



Machine learning in smart manufacturing

We square the circle.
www.sota-solutions.de



Intro



about us



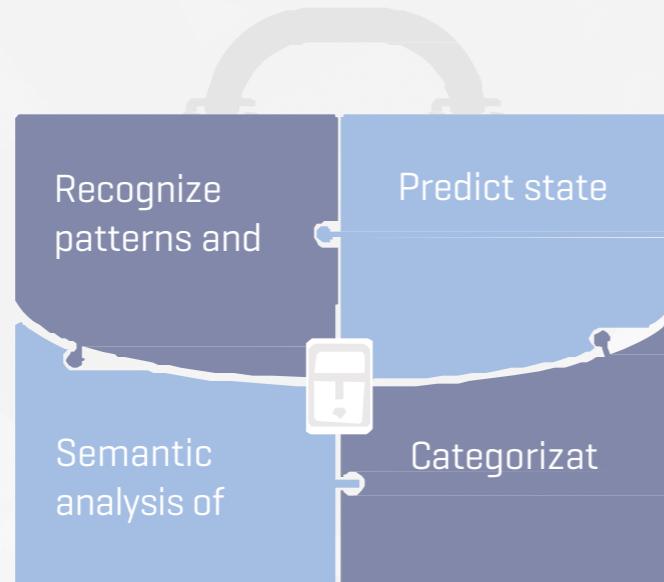
solutions



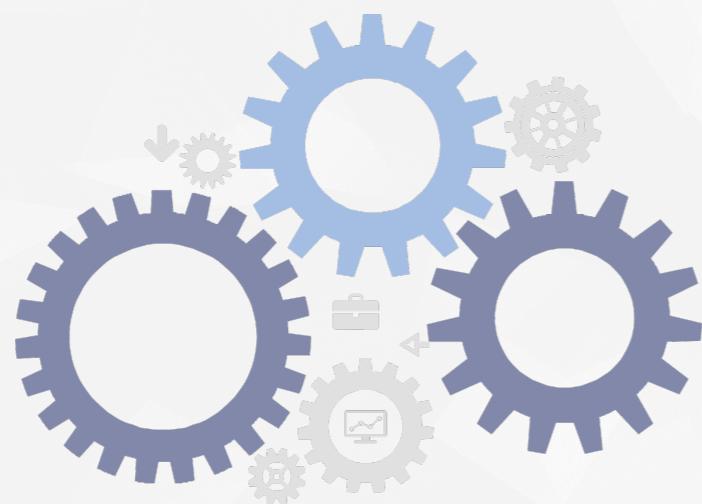
KBA-Demo



SOTA Solutions



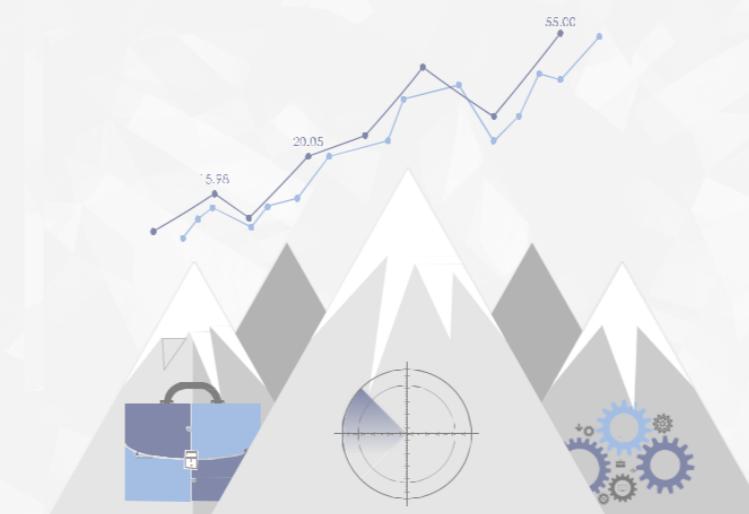
Categorization



Simulation



Forecasts



Optimization



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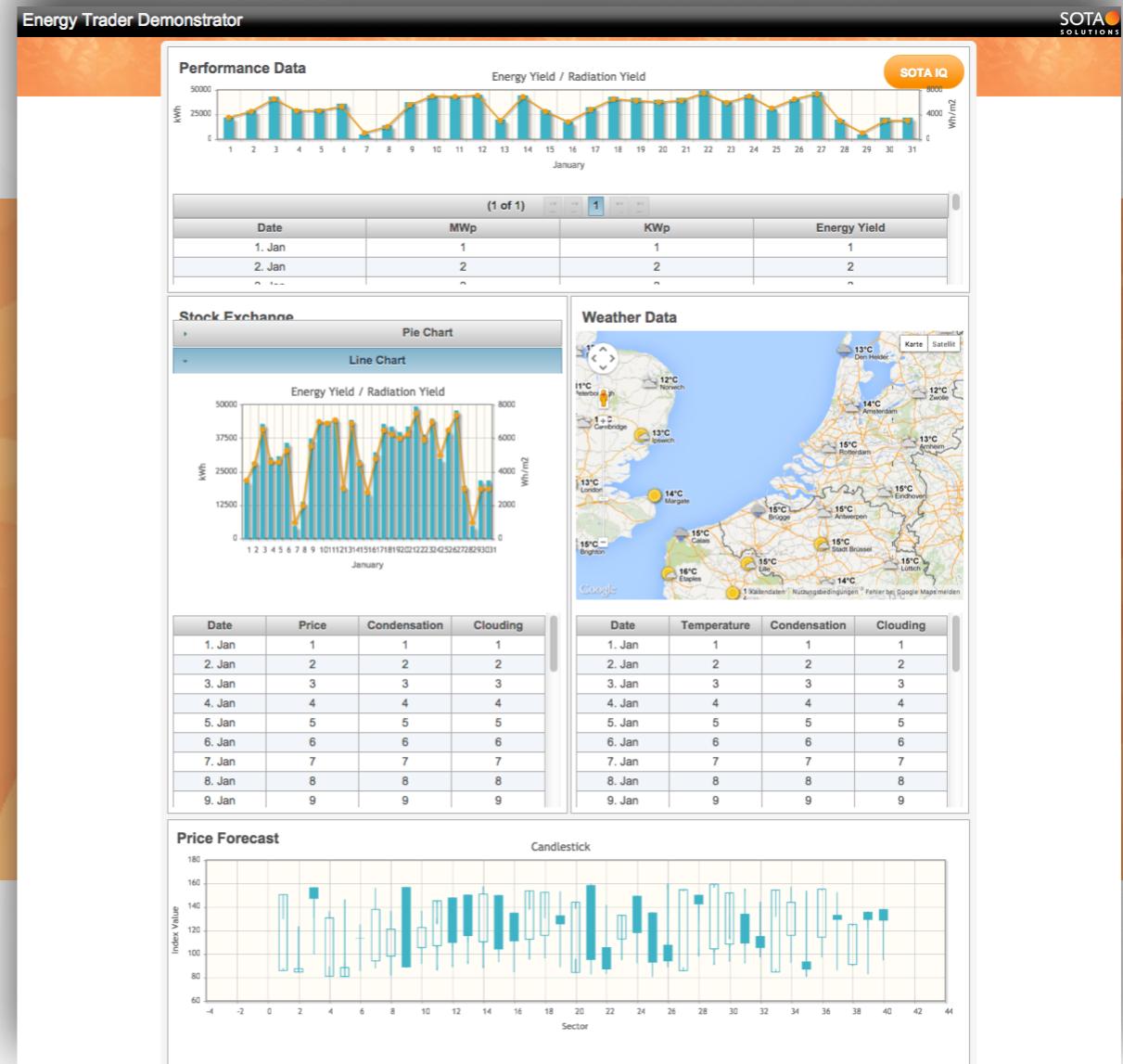


final

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Energy applications

- simulation of biogas power plants
- CHP schedule optimization for power plants
- optimized investment planning
- production- and demand-forecast for energy trading





Intro



about us



solutions



final

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Service applications

- market forecasts (prices, demand, competitor-strategy)
- semantic analysis (document management, text-understanding)
- contextualisation and pattern recognition





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about us



solutions

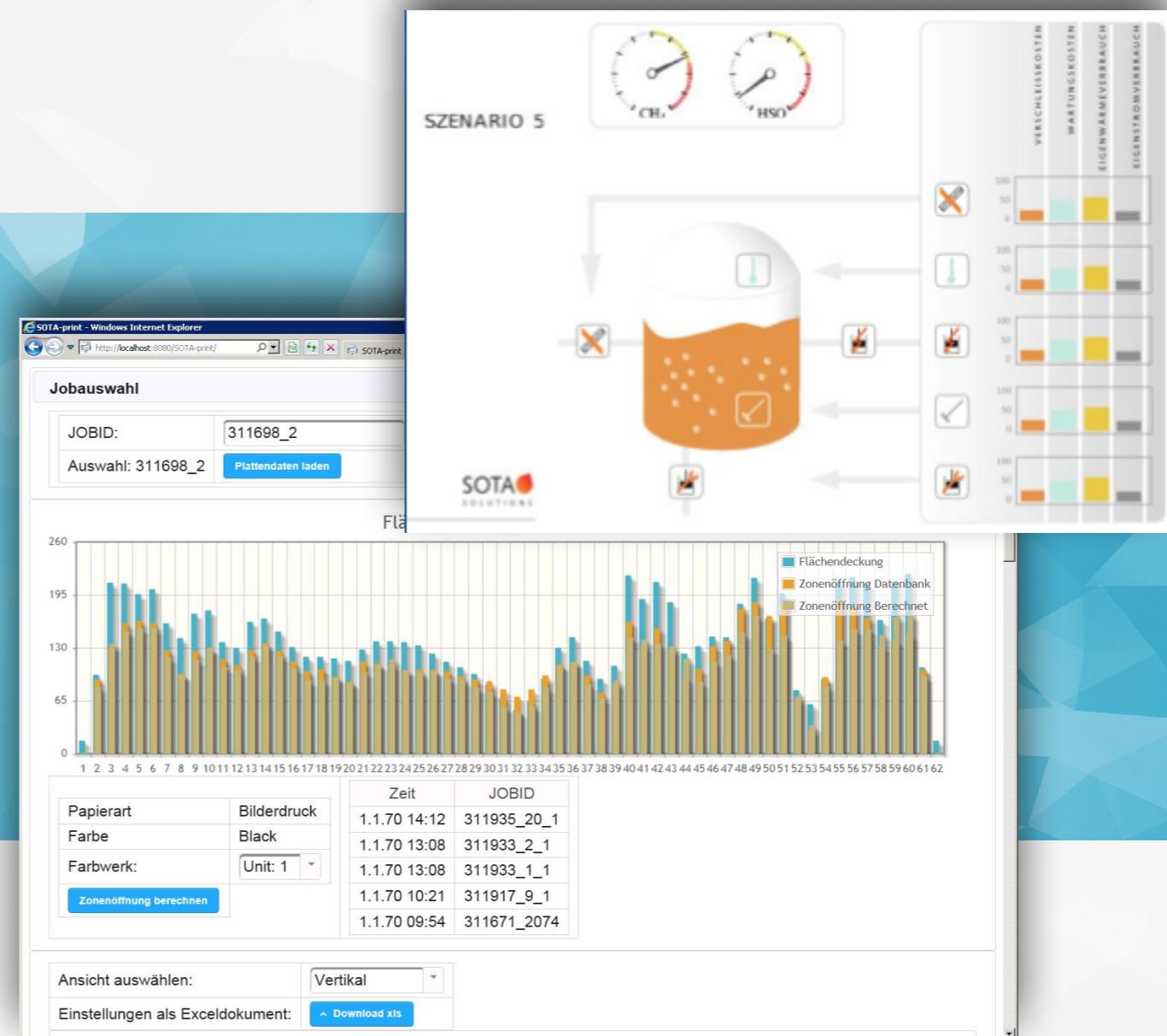


final

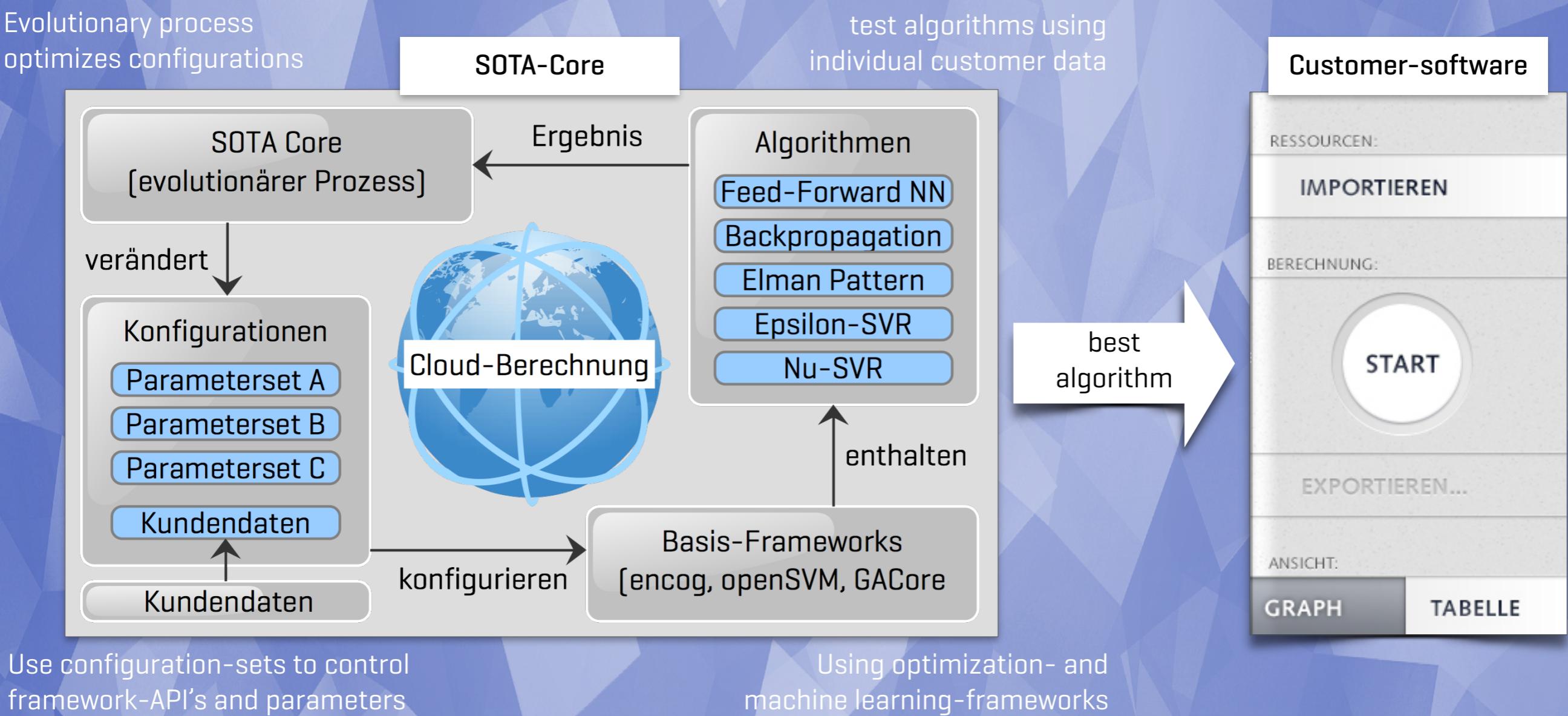
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Industry applications

- mixture optimization in biochemical production
- optimized printing machine setup
- production-scheduling
- energy management



- **Automated software development for machine learning applications**
- Shorten development time, increase quality through meta- & hyper-parameter optimization
- Usage of genetic/evolutionary algorithms, genetic programming, evolutionstrategy, neural nets, support vector machines [GA, EA, GP, ES, NN, SVM]



It's easy to find effective algorithms,
it's very hard to get good training data!

- 1.availability [missing data]
- 2.obscurity [proprietary data]
- 3.variability [attrition influence]
- 4.interoperability [integration]



Application printing industry

Machine parameter optimization

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Unsere Leistungen



KBA-Demo

Printing industry

Self calibrating printing machine

**Reduction of make-ready times is
the challenge our partners**

The development of our SOTA-Print Technology was initiated from printing companies within the Gundlach Group. The application was developed and tested together with our partners at a local printing company in Berlin

Business environment:

- 2 printing machines
- 2 to 4 makeready steps per job
- 13.000 makeready steps per year
- up to 4Mio. sheets of paperwaste per year





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Printing industry

Self calibrating printing machine



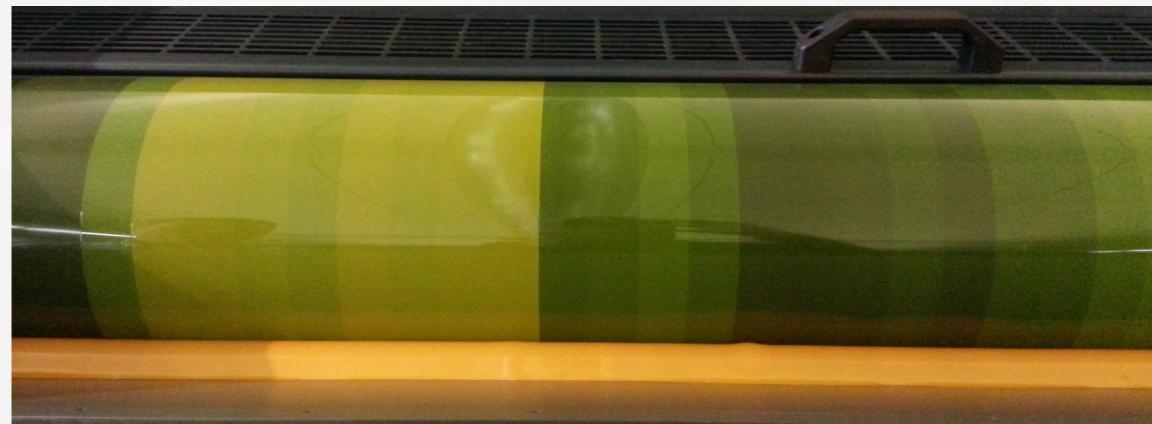
4 printing units

62 zone parameter per unit

2 additional unit settings

10 different colors

60 different materials





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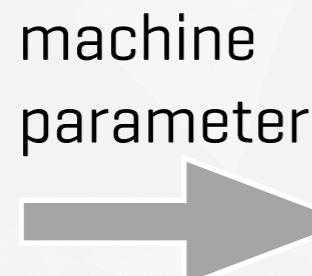
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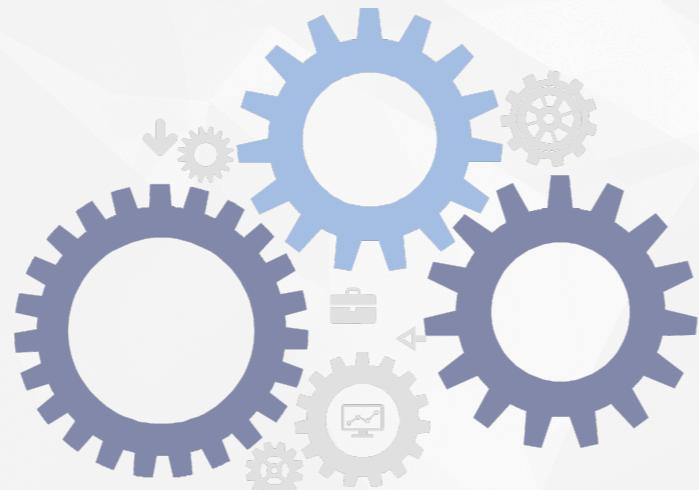
KBA-Demo

Printing industry

Project approach



Learn machine behavior



printing result

```
graph LR; Simulation --> Optimization[Optimization]
```

optimize machine setting





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KBA-Demo



Printing industry

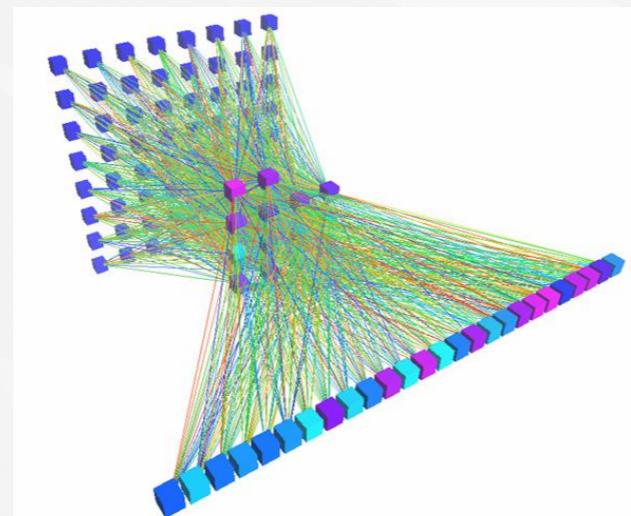
Project approach



machine
parameter



Learn machine behavior



Neural Nets

printing
result



optimize machine setting



Optimization

Database



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Printing industry

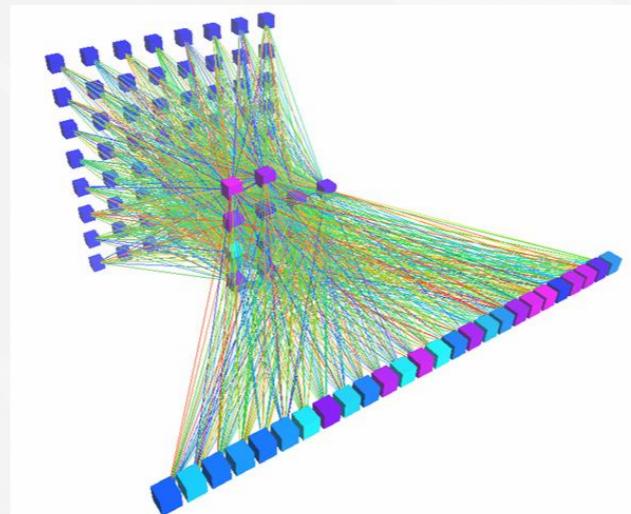
availability problem



machine
parameter



Learn machine behavior



Neural Nets

printing
res.



optimize machine setting



Optimization

Problem 1: availability (missing data)

- No historical data for printing results
- Data format is proprietary



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KBA-Demo

Printing industry

solve availability

before



machine
parameter



Learn machine behavior



Simulation

printing
result



optimize machine setting



Database

Optimization

after



job
definition



Learn optimization method



Optimization

[optimal]
machine parameter





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Printing industry

obscurity problem



Problem 2: obscenity[proprietary data formats]

- Database is not documented
- job definition is a binary blob



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Printing industry

solve obscurity

Translate data formats using editors [e.g. www.asciitohex.com]

Binary

```
01001001 00100000 01100111 01100001
01110110 01100101 00100000 01100001
00100000 01100011 01110010 01111001
00100000 01101111 01100110 00100000
01100001 01110011 01110100 01101111
01101110 01101001 01110011 01101000
01101101 01100101 01101110 01110100
00101110 00100000 01001001 00100000
```

Convert**Copy to Clipboard**

Hexadecimal

```
49 20 67 61 76 65 20 61 20 63 72 79 20 6f 66 20
61 73 74 6f 6e 69 73 68 6d 65 6e 74 2e 20 49 20
73 61 77 20 61 6e 64 20 74 68 6f 75 67 68 74 20
6e 6f 74 68 69 6e 67 20 6f 66 20 74 68 65 20 6f 74
68 65 72 20 66 6f 75 72 20 4d 61 72 74 69 61 6e
20 6d 6f 6e 73 74 65 72 73 3b 20 6d 79 20 61 74
74 65 6e 74 69 6f 6e 20 77 61 73 20 72 69 76 65
74 65 64 20 75 70 6f 6e 20 74 68 65 20 6e 65 61
```

Convert**Copy to Clipboard**

BASE64

```
SSBnYXZlIGEgY3J5IG9mIGFzdG9uaXNobWVudC4g
SSBzYXcgYW5kIHRob3VnaHQgbm90aGluZyBvZiB0
aGUgb3RoZXIgZm91ciBNYXJ0aWFuIG1vbnnN0ZXJz
OyBteSBhdHRIbnRpb24gd2FzIHJpdmV0ZWQgdXB
vbiB0aGUgbmVhcmVYIGluY2lkZW50LiBTaW11bH
RhbmVvdXNseSB0d28gb3RoZXIgc2hlbGxzIGJ1cnN
0IGluIHRoZSBhaXIgbmVhciB0aGUgYm9keSBhcYB
0aGUgaG9vZCB0d2IzdGVkIHJvdW5kIGluIHRpbWU
```

Convert**Copy to Clipboard**

Decimal

```
73 32 103 97 118 101 32 97 32 99 114 121 32 111
102 32 97 115 116 111 110 105 115 104 109 101
110 116 46 32 73 32 115 97 119 32 97 110 100 32
116 104 111 117 103 104 116 32 110 111 116 104
105 110 103 32 111 102 32 116 104 101 32 111
116 104 101 114 32 102 111 117 114 32 77 97 114
116 105 97 110 32 109 111 110 115 116 101 114
115 59 32 109 121 32 97 116 116 101 110 116 105
```

Convert**Copy to Clipboard**

Reverse engineer relevant data using example datasets

Hire freelancer experts!

Blob-Variante 02						
Offset	233	233	233	4	233	233
2042	233	233	233	4	233	233
2043	156	156	156	247	156	156
2044	4	4	4	4	4	4
2045	0	0	0	0	0	0
2046	3	3	3	3	3	3
2047	11	11	11	11	11	11
2048	126	126	126	126	126	126
2049	0	0	0	0	0	0
2050	1	1	1	1	1	1
2051	0	0	0	0	0	0
2052	1	1	1	1	1	1
2053	0	0	0	0	0	0
2054	2	2	2	2	2	2
2055	1	0	0	0	0	0
2056	0	0	0	0	0	0
2057	70	0	0	0	0	0
2058	0	0	0	0	0	0
2059	89	3	0	10	0	0
2060	0	0	0	0	0	0
2061	99	3	0	183	0	120





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KBA-Demo

Evaluation

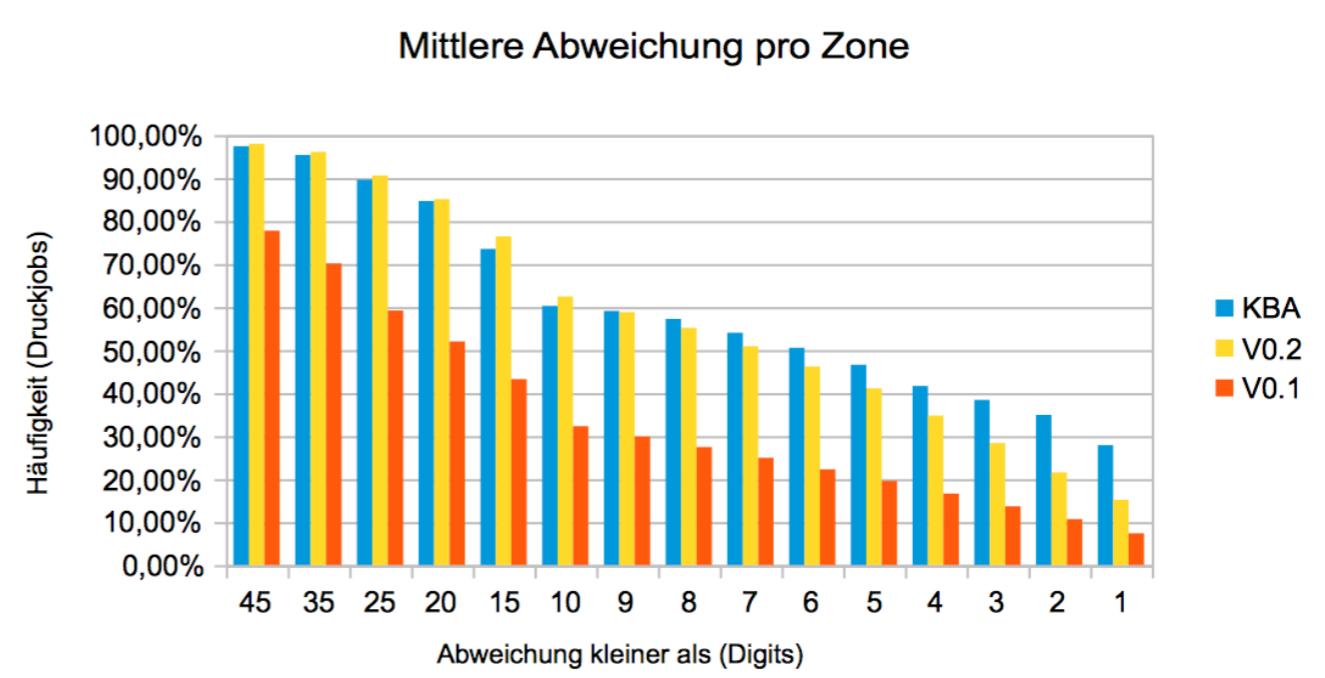
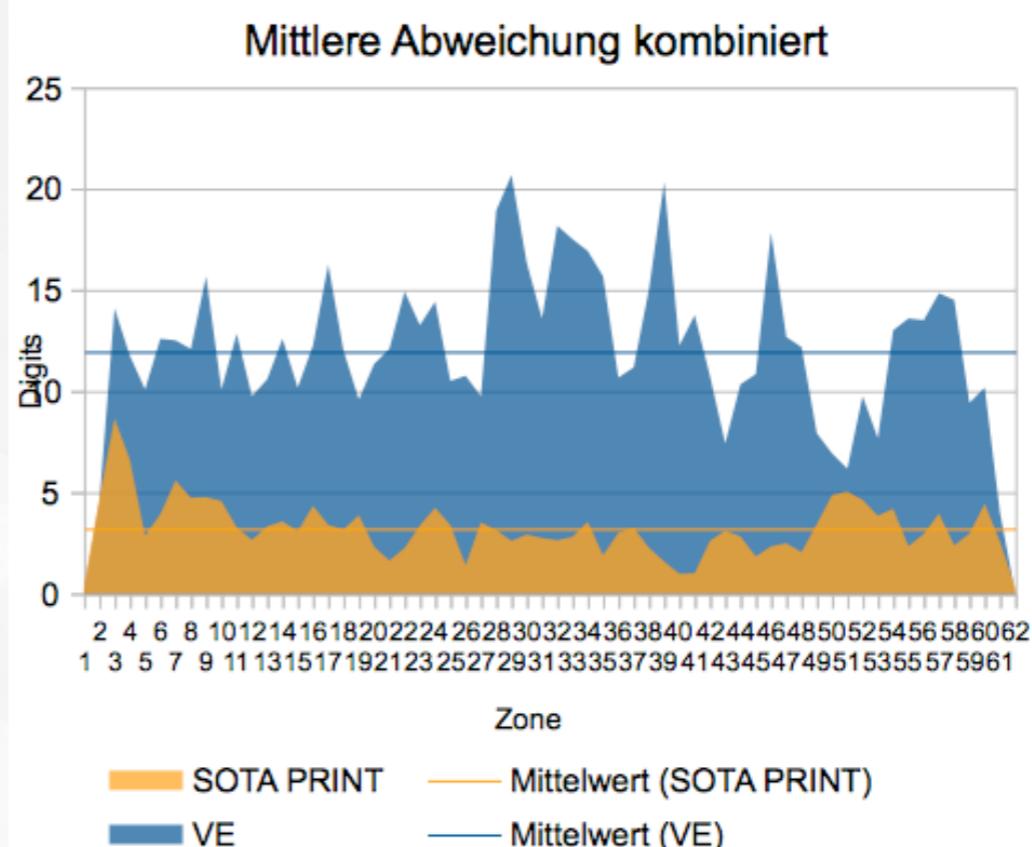
SOTA Print Demonstration

Datasources

- Data from last 3-6 Month
- Segmentation for zone, inktype and papertype

Demonstrator

- Corellations were learned well
- about 40% precision increase compared to standard settings





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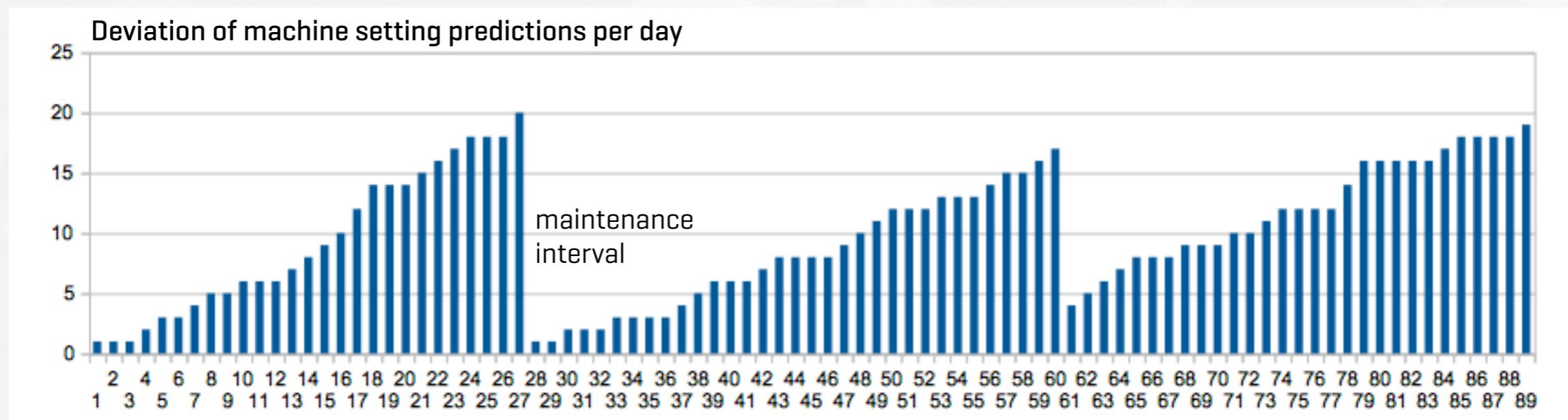
KBA-Demo

Printing industry

variability problem

Attrition influence can cause bad results for a well trained system!

Attrition and maintenance-interval effects over time:



Solution:

- compute bias on a daily base to compensate attrition
- if possible: integrate attrition/maintenance infos into training data



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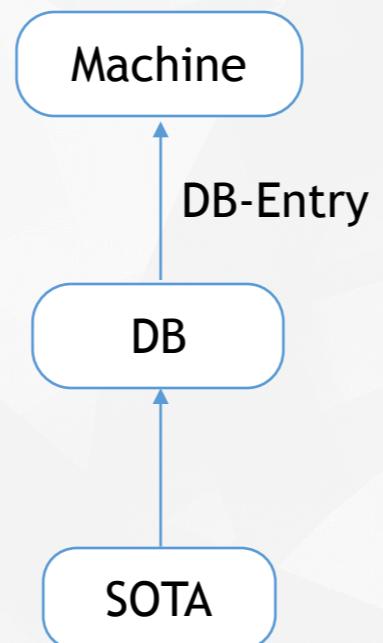
KBA-Demo

Printing industry

interface problems

1st integration approach:

Use existing Database to send optimized setting to machine





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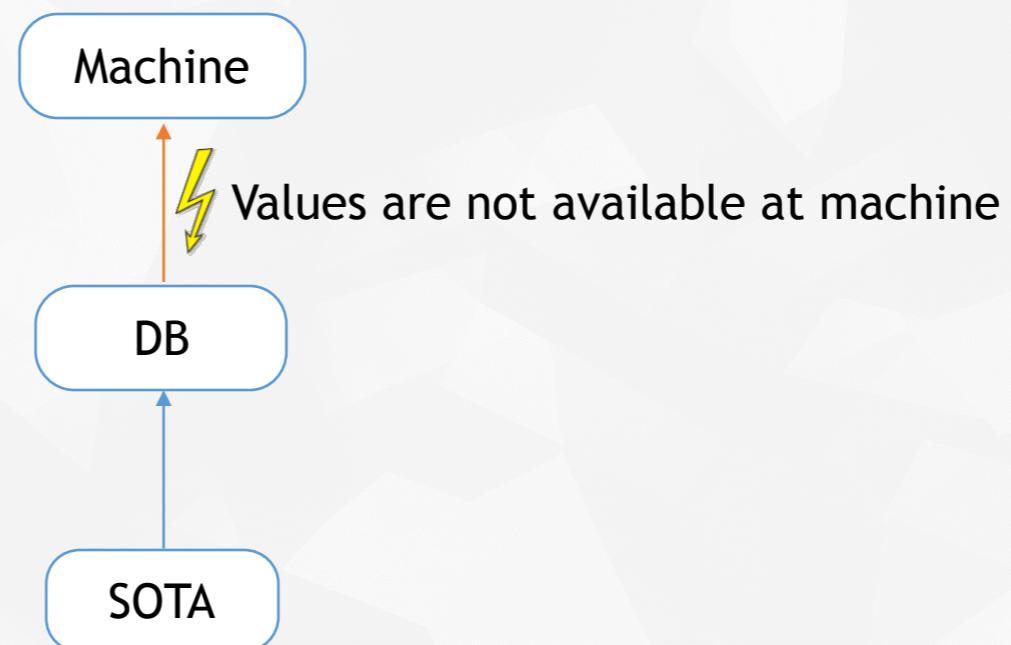
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KBA-Demo

Printing industry

interface problems





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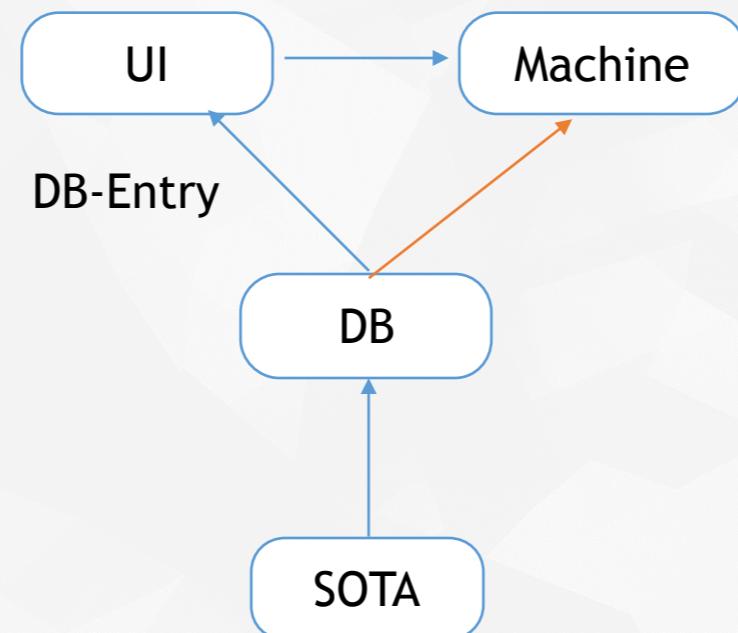
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Printing industry

interface problems

2nd integration approach:

Use Database to send optimized setting to existing user interface





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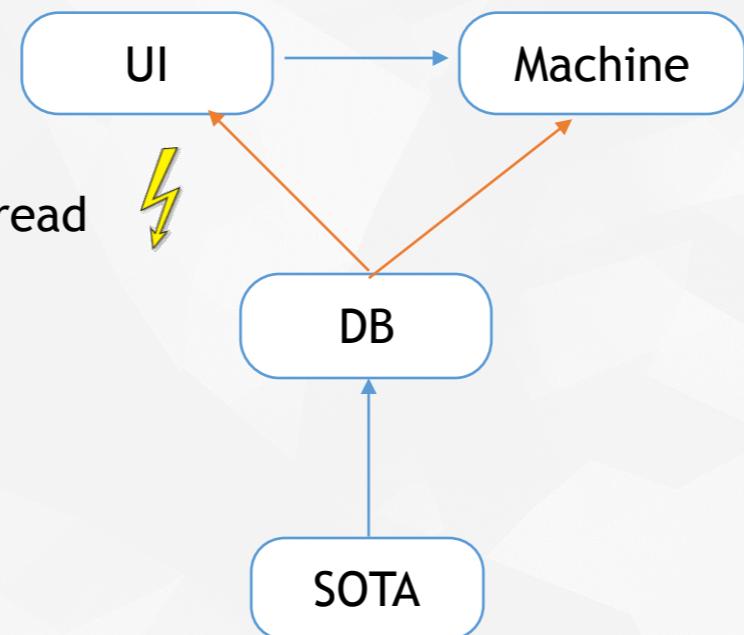


KBA-Demo

Printing industry

interface problems

Database values were not read
because of - Caching -





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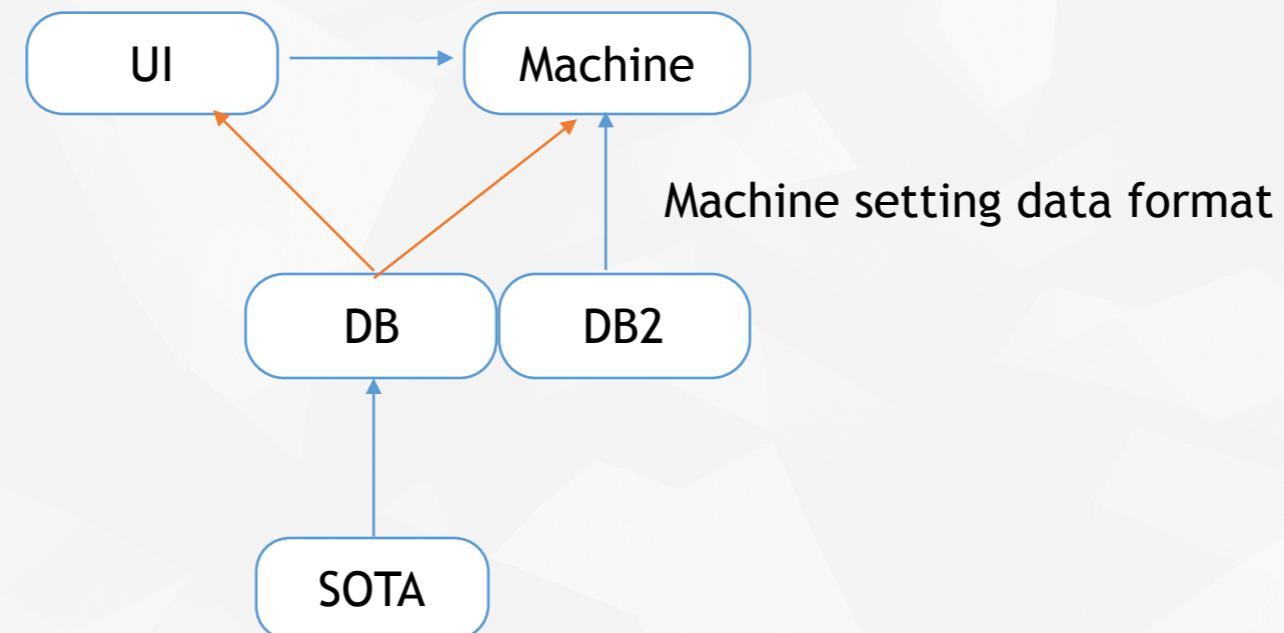
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Printing industry

interface problems

3rd integration approach:

Second database where identified, specifically for machine settings





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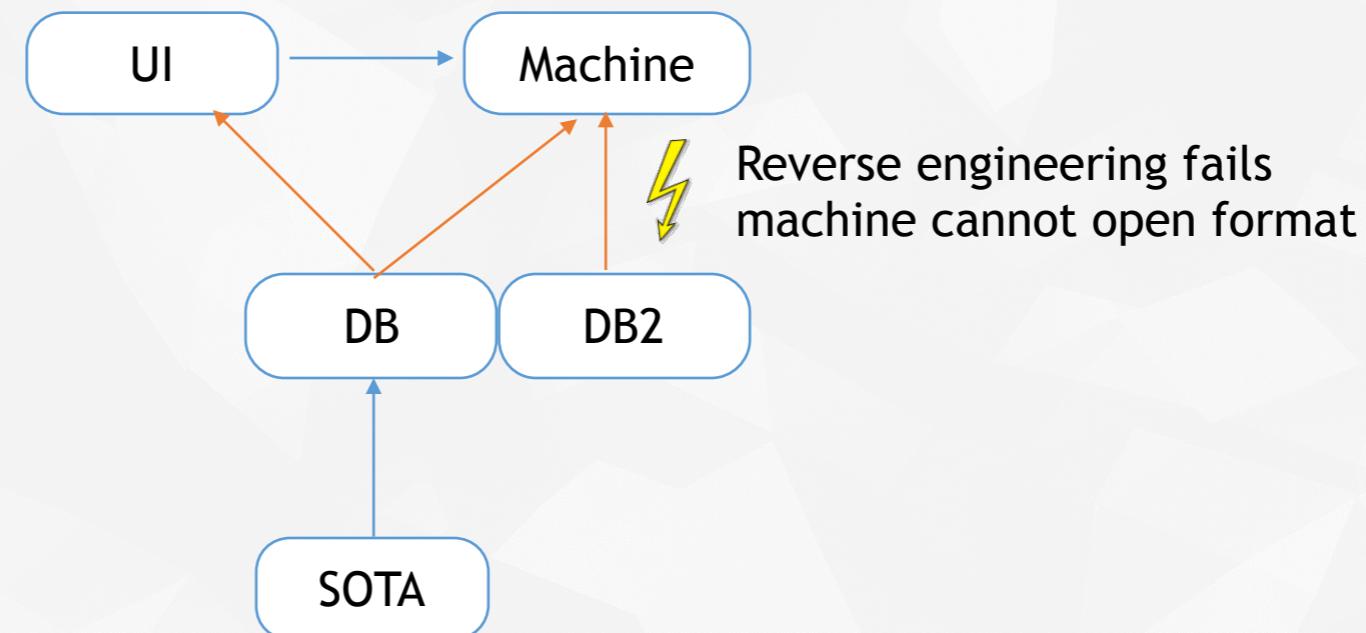


KBA-Demo



Printing industry

interface problems





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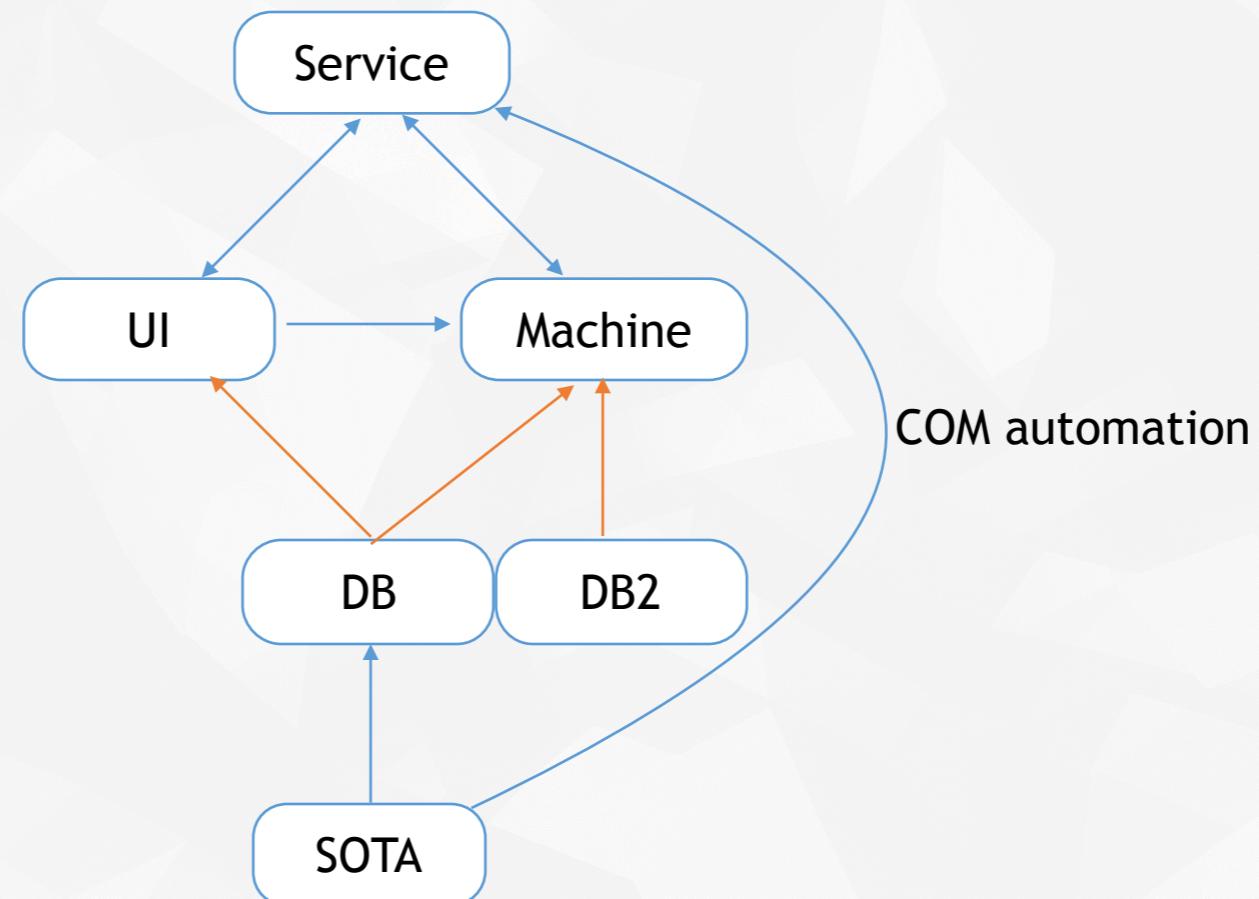
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Printing industry

interface problems

4th integration approach:

Use existing service through OLE automation [public interface definition]





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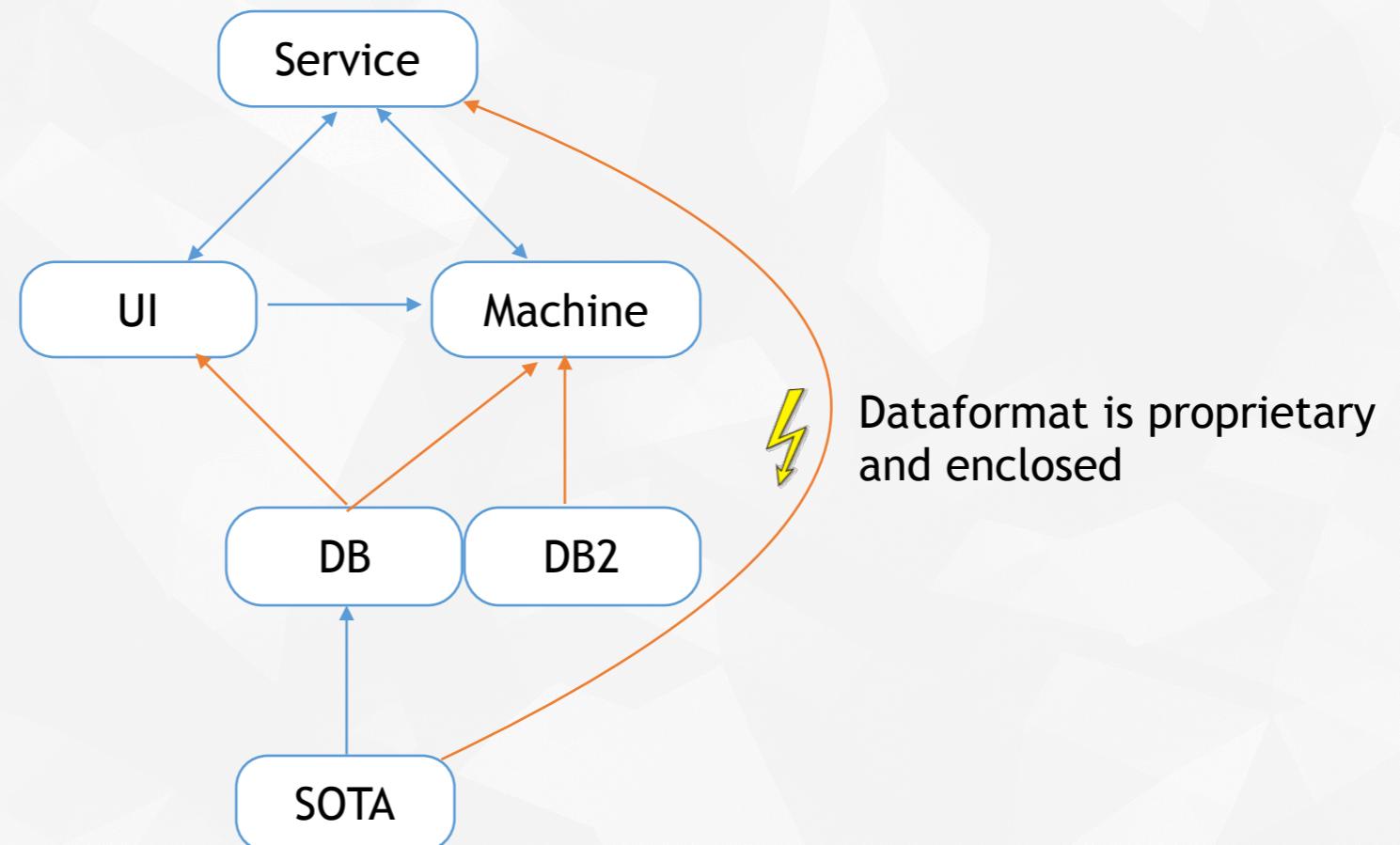
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interface problems





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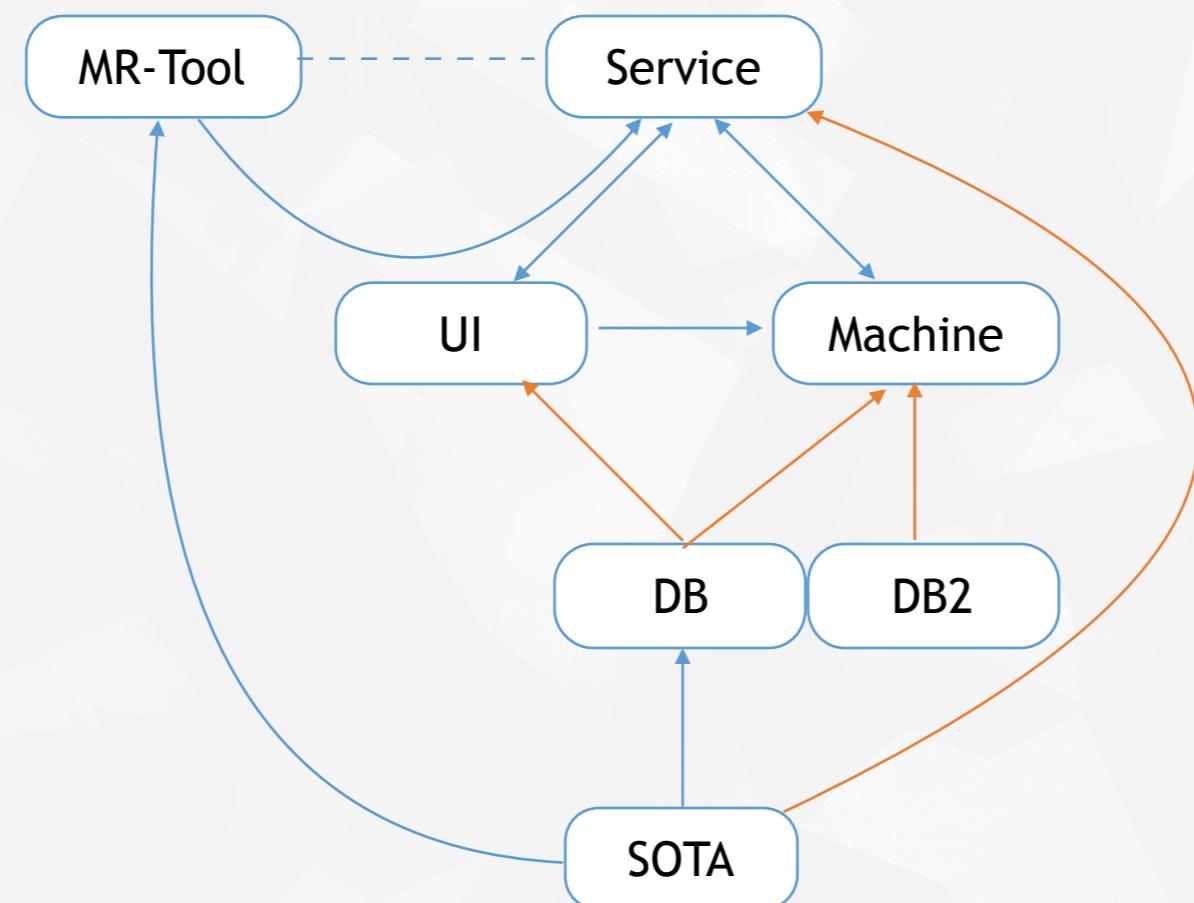
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Printing industry

interface problems

5th integration approach:
Hire experienced freelancer to connect to service





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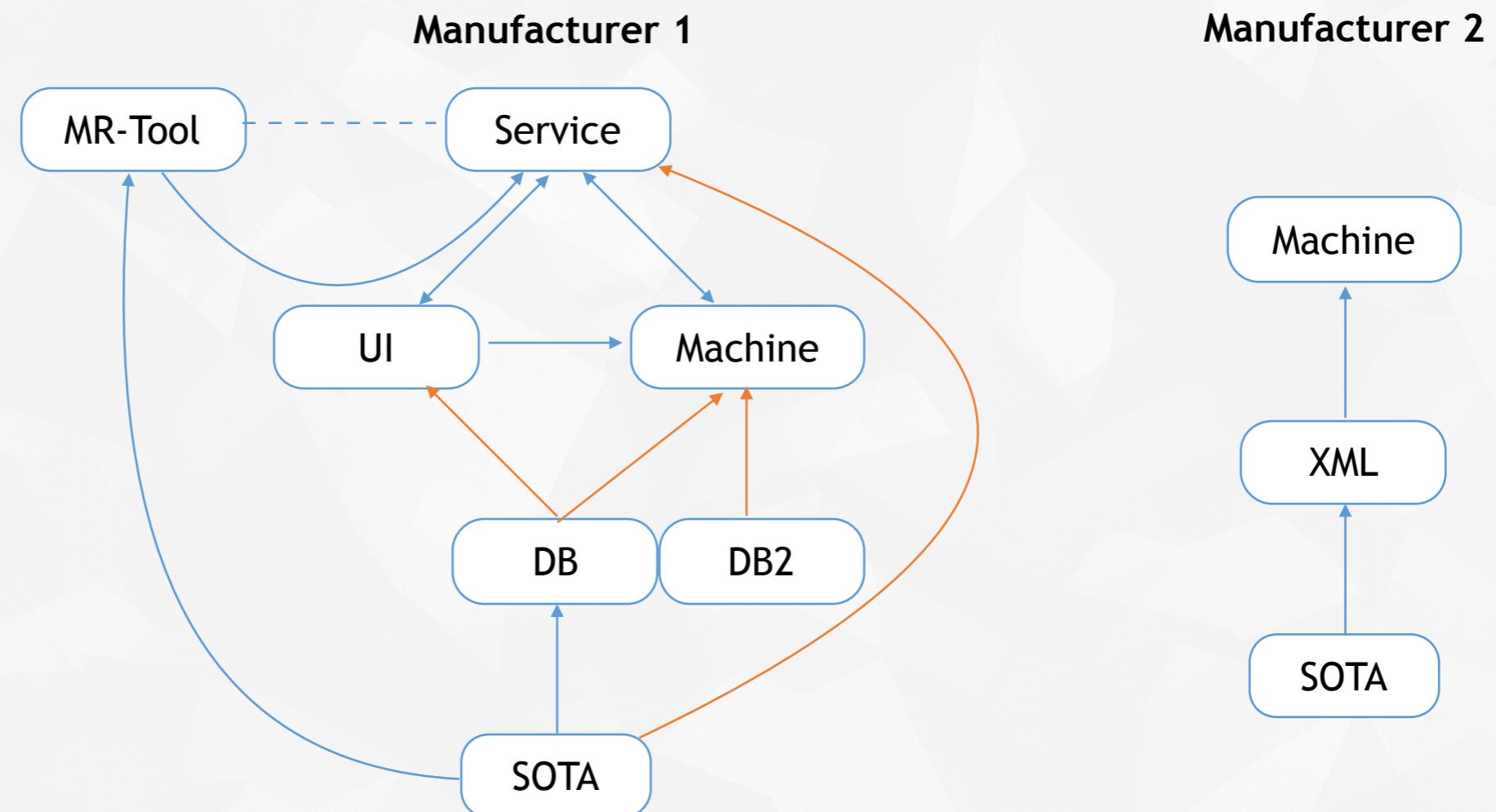
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Printing industry

interface problems

5th integration approach was successful.



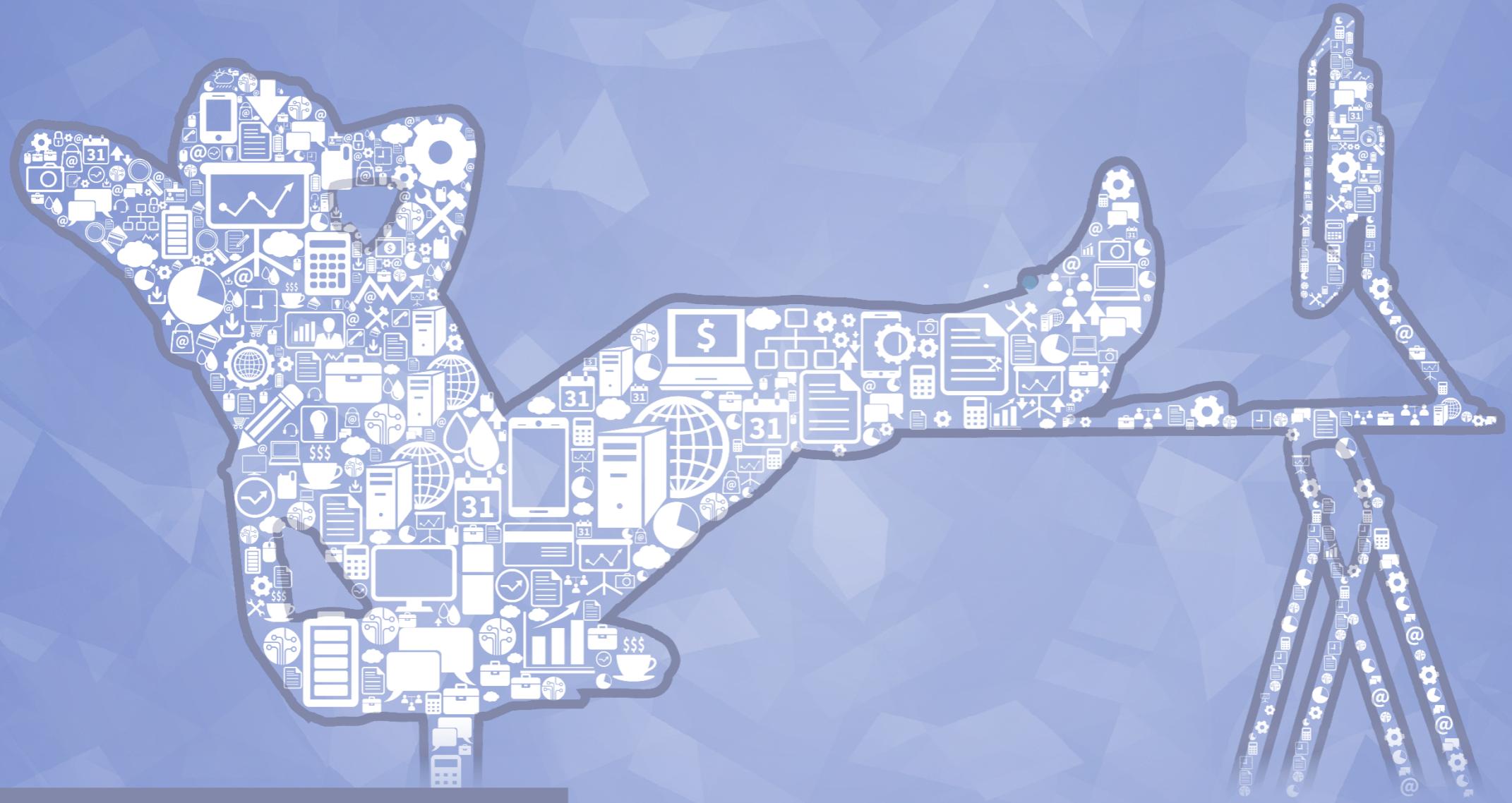
Other manufacturers use simpler interface architecture



SOTA Print roll offset

At least, project was a success story
(up to 200.000€ paper save per year)

	Rollen	
Druckmaschine	Lithoman 4080627	
	min	max
Stundensatz Personal/Maschine	550 €	550 €
Zylinderumdrehungen / h	20.000	35.000
Abschnitte für Andruck	2.000	3.500
Zeitkosten pro Abschnitt	0,0275 €	0,0157 €
Papierkosten pro Tonne	600 €	800 €
Papierge wicht pro Abschnitt(gramm)	42	153
Papierkosten pro Abschnitt	0,025 €	0,122 €
Gesamtkosten pro Abschnitt	0,053 €	0,138 €
Gesamtkosten pro Andruck	105 €	428 €
Drucke Gesamt	2.000	2.500
Anzahl niedere Qualität (sofort in Farbe)	0	0
Relevante Jobs für Einsparung	2.000	2.500
Anteil der Einsparung durch verkürzen des Andrucks	10,0%	20,0%
Eingesparte Abschnitte	400.000	1.750.000
Einsparung Papierkosten	10.080 €	214.200 €
Einsparung Zeitkosten	11.000 €	27.500 €
Einsparung gesamt p.a.	21.080 €	241.700 €



IQ for printing machines

artificial intelligence reduces maculation

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