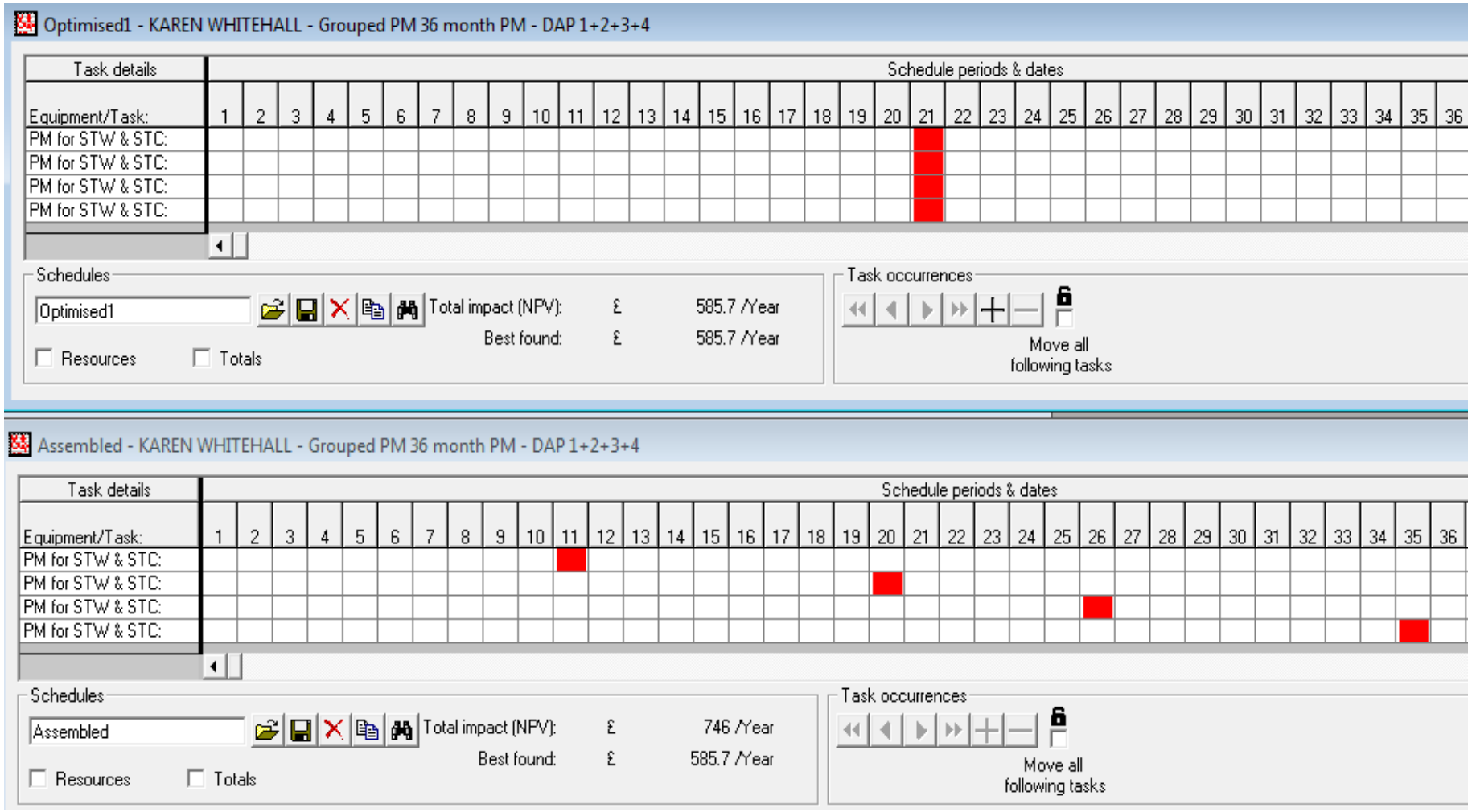

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Draft conclusion:

- The initial step of packaging work on a daily basis will improve field staff efficiency by 10% to 20%

- Optimising intervals between PPMs could produce even larger benefits.

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End

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