AGENDA

01 Service Design Development

02 Data preparation

03 Model implementation

04 Technical Validation

05 Service Implications

06 Conclusion

01.

Service Design Development

" How might we improve the efficiency of HBI's maintenance process? "

Value Proposition

Predictive model for maintenance based on historical data

1

Early alert of failure events of devices

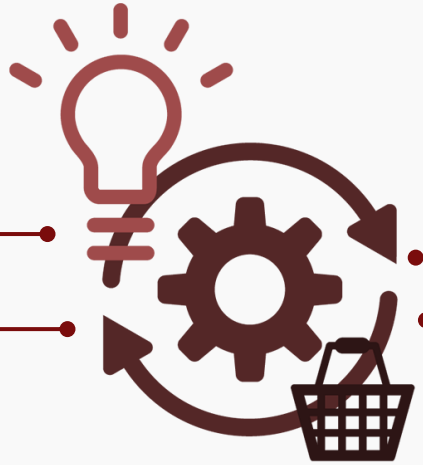
2

Information about the correlation among the failed luminaires

Pain Relievers

Enable HBI to act promptly towards device failure

Enhance the product life cycle



Lower maintenance costs for HBI by route optimization

Increase in Customer Satisfaction for HBI's customers and building users

Gains Creators

Decrease uncertainty in HBI's daily tasks

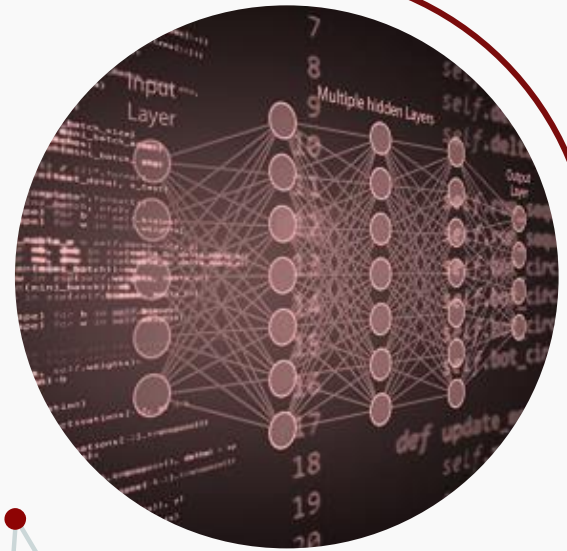
More control over costs

Secure long-term customer relationship

Facilitates Circular Economy in HBI's processes

02.

Data Preparation



Filtering

Data Frame

Device ID	Time	Battery voltage	Failure flag	Devices (app_id)
94df83...	2021-01-28 07:51:37	4337	0	sqippa-autogen
...	...	...	...	sqippa-autogen
...	...	...	...	adeunis_products
...	...	...	...	sqippa-autogen

Devices

app_id == “sqippa-autogen”

Variables

- ✓ Device ID
- ✓ Time
- ✓ Battery voltage
- ✓ LED intensity
- ✓ Temperature
- ✓ Failure flag

Compression

Before

Time	Battery Voltage	Failure Flag
2021-01-28 07:51:37	4337	0
2021-01-29 15:48:46	4251	0
2021-01-29 23:43:55	4254	0
2021-01-30 23:40:52	4251	0
2021-01-31 15:41:17	4287	0
2021-01-31 23:38:50	4249	0
2021-02-01 07:37:44	4258	0
2021-02-02 23:35:44	4286	0
2021-02-03 07:31:44	4249	0
2021-02-03 23:29:32	4271	0
2021-02-04 07:30:15	4274	0
2021-02-04 23:28:06	4261	0
2021-02-05 07:27:35	4282	0
2021-02-06 15:22:33	4274	0
2021-02-08 07:14:33	4258	0

Simple Average

After

Time	Battery Voltage	Failure Flag
2021-01-28	4337.000	0
2021-01-29	4252.500	0
2021-01-30	4251.000	0
2021-01-31	4268.000	0
2021-02-01	4258.000	0
2021-02-02	4286.000	0
2021-02-03	4260.000	0
2021-02-04	4267.500	0
2021-02-05	4282.000	0
2021-02-06	4274.000	0
2021-02-07	*NA*	*NA*
2021-02-08	4258.000	0
2021-02-09	4258.000	0
2021-02-10	4264.000	0
2021-02-11	*NA*	*NA*

Imputation

Before

Time	Battery Voltage	Failure Flag
2021-01-28	4337.000	0
2021-01-29	4252.500	0
2021-01-30	4251.000	0
2021-01-31	4268.000	0
2021-02-01	4258.000	0
2021-02-02	4286.000	0
2021-02-03	4260.000	0
2021-02-04	4267.500	0
2021-02-05	4282.000	0
2021-02-06	4274.000	0
2021-02-07	*NA*	*NA*
2021-02-08	4258.000	0
2021-02-09	4258.000	0
2021-02-10	4264.000	0
2021-02-11	*NA*	*NA*

Linear Weighted Moving Average

Linear Weighted Moving Average

After

Time	Battery Voltage	Failure Flag
2021-01-28	4337.000	0
2021-01-29	4252.500	0
2021-01-30	4251.000	0
2021-01-31	4268.000	0
2021-02-01	4258.000	0
2021-02-02	4286.000	0
2021-02-03	4260.000	0
2021-02-04	4267.500	0
2021-02-05	4282.000	0
2021-02-06	4274.000	0
2021-02-07	4269.381	0
2021-02-08	4258.000	0
2021-02-09	4258.000	0
2021-02-10	4264.000	0
2021-02-11	4269.136	0

Lags

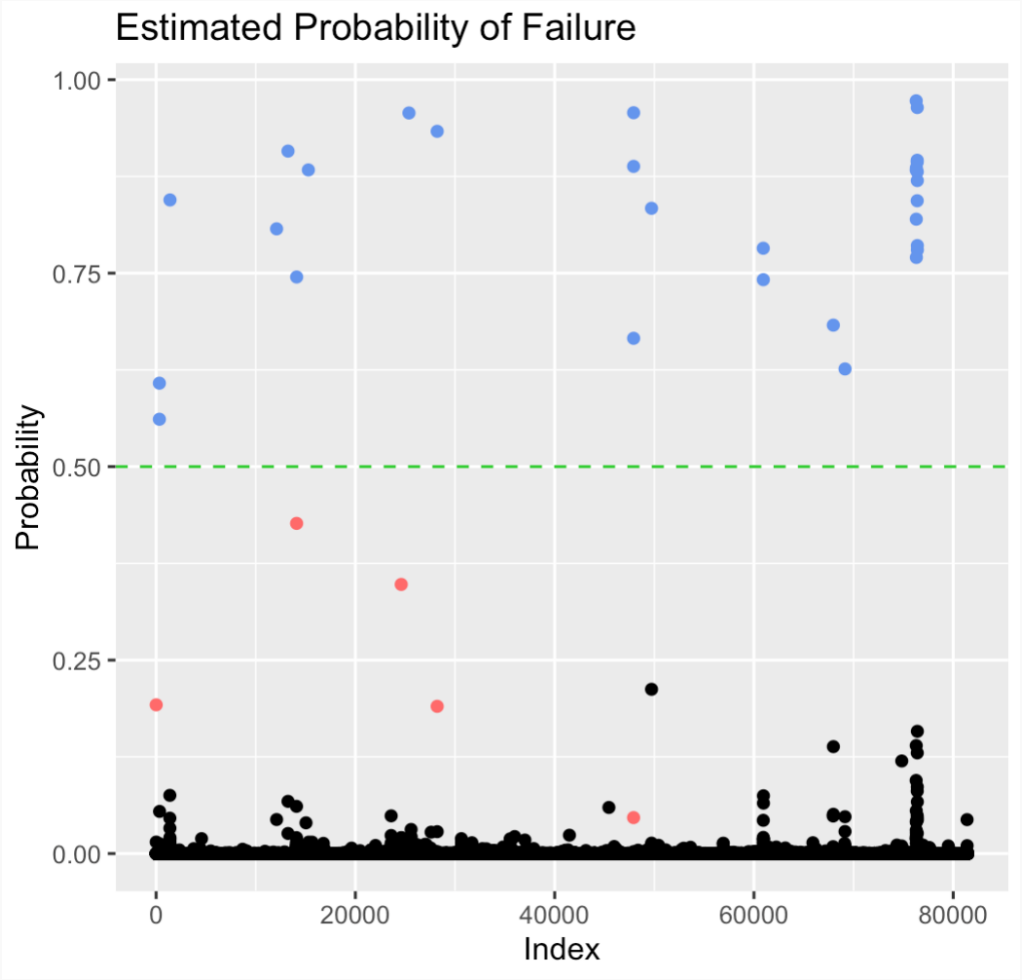
Time	Battery Voltage	Battery Voltage Lag 1	Battery Voltage Lag 2
2021-01-28	4337.000	*NA*	*NA*
2021-01-29	4252.500	4337.000	*NA*
2021-01-30	4251.000	4252.500	4337.000
2021-01-31	4268.000	4251.000	4252.500
2021-02-01	4258.000	4268.000	4251.000
2021-02-02	4286.000	4258.000	4268.000
2021-02-03	4260.000	4286.000	4258.000
2021-02-04	4267.500	4260.000	4286.000
2021-02-05	4282.000	4267.500	4260.000

03.

Model Implementation

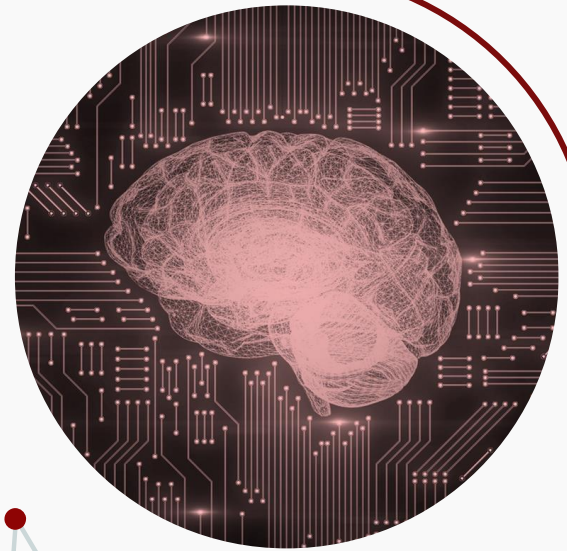
Predictors
Battery voltage Lag 1
Battery voltage Lag 2
LED intensity Lag 1
LED intensity Lag 2
Temperature Lag 1
Temperature Lag 2
Failure flag Lag 1
Failure flag Lag 2

Outcome
Estimated probability of Failure


Estimated Probability of Failure
1.00
0.75
0.50
0.25
0.00
Probability
0
20000
40000
60000
80000
Index

04.

Technical Validation



Results and Discussions

Data Cleaning

44 Errors out of
300.000 observations

Training Set

33 Errors (75%)

Test Set

11 Errors (25%)

Suggestions

Acquisition of external data

Improve the depth and width of the data currently possessed by HBI

Simulate data on laboratories

- Have a better understanding of the variables and the behavior of the devices
- Have enough data to properly train the model

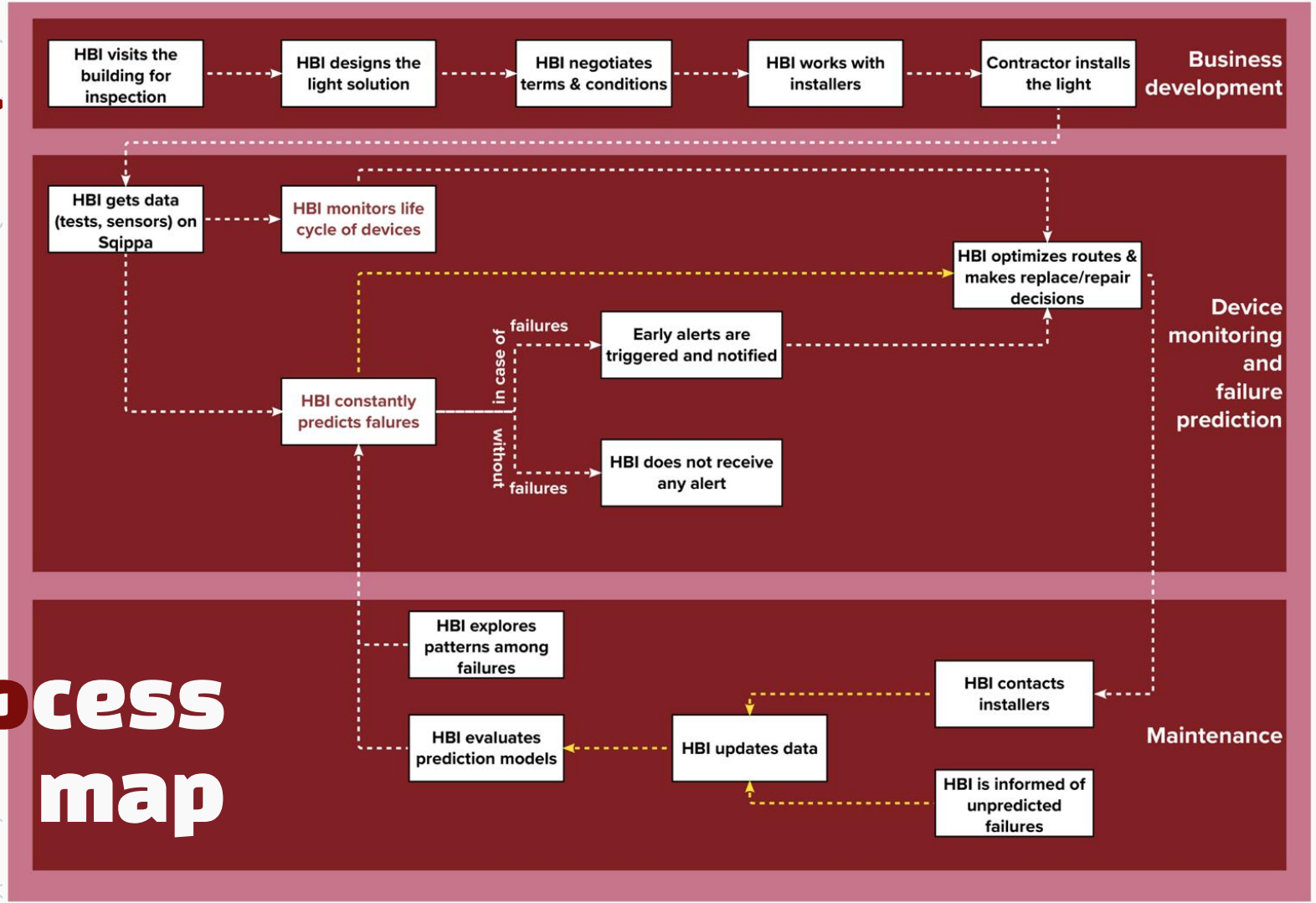
05.

Service Implications

Validity and Potentials of the model

Feature	Gain
payload_fields_battery_voltage_lag1	0.447788
payload_fields_battery_voltage_lag2	0.148353
payload_fields_temperature_microcontroller_lag1	0.113752
payload_fields_led_intensity_lag2	0.100151
payload_fields_temperature_microcontroller_lag2	0.085519
payload_fields_led_intensity_lag1	0.061552
payload_fields_flag_lag1	0.042884

process map


HBI visits the building for inspection
HBI designs the light solution
HBI negotiates terms & conditions
HBI works with installers
Contractor installs the light
Business development
HBI gets data (tests, sensors) on Sqippa
HBI monitors life cycle of devices
HBI optimizes routes & makes replace/repair decisions
HBI constantly predicts falures
in case of failures
Early alerts are triggered and notified
without failures
HBI does not receive any alert
Device monitoring and failure prediction
HBI explores patterns among failures
HBI evaluates prediction models
HBI updates data
HBI contacts installers
HBI is informed of unpredicted failures
Maintenance

06.

Conclusion

3 steps to kick off

Iteratively model data

01

Optimize data collection procedure

02

03

Revise and adapt the process map

THANKS

Do you have any questions?

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