

Utilizing

Available Maintenance Data, Experience and Skills to Enhance the Performance of Rotating Equipment Cost-Effectively

A Case Study

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همایش

بین‌المللی مدیریت فنی و نگهداری و تعمیرات

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Project Summery

Summary

- * In order to contribute to the improvement of rotating equipment performance in a cost-effective way, this project proposed a consistent model, which utilizes eMaintenance Decision Support System (eMDSS)
- * The model proposes technical and economic indicators in favor of improving the utilization of at disposal but not utilized maintenance resources including maintenance data, personnel skills and experience to enhance maintenance performance.
- * The study utilizes eMDSS, which provides an intelligent facilitator for improvement of accurate decision-making and identifying and prioritizing maintenance problems and investments.
- * Based on cost-effective scenario for future with a saving value exceeding 133K€ and profit of 114K€ for just one case equipment throughout hundreds
- * Reliability of the achieved results are tested and approved in detail.

Agenda

- * Introduction to the Problem*
- * Model Development into Analysis*
- * Degree Project Outcomes*
- * Project applicability/side effects at Case Company*

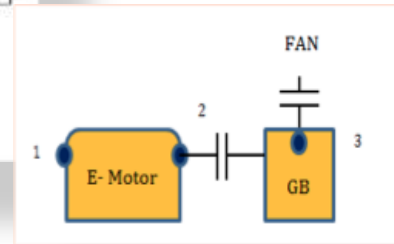
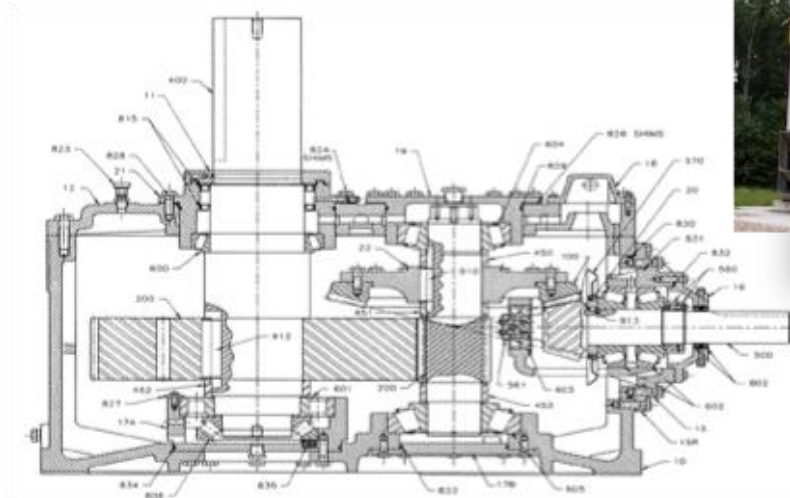
Literature survey approach

19 keywords are used in different combinations to cover the whole aspects by searching in 6 scholar search engines; Including but not limited to:

- Maintenance Accurate decision making
- Cost-effective decision making
- Maintenance performance / Skills / Data / Experience
- Analysis tool / Model
- Maintenance Profitability
- Trend extrapolation
- ...

Case study

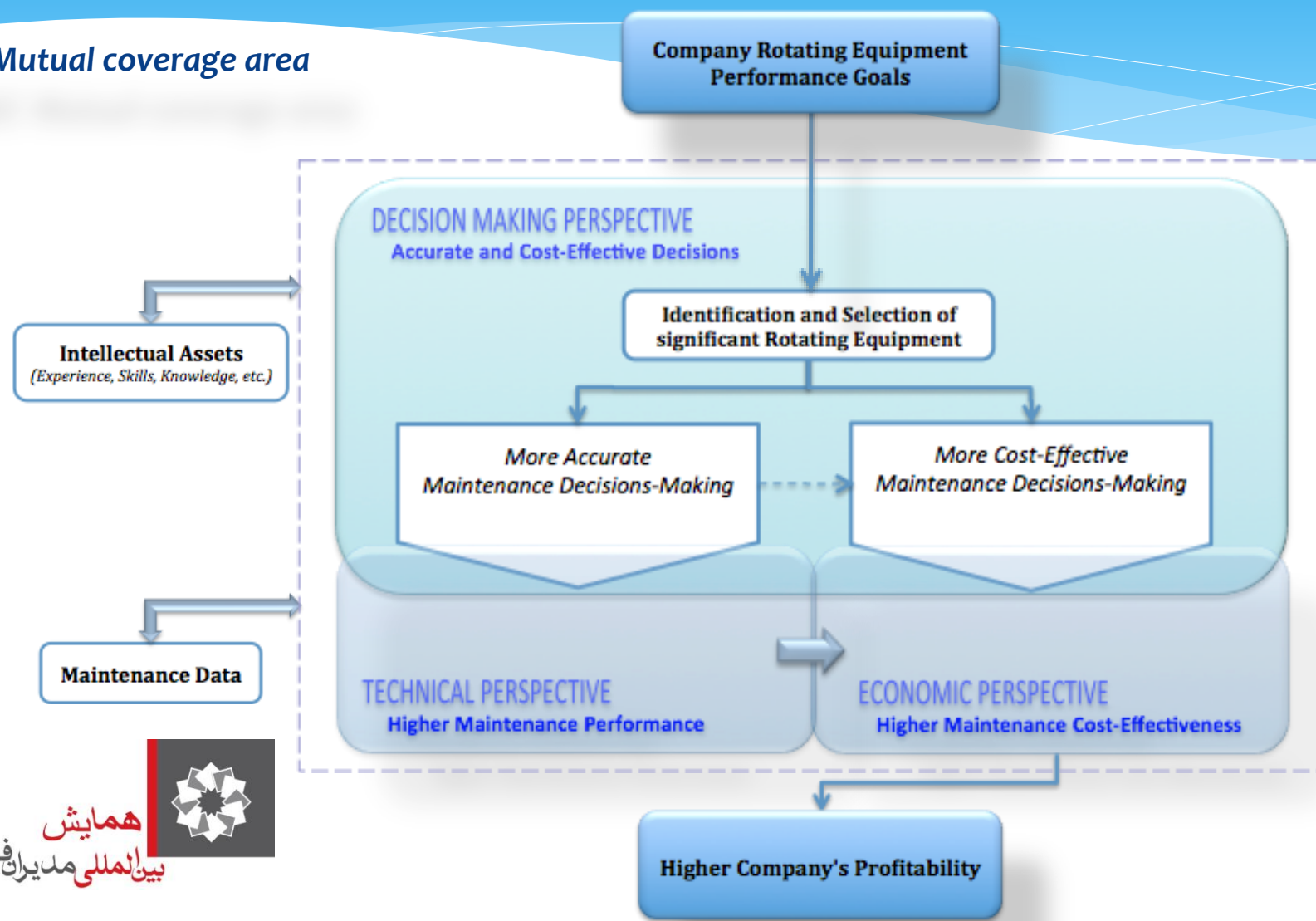
- * Selected Maintenance Strategy: VBM (Vibration Based Maintenance)
- * Selected candidate: Cooling tower gearbox (NK4-M-K842)



Model Development

General view

Overlaps: Mutual coverage area



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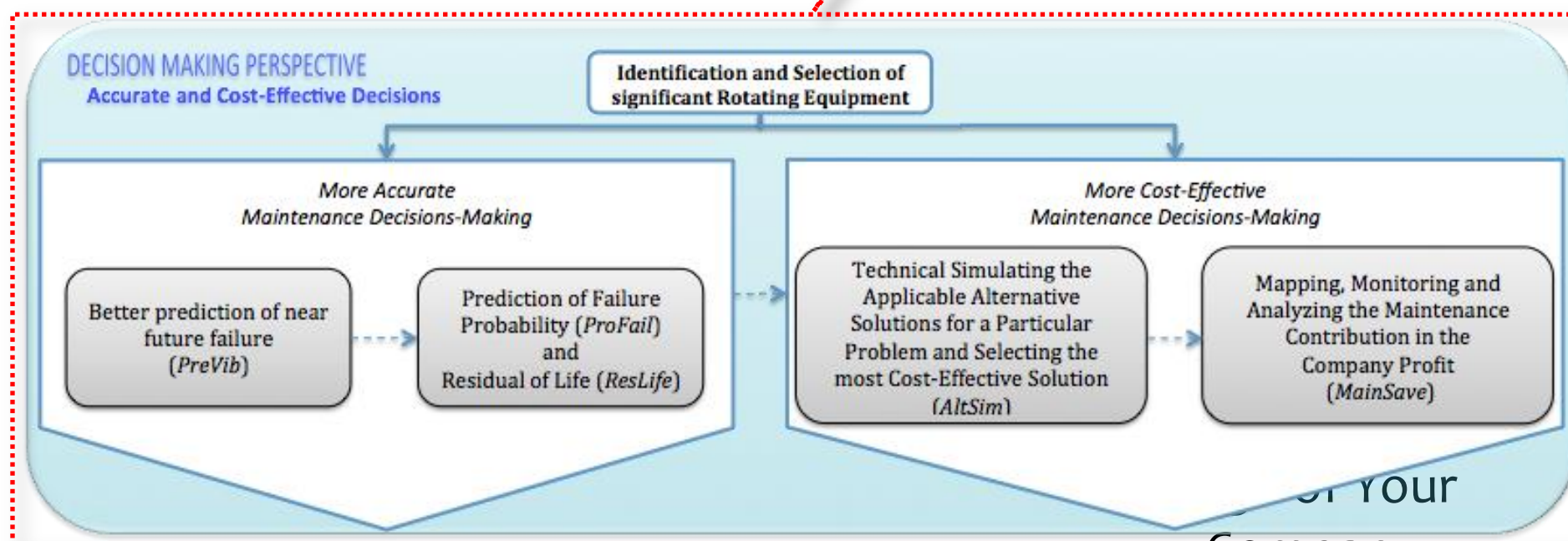
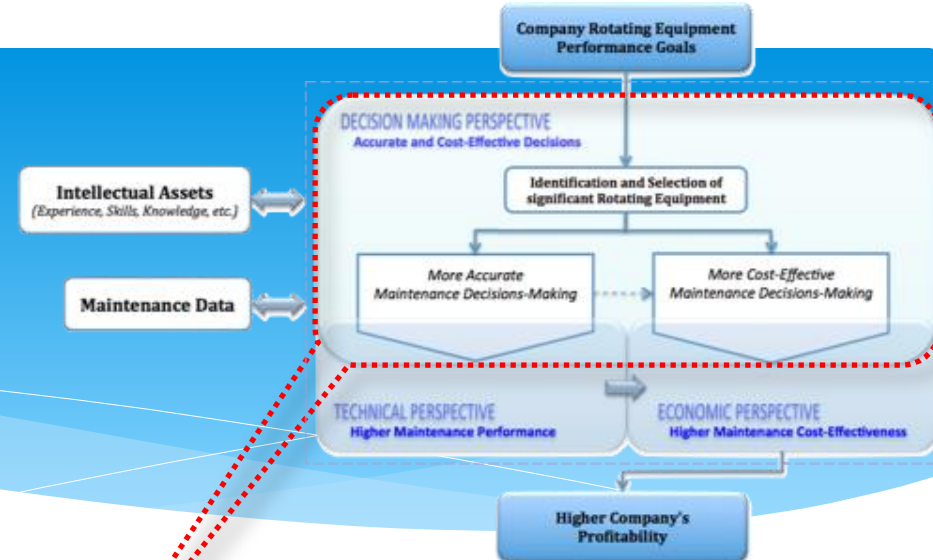
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Model Development

Decision-Making perspective



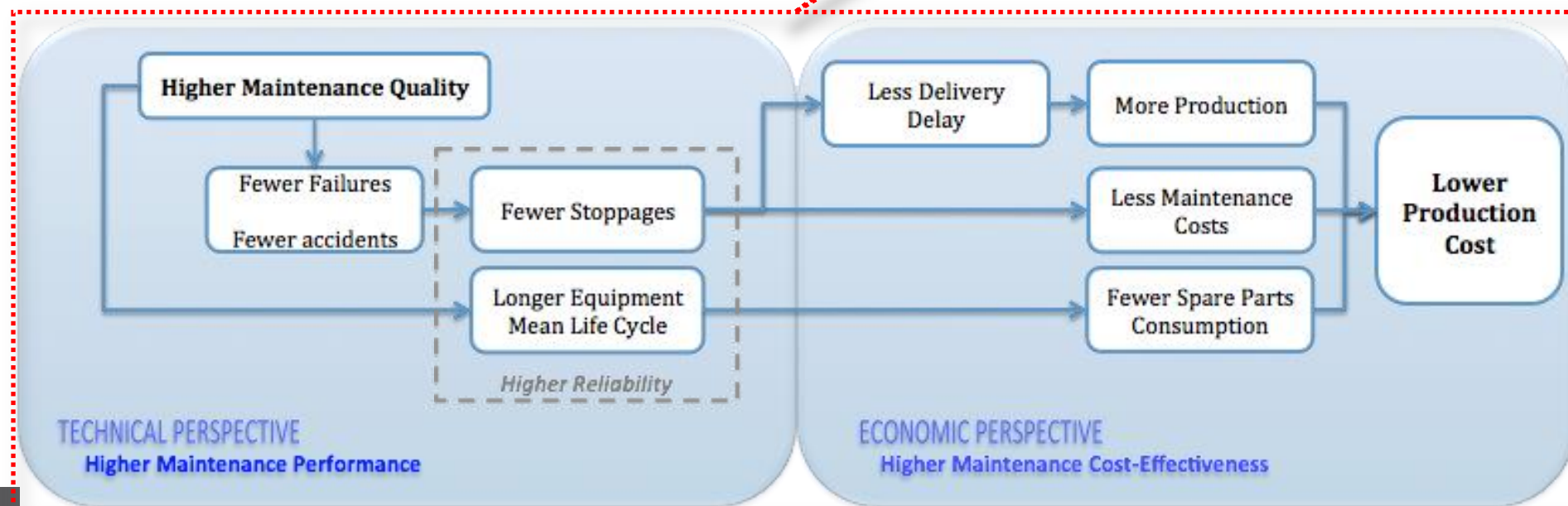
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Model Development

Technical and Economic Perspectives



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From Model to Analysis

eMDSS (tested successfully in Volvo; FIAT; Stora enso; Gurato, etc.)

The project recognized and utilized eMDSS software as an analysis tool/facilitator

Technical analysis

future vibration predictions; residual life; failure probability

The software learns from failures and corrects its predictions (intelligent)

Economic analysis

Cost-effectiveness analysis for previous maintenance investments

&

Cost-effectiveness analysis for future maintenance scenarios

*Accurate
Decisions*

*Investment
Simulations*

*Maintenance
Savings*

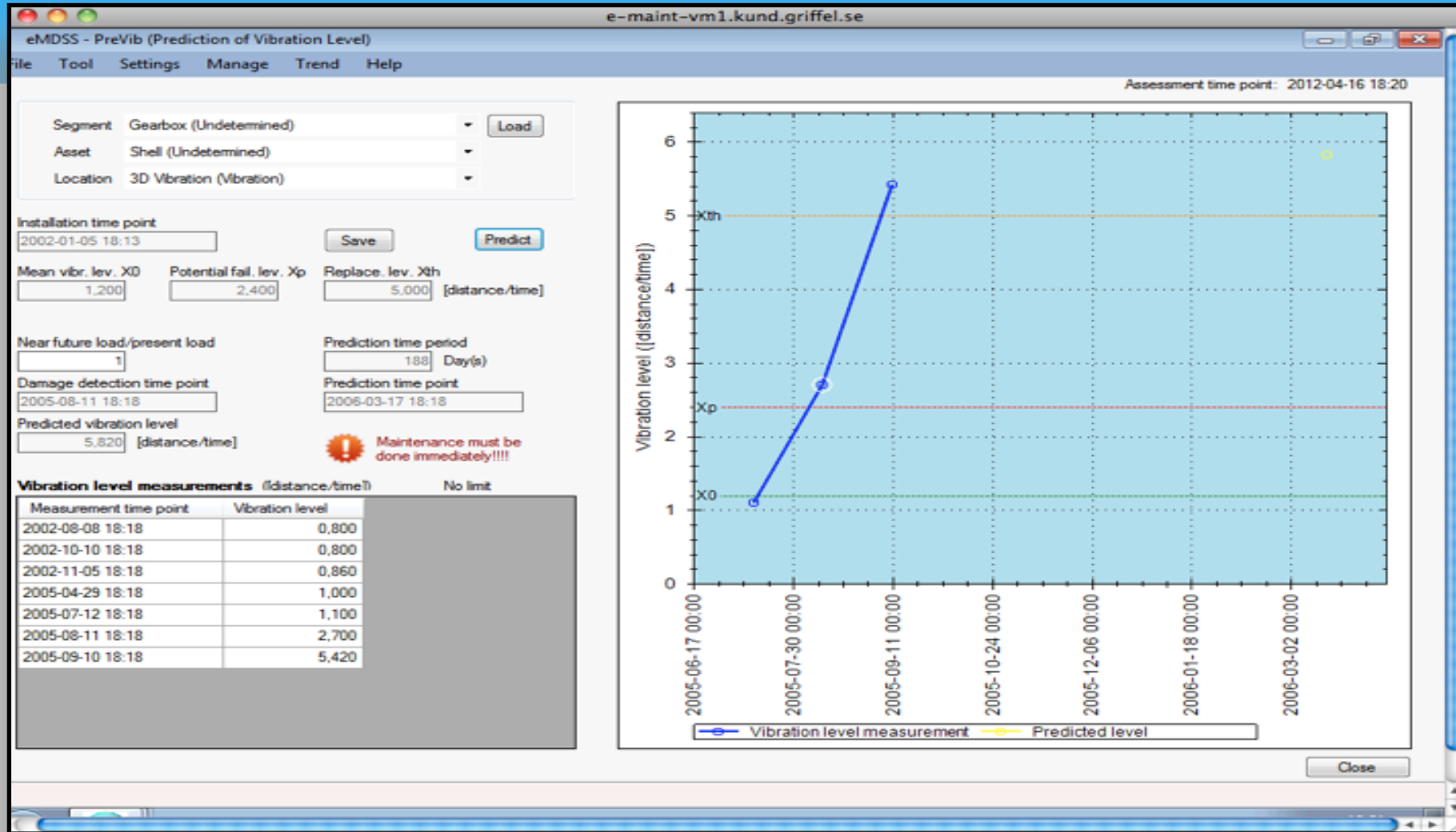


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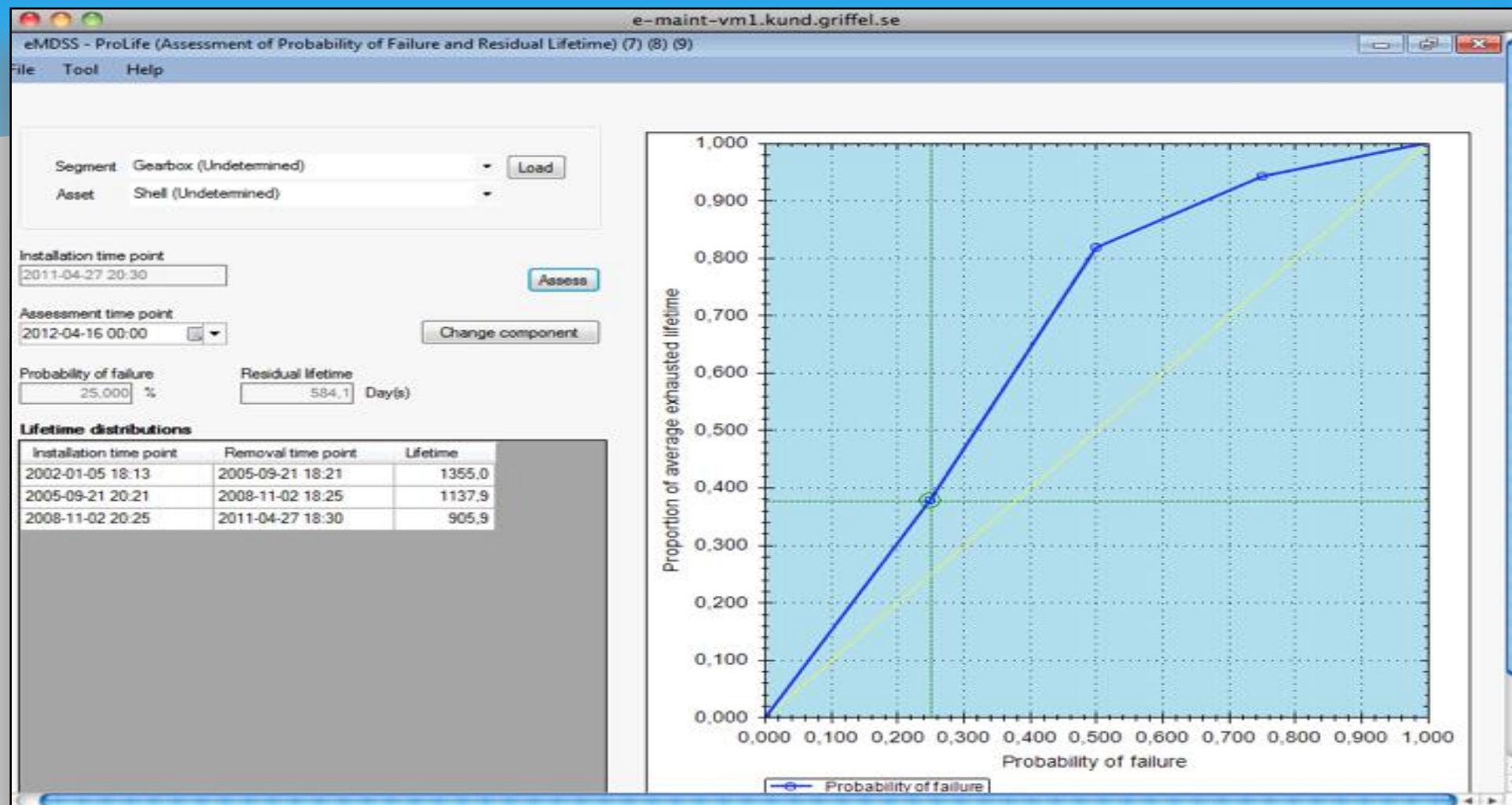
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PreVib (Prediction of Vibration Level)



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ProLife (Probability of Failure)



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MainSave (Maintenance Savings)

eMDSS - MainSave (Maintenance Savings & Performance)

File Settings Help Manage

Segment: Gearbox - process

Previous period start: 2005-05-24 00:00:00

Current period start: 2008-11-02 00:00:00

Current period end: 2012-04-13 00:00:00

Assessment time point: 2012-05-17 01:16

Profit margin previous period: 6,42 [currency/quantity]

Total investment: 30388 [currency]

Depreciation period: 10 Year(s)

Clear

Savings

Total saving (Loss): 67428,9 [currency/period]

Profit (Loss): 56955,5 [currency/period]

Rate of saving to investment: 6,438 times

Rate of investment to potential saving: 15,423 %

Maintenance investment

Investment per period: 10473,5 [currency/period]

Rate of total saving to potential saving: 99,294 %

OEE (%)

Previous period	Current period	Difference
99,67	99,84	0,17

Potential saving: 67908,0 [currency/period]

Failures

Include ☒

Number of failures: Previous period: 2, Current period: 1 [number]

Average failure time previous period: 48,0 Hour(s)

Saving (Loss): 15408,0 [currency/period]

Average failure time

Include ☒

Average failure time: Previous period: 48,0, Current period: 48,0 Hour(s)

Number of failures current period: 1 [number]

Saving (Loss): 0,0 [currency/period]

Production

Production rate current period: 50,000 [quantity/time]

Production time current period: 30144,0 Hour(s)

User defined expenses [[currency/period]]

Include ☒

Type of expense	Previous period	Current period	Saving (Loss)	Include
Gearbox Repair Cost	74457,0	36750,0	37707,0	<input checked="" type="checkbox"/>
Logistics and Man...	30064,0	15750,0	14314,0	<input checked="" type="checkbox"/>

Short stoppages

Include ☒

Number of short stoppages: Previous period: 0, Current period: 0 [number]

Average short stoppage time previous period: 0,0 Hour(s)

Saving (Loss): 0,0 [currency/period]

Quality production

Include ☒

Quality rate: Previous period: 1,000, Current period: 1,000

Saving (Loss): 0,0 [currency/period]

Close



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AltSim (Alternative Simulations)

eMDSS - AltSim (Alternative Simulations)

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Segment: Gearbox - process

Reference period: 2005-05-24 00:00:00 - 2012-04-13 00:00:00

Anticipated period: 2012-04-14 00:00:00 - 2022-04-12 00:00:00

Load

Reference | Alternative 1 | Alternative 2 | Alternative 3 | Results

Investments alternative summaries

Priority	Type of investment	Total saving (Loss) [currency/period]	Profit (Loss) [currency/period]	Rate of saving to investment %	Potential saving [currency/period]	Conf. level %
1	Alternative3 Alternative Scenario-3	133741,0	114741,0	703,900	69360,0	95
2	Alternative1 Alternative Scenario-1	64381,0	49381,0	429,207	138720,0	60
3	Alternative2 Alternative Scenario-2	6541,0	-29459,0	18,169	196560,0	80

Sort alternatives according to...

☐ rate of saving to investment

☒ profit

Save

Close



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Project Outcomes

- * Higher accuracy in prediction of potential failures
 - * Just in one case, 148.6K€ cost could have been postponed—at least- for three months
- * Higher accuracy in calculating failure probability and residual lifetime
 - * The last gearbox replacement in 2011 estimated to work for another 584 days with 25% probability of failure.

Project Outcomes (continued)

- * Selection of the most cost-effective maintenance scenario
 - * the company is recommended to focus on scenario-C with the highest total saving (133,837€) and least potential savings (69,408€).
- * Mapping and monitoring previous maintenance investments:
 - * 25K€ investments in 2008; 67,429€ of savings; 0.17% improvement in OEE; and still 56,955€ of potential saving.

Thesis Achievements

- * **EFNMS** (European Federation of Maintenance Societies) Excellence Award
for Best Master Thesis in Maintenance (as the Runners-up)

Helsinki, Finland – 5/2014

- * **Utek** (Swedish Maintenance Technology Society) Award
for the best Master thesis in the field of Asset Management, Availability and Maintenance

Stockholm, Sweden – 5/2013

- * **Sparbanksstiftelsen Kronan** Degree project Scholarship Award
for proven high creativity, entrepreneurship and innovation

Halmstad, Sweden – 11/2012

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Thanks You

Should you require any more information,
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