

Assessing the Cost and Benefit of a Microservice Landscape Discovery Method - A Case Study at a Large German Enterprise

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Agenda

1. Motivation & problem statement

2. Research questions

3. Solution concept

4. Case study

5. Evaluation Results



Motivation

Enterprise Architecture Documentation is a challenge ever since for EAM

- Relevant EA information is scattered across diverse information systems and stakeholders [5]
- Ongoing tracking of changes to keep the model up to date [1, 2]
- EAD is mostly performed manually; often there is no defined process and responsibilities [1]

→ EA Documentation is a time-consuming, cost intensive and error-prone task [1, 2, 3]

Recent trends challenge EAD processes all the more:

- Growing adoption of agile development practices (DevOps, Scrum, CI/CD) [7]
- Growing usage of cloud- and microservice based applications [3]

Implications → Automation has become a must to cope fast-paced EA environments!

Challenges [3]:

- accelerated architectural change
- increasing diversity of technologies
- increasing architectural complexity

Opportunities [8]:

- new valuable EA data sources
- easy access via exposed APIs

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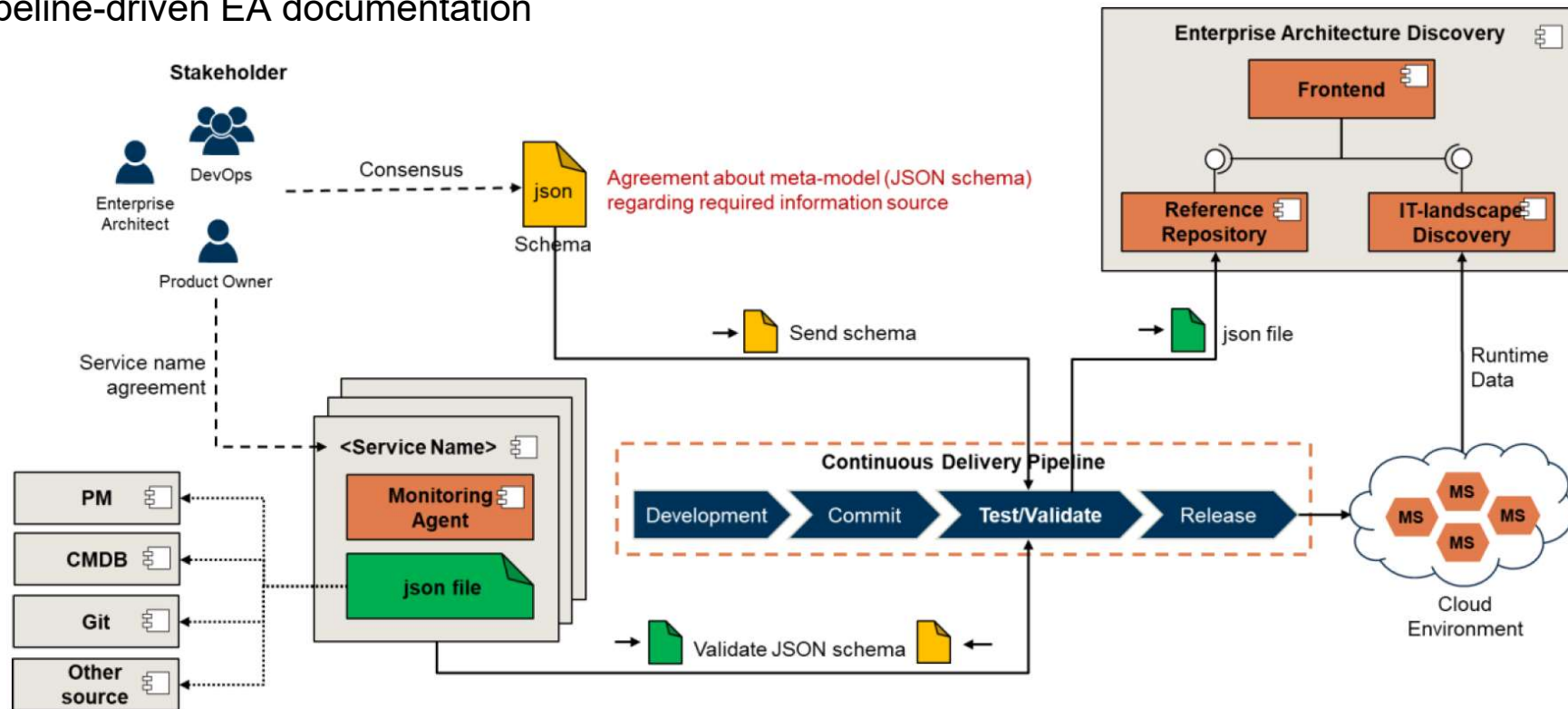
5. Evaluation results



Solution Approach

Key characteristics

- Runtime data retrieved from cloud platforms and distributed tracing
- Static information provided with a configuration file
- Pipeline-driven EA documentation



RQ1

How can the suggested solution be integrated into agile development and what challenges do occur?

RQ2

What EA model elements should be documented and to what degree can this be automated using the solution approach?

RQ3

What are the solutions integration costs and value propositions for Enterprise Architecture Management?

Agenda

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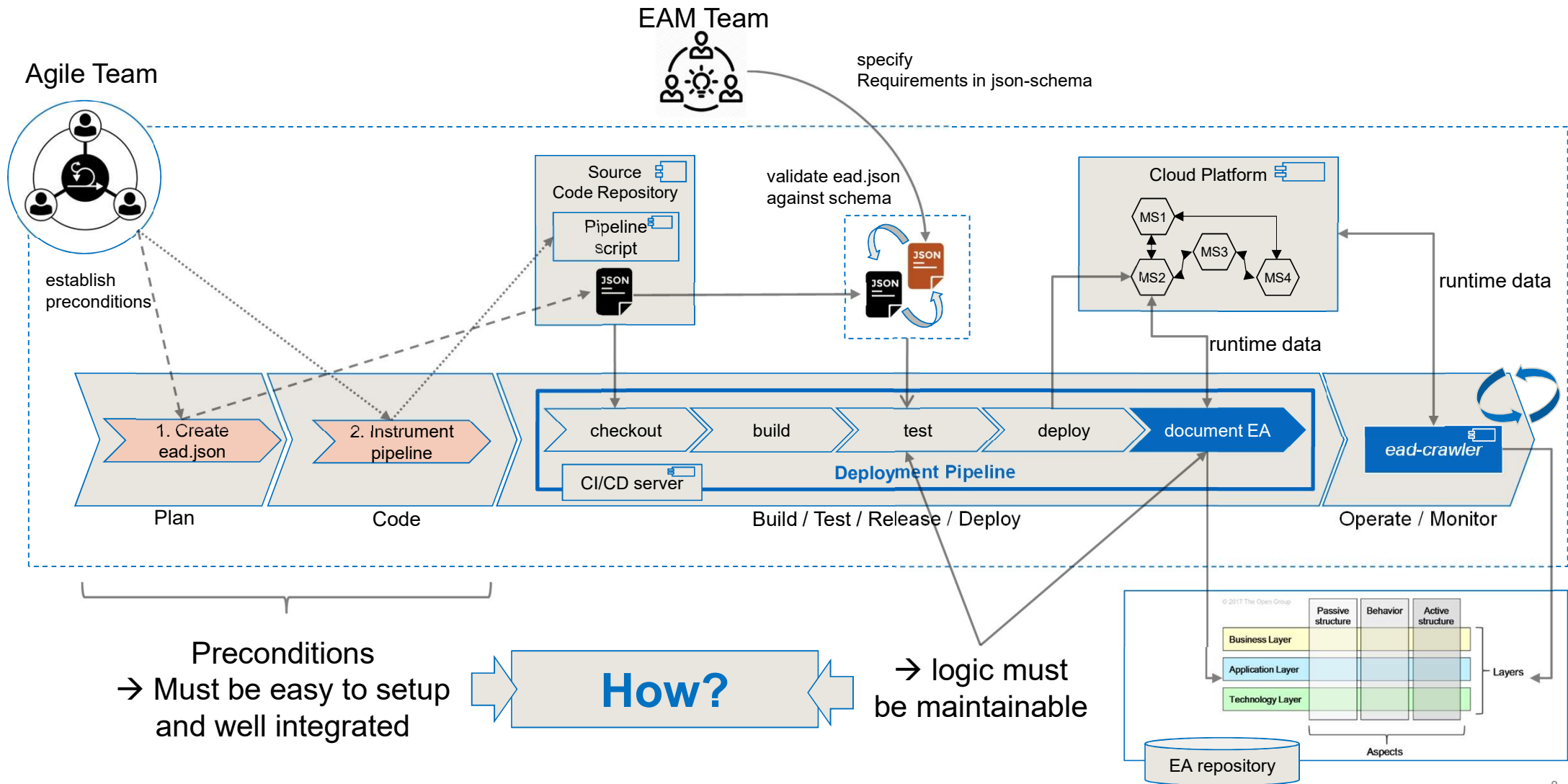
3. Solution concept

4. Case study

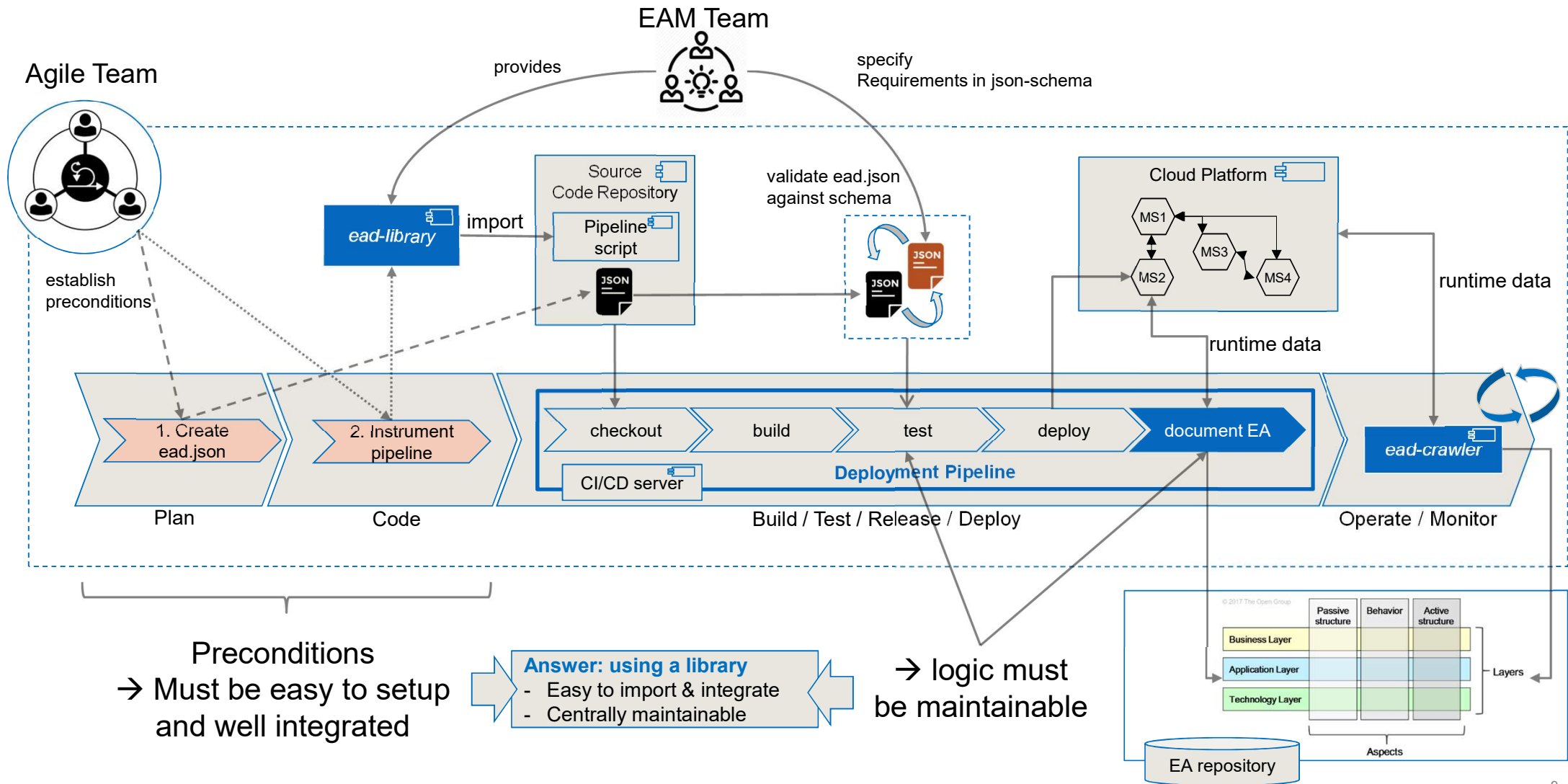
5. Evaluation results



How can the solution be integrated easily?



How can the solution be integrated easily?



Example: ead.json configuration file

Necessary steps:

1. Copy&paste the template
2. Fill-in the template (see example below)

Example:

```
{
  "application_component_name": "ProposalService",
  "description": "reads and stores proposals [...]",
  "superordinate_application": "Offering-Services",
  "business_domains": [
    "Domäne A",
    "Domäne B"],
  "business_process": ["Process A"],
  "business_units": [
    "Unit A",
    "Unit B"],
  "business_objects": [
    "Offering",
    "Proposal",
  " federated_information_source_1": "<URL>",
  " federated_information_source_2": "<URL>",
}
```

Descriptive information

Business Layer Relationships

Federated information sources

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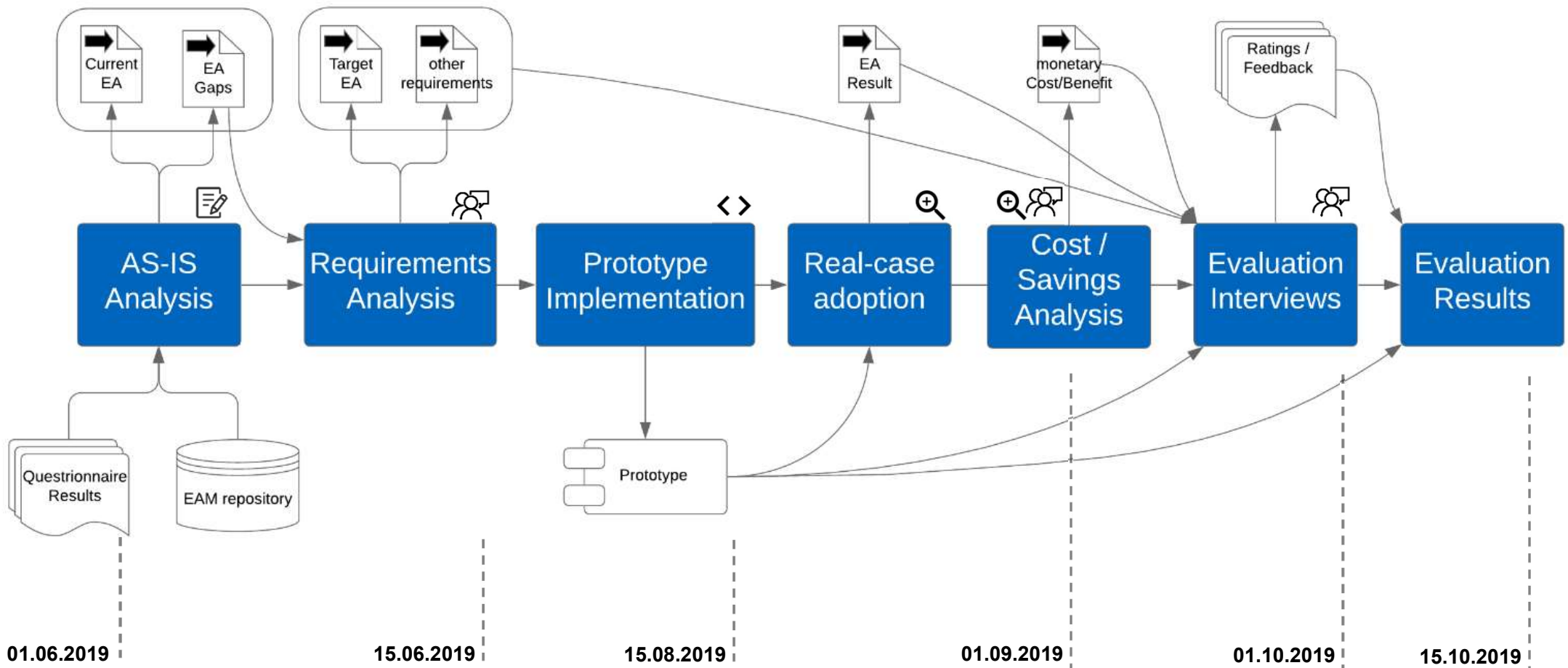
4. Case study

5. Evaluation results

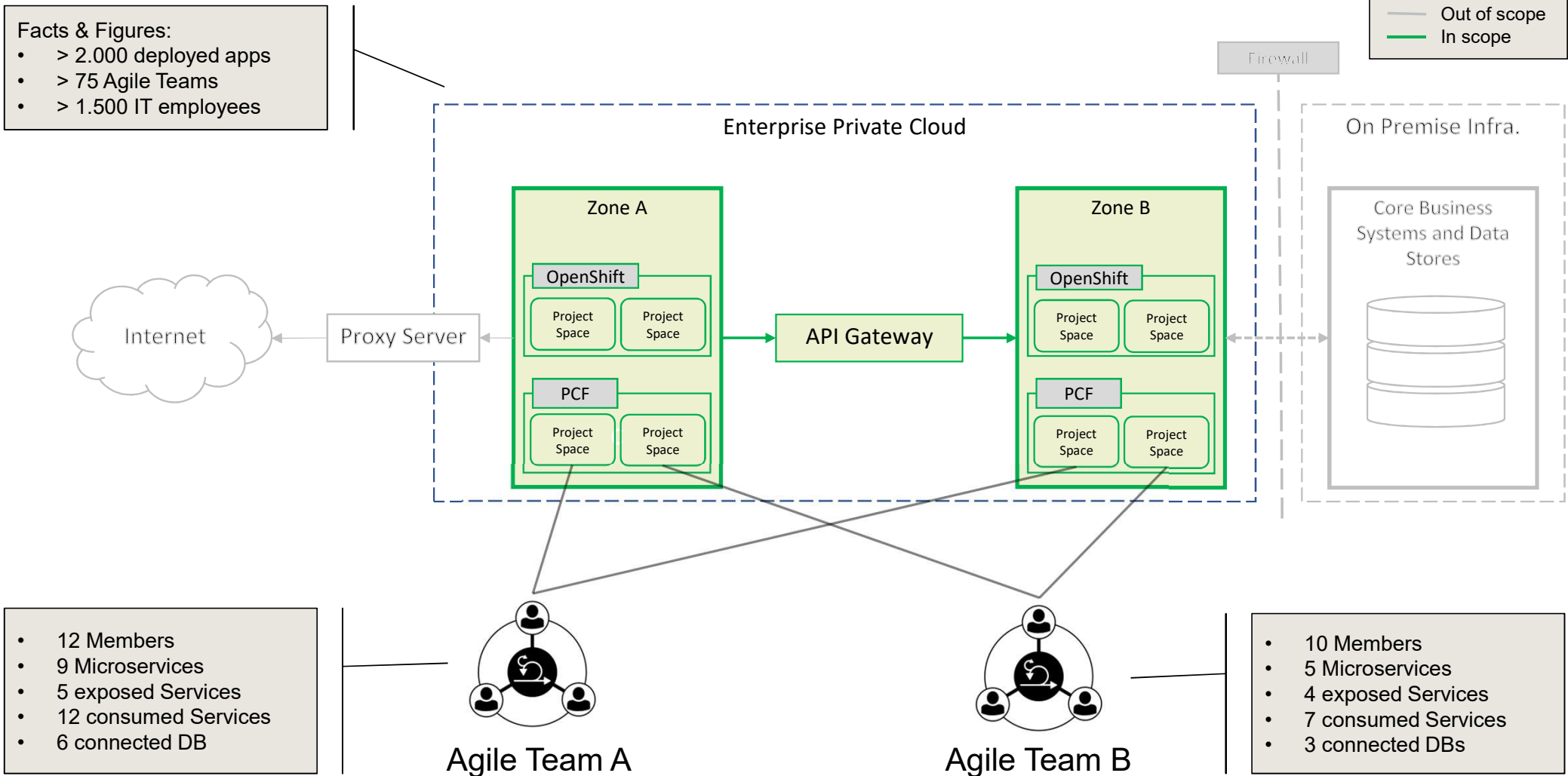


Case Study Overview

- Questionnaire
- Expert Interview
- Source Code
- Qualitative Analysis



Evaluation Environment – a large German enterprise



Status Quo and automation requirements

1. Requirements Analysis

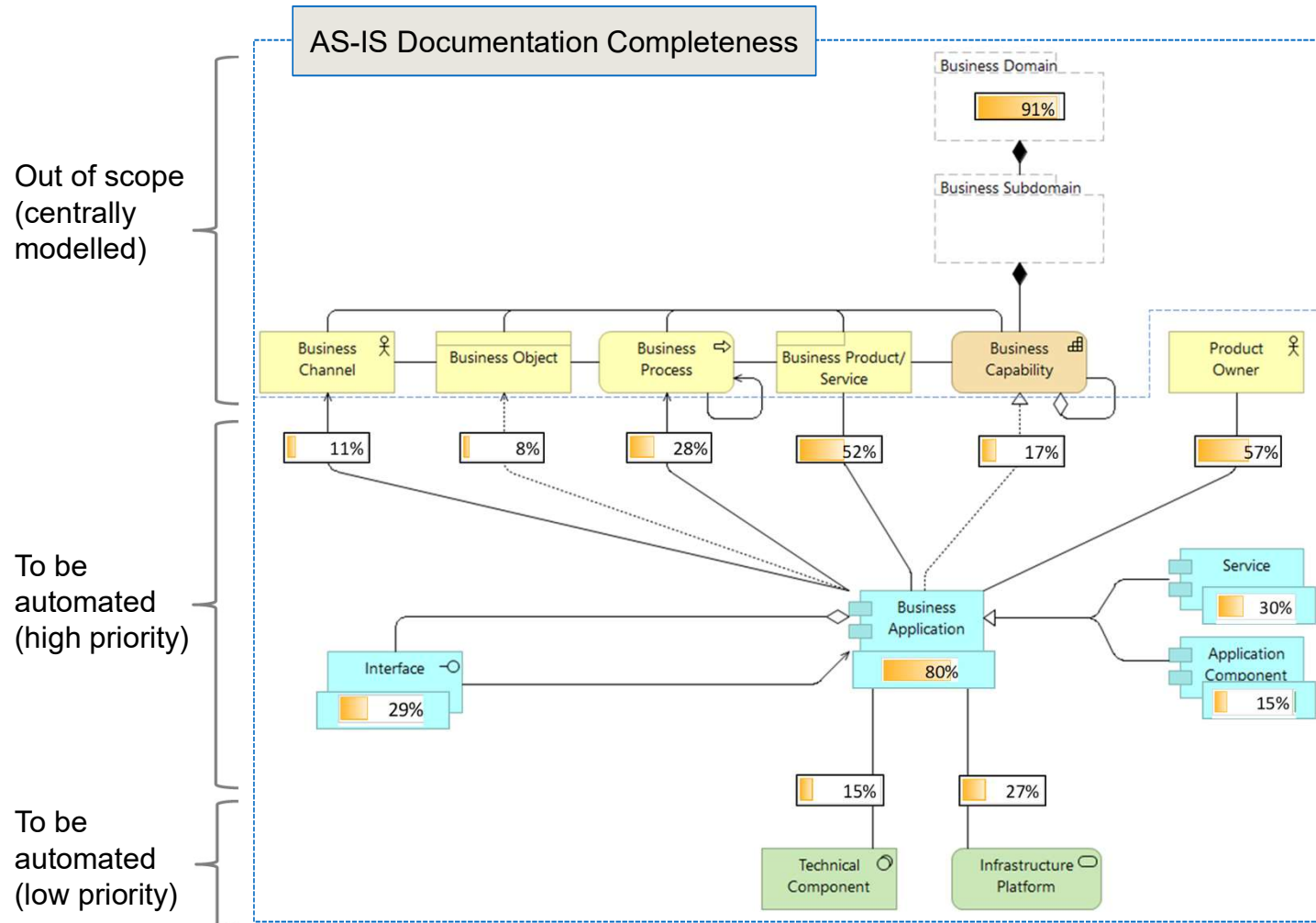
- What should be documented?
 - What should be automated?
- Automation priority rank

2. Selection of information sources

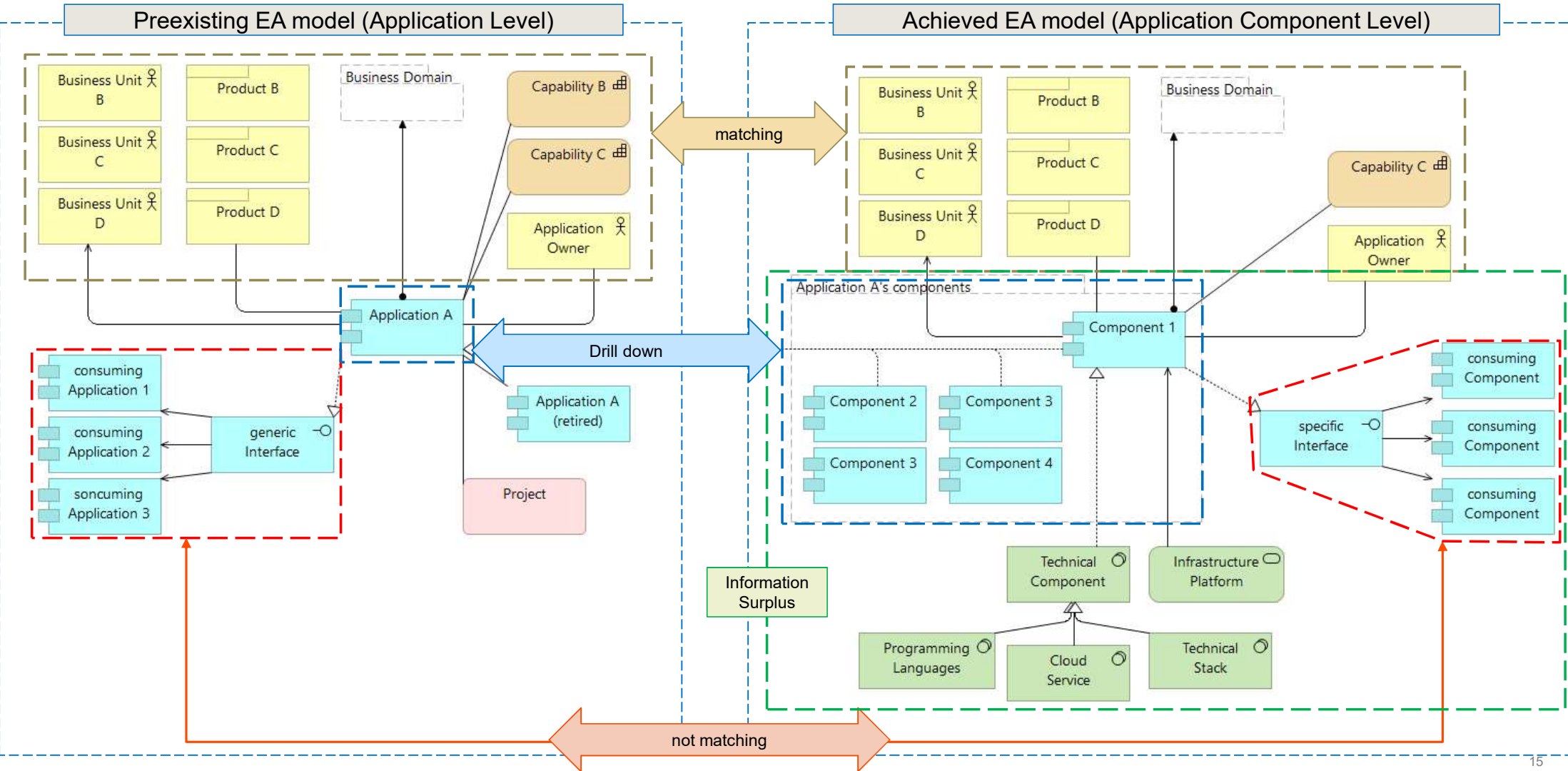
- What EA elements are covered?
 - Does this correspond to automation priority?
- EA contribution matrix

3. Information sources selected

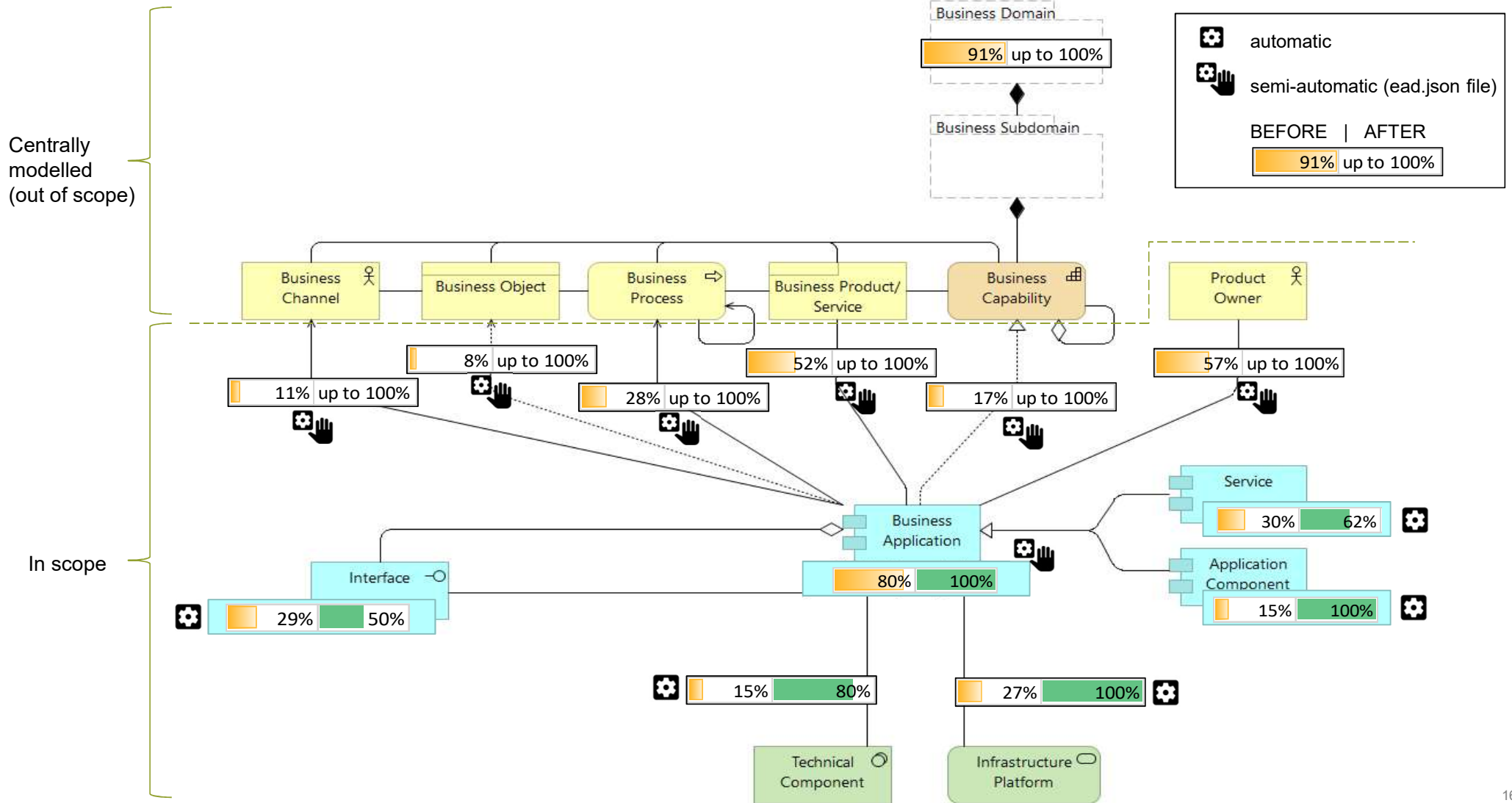
- CloudFoundry (cloud platform)
- ApiGee (API gateway)
- GitHub (VCS) incl.
 - Config-files
 - *ead.json file*



Achievements - Example

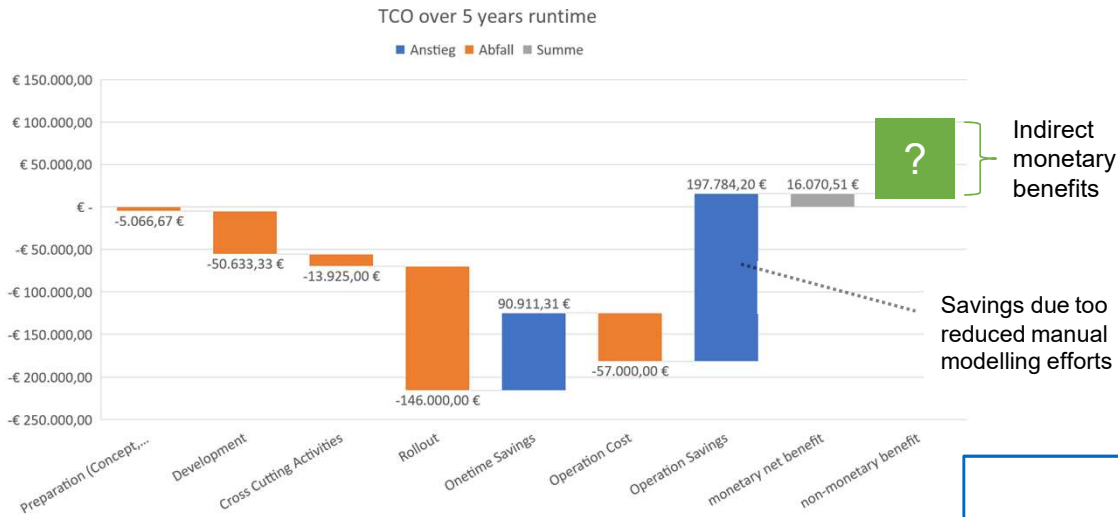


Achievements – Overall Documentation Completeness



Economic feasibility based on expert estimation

210k EUR invest amortised in 4 to 5 years plus non-monetary benefits



→ ... # of pipelines & applications are key cost driver

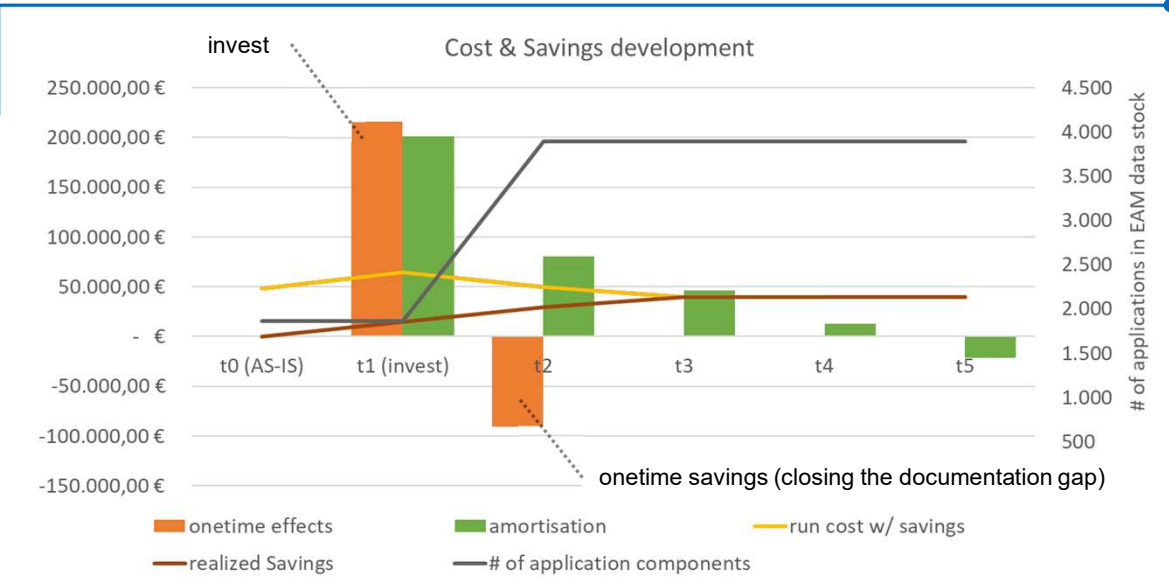
→ ... amortisation within 4 to 5 years latest

→ ... non-monetary benefits need to be considered!

Modelling cost per application cut in half... ←

58% saved on monthly modelling efforts... ←

further reduction of roll-out cost required... ←



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Interview Register



Experts of different roles:

- Enterprise Architects → responsible for EAM repository (meta model, modelling guidelines, automation)
- Domain Architects → responsible for EA model of a certain domain
- Product Owner → responsible for EA model of a certain application
- Developer → no responsibility within EA but directly affected by the solution

	EA1	EA2	EA3	EA4	EA5	EA6	EA7	EA8	EA9	DA1	DA2	DA3	DA4	PO1	PO2	DEV1	DEV2	#
Years Of Experience	8	1,5	11	9	2	5	2,5	5	7	8	10	1	2	3	2,5	6	7	
AS-IS EA Documentation Survey	X	X	X	X	X	X	X											7
Requirements Analysis Interview	X	X																2
Cost & Savings Estimation		X	X				X			X								4
Evaluation Interview		X	X			X	X	X	X	X	X	X	X	X	X	X	X	14
TOTAL:																		27

EA	Enterprise Architect	6
DA	Domain Architect	4
PO	Product Owner	2
DEV	Software Developer	2

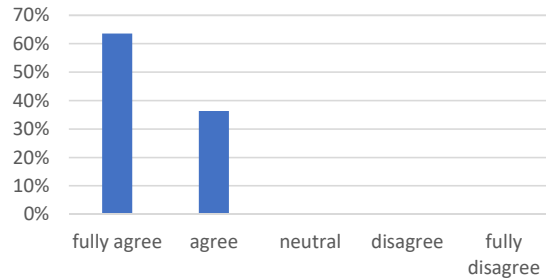
Effectiveness

The solution is perceived practicable and well suited for EA model maintenance automation

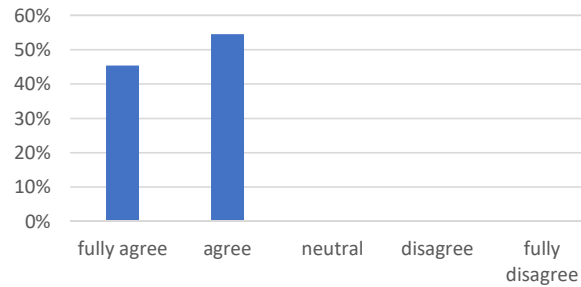


The approach is reasonable and practicable with regards to...

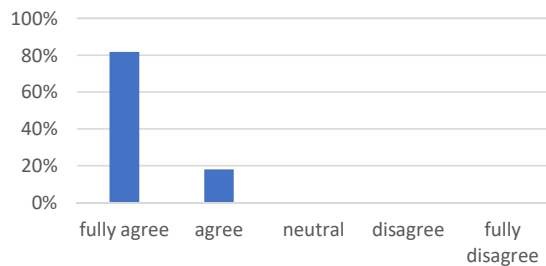
... pipeline integration



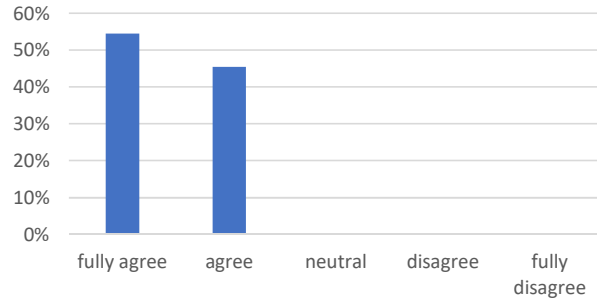
... the use of runtime data



... responsibility of agile teams



... the use of ead.json config file



Key Feedback & Findings

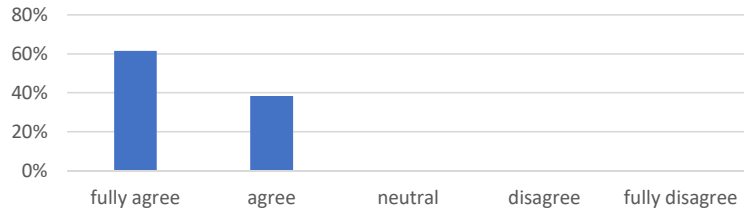
- 1 ...enables EA documentation closest to knowledge carriers
- 2 ...engagement of agile teams is a necessity to scale EA documentation
- 3 ...ead.json is crucial to make runtime data valuable & useable for EA

Concerns & Suggestions

- 1 ...too much focus on AS-IS state of EA
- 2 ...need to start automation from the EA planning phase

Ease of Use

The solution is easy to adopt and well integrated with agile development



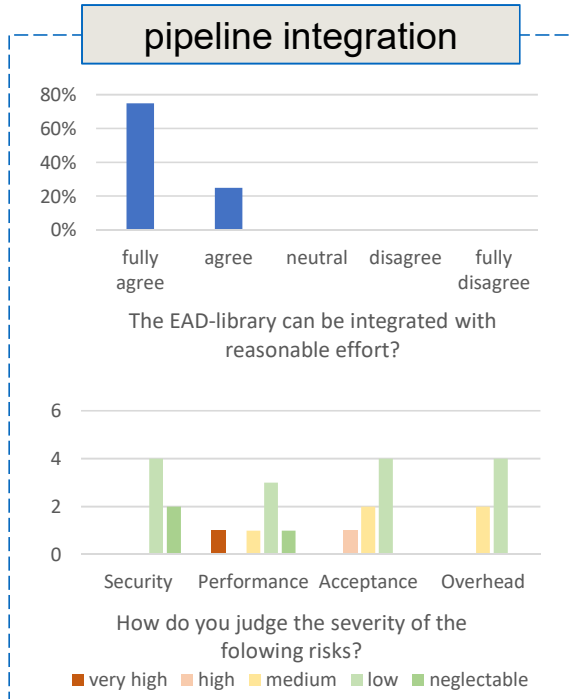
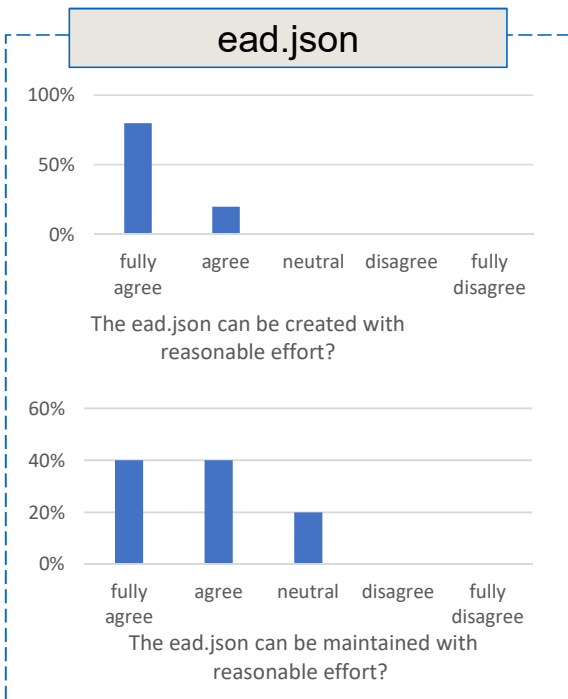
The suggested solution is easy to integrate into the agile development process?

Key Feedback & Findings

- 1 ...involves agile teams in EA using their natural environment
- 2 ...fits well into agile development process
- 3 ...lightweight and easy to adopt

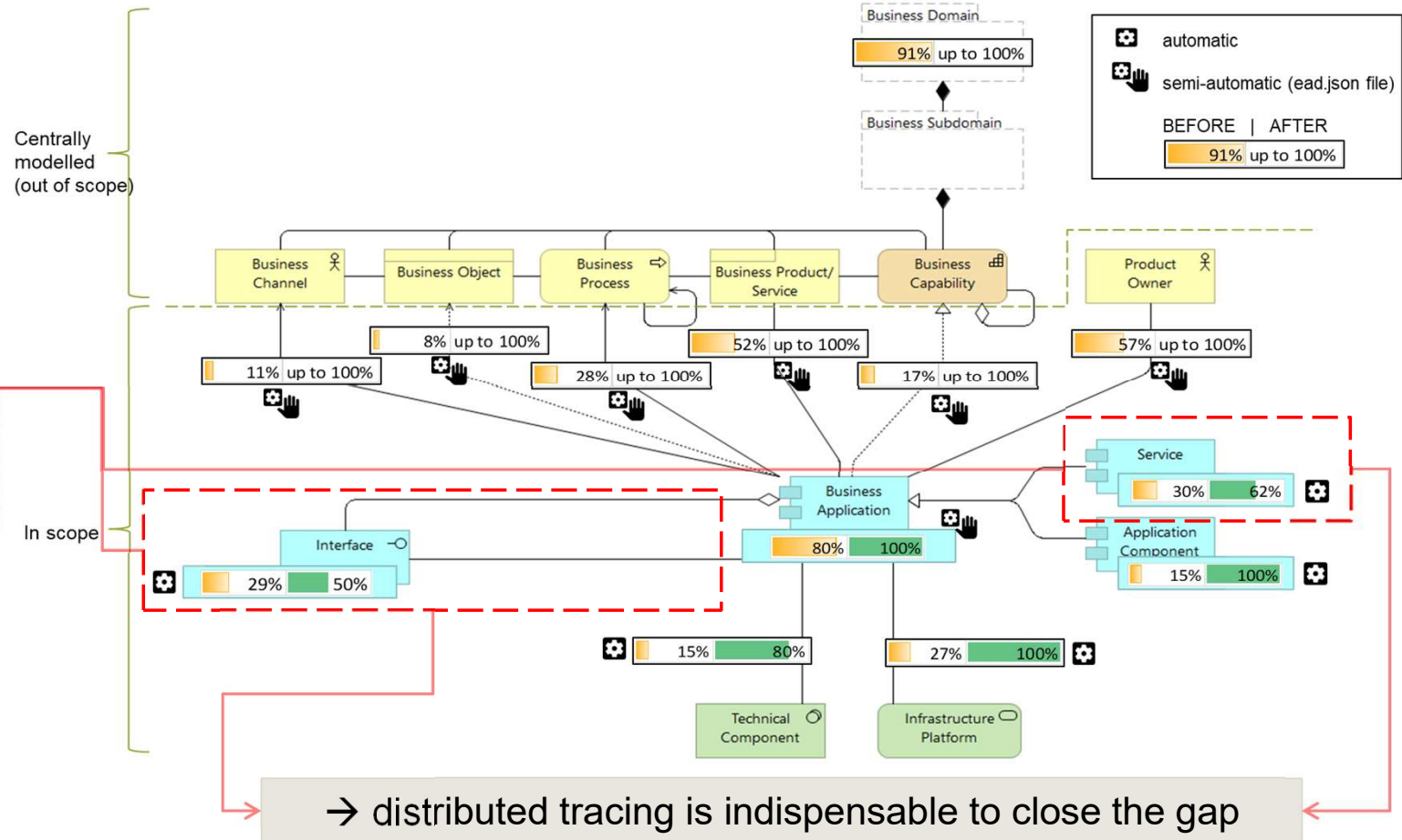
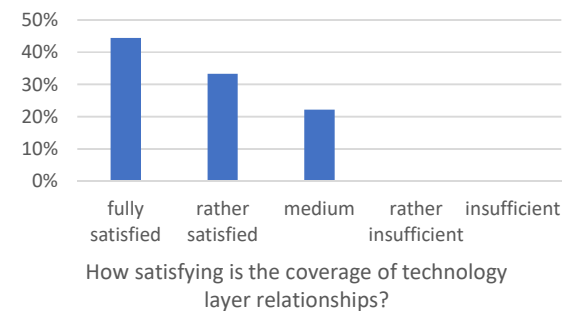
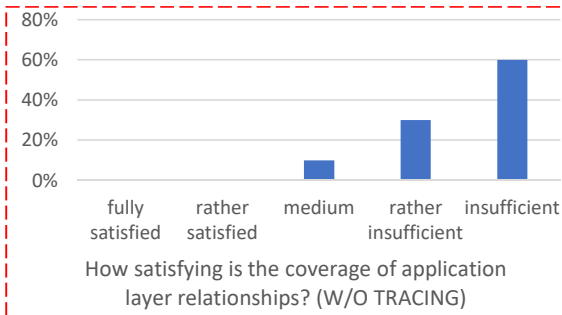
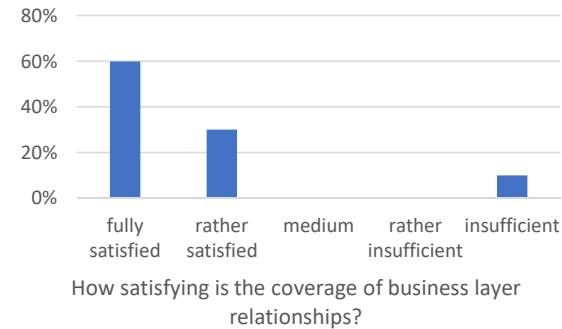
Concerns & Suggestions

- 1 ...technical enforcement required
- 2 ...bind ead.json to the runtime artefacts



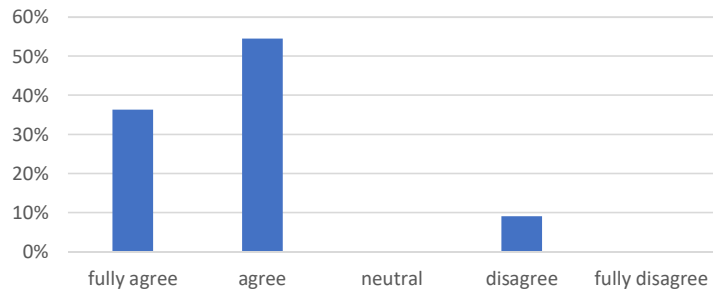
EA model coverage & perceived satisfaction

Satisfying EA model coverage except for application layer relationships

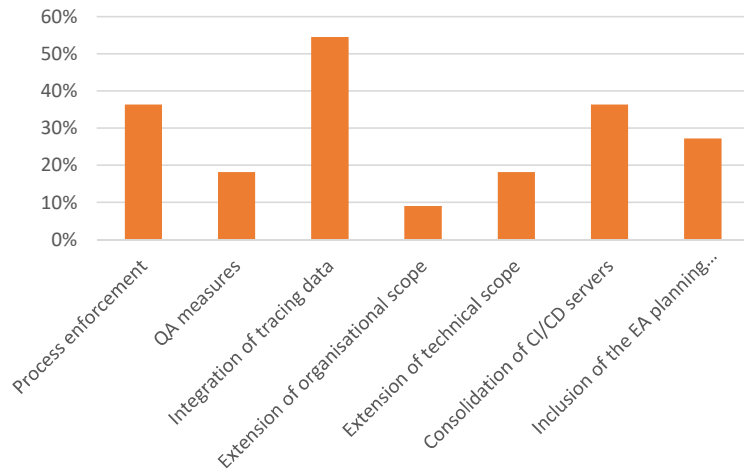


Conclusion

Would you roll out the suggested solution?



Conditions for a roll-out



Key Feedback & Findings

- 1 Experts support the roll-out even w/o distributed tracing
- 2 Distributed tracing is key to make the solution more valuable

Potential future use cases

- 1 Integration of EA planning phase
- 2 Definition and calculation of KPIs based on real-time data
- 3 Automatic assessment of architectural guideline compliance



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Backup



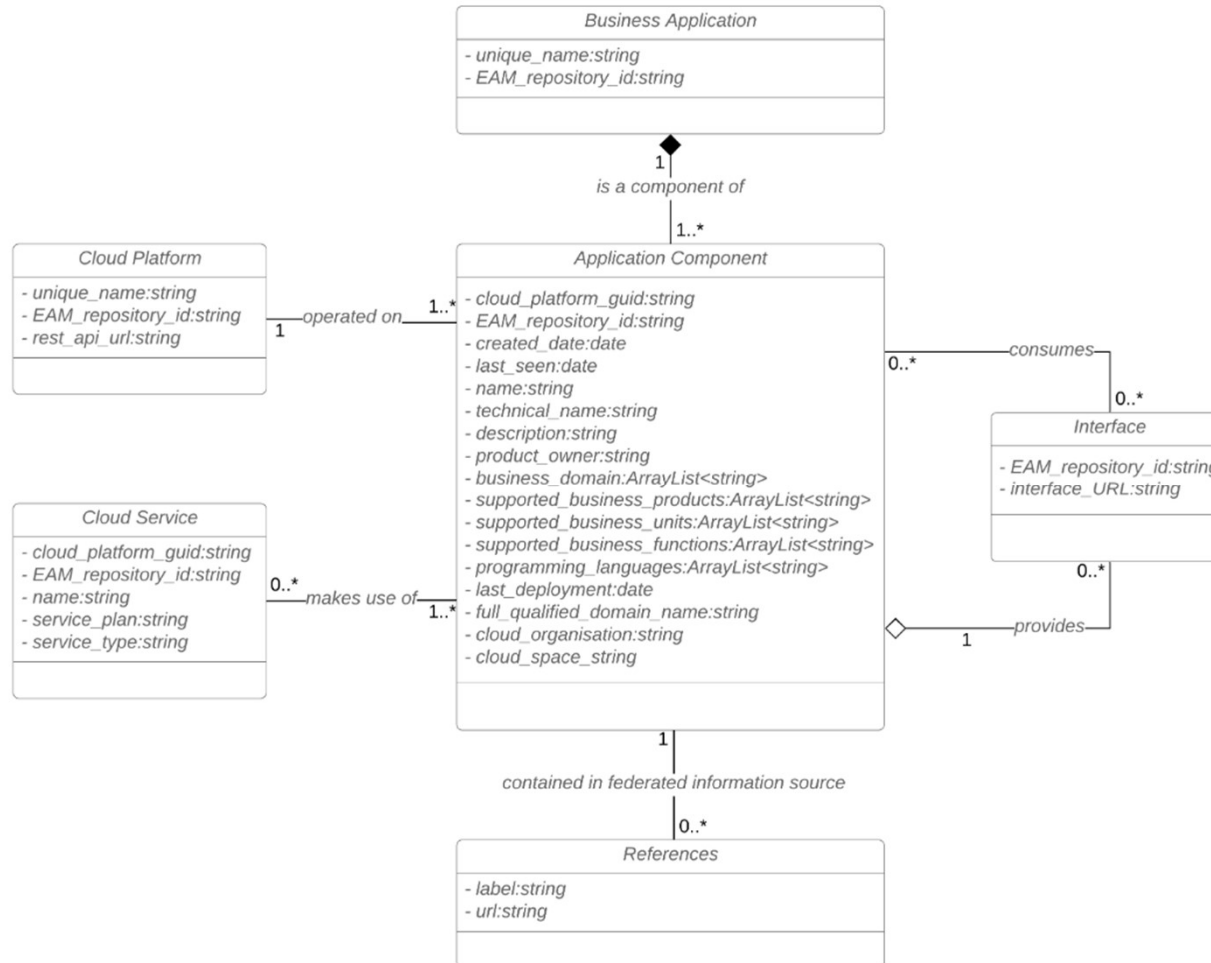
Estimated cost & savings



		current data stock	documentation gap	total data stock
		PERT SUM	PERT SUM	PERT SUM
COST	monthly efforts in hours	39,96	16,69	56,65
	monthly Cost in EUR	3.995,56 €	1.669,30 €	5.664,86 €
	yearly Cost in EUR	47.946,70 €	20.031,63 €	67.978,33 €
SAVINGS	monthly savings in hours	24,40	8,57	32,96
	monthly savings in EUR	2.439,69 €	856,72 €	3.296,40 €
	yearly savings in EUR	29.276,22 €	10.280,62 €	39.556,84 €
		PERT SUM	PERT SUM	PERT SUM
	Savings Potential	61%	51%	58%

		Effort in hours	Cost in €	Percentage
IMPLEMENTATION	GRAND TOTAL - IMPLEMENTATION	557,00	55.700,00 €	26%
	TOTAL - Preparation	50,67	5.066,67 €	9%
	RampUp / Documentation	25,33	2.533,33 €	50%
	Concept / Planning	25,33	2.533,33 €	50%
	TOTAL Cost - EAM Integration	52,00	5.200,00 €	9%
	Backend Extension	0,00	- €	0%
	Iteraplan Integration	52,00	5.200,00 €	100%
	TOTAL Cost - EA Source Integration	454,33	45.433,33 €	82%
	CloudFoundry	37,79	3.779,17 €	8%
	Kubernetes	37,79	3.779,17 €	8%
	ApiGee	31,29	3.129,17 €	7%
	Github	19,42	1.941,67 €	4%
Jenkins	11,79	1.179,17 €	3%	
ead.json	38,92	3.891,67 €	9%	
Testing	277,33	27.733,33 €	61%	
ROLL-OUT	TOTAL Cost - Roll-out	1460,00	146.000,00 €	68%
	ead.json creation	1080,00	108.000,00 €	74%
	pipeline integration	328,00	32.800,00 €	22%
	troubleshooting	52,00	5.200,00 €	4%
CROSS CUTTING ACTIVITIES	TOTAL Cost - Cross Cutting Activities	139,25	13.925,00 €	6%
	Project Management	27,85	2.785,00 €	20%
	Quality Assurance	55,70	5.570,00 €	40%
	Communication / Information	55,70	5.570,00 €	40%
TOTAL ONE TIME COST		2156,25	215.625,00 €	100%
RUN COST		hours / year	Cost in € / year	PERCENTAGE
	TOTAL Cost - Operation & Maintenance	96,00	11.400,00 €	100%
	Maintenance	96,00	9.600,00 €	84%
	Infrastructure Operation	n.a.	1.800,00 €	16%
TOTAL YEARLY RUNNING COST		96,00	11.400,00 €	100%

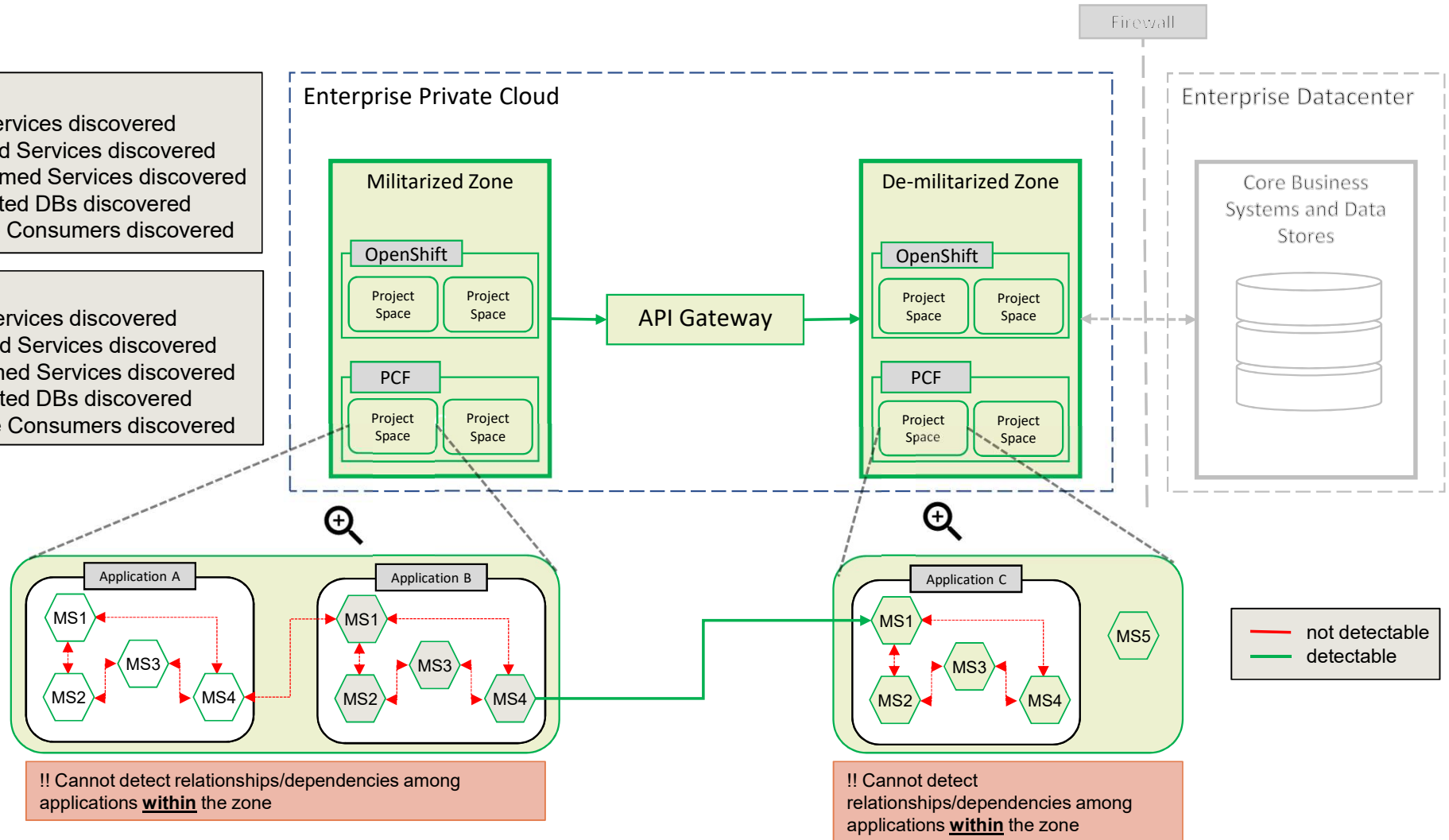
Locigal data model

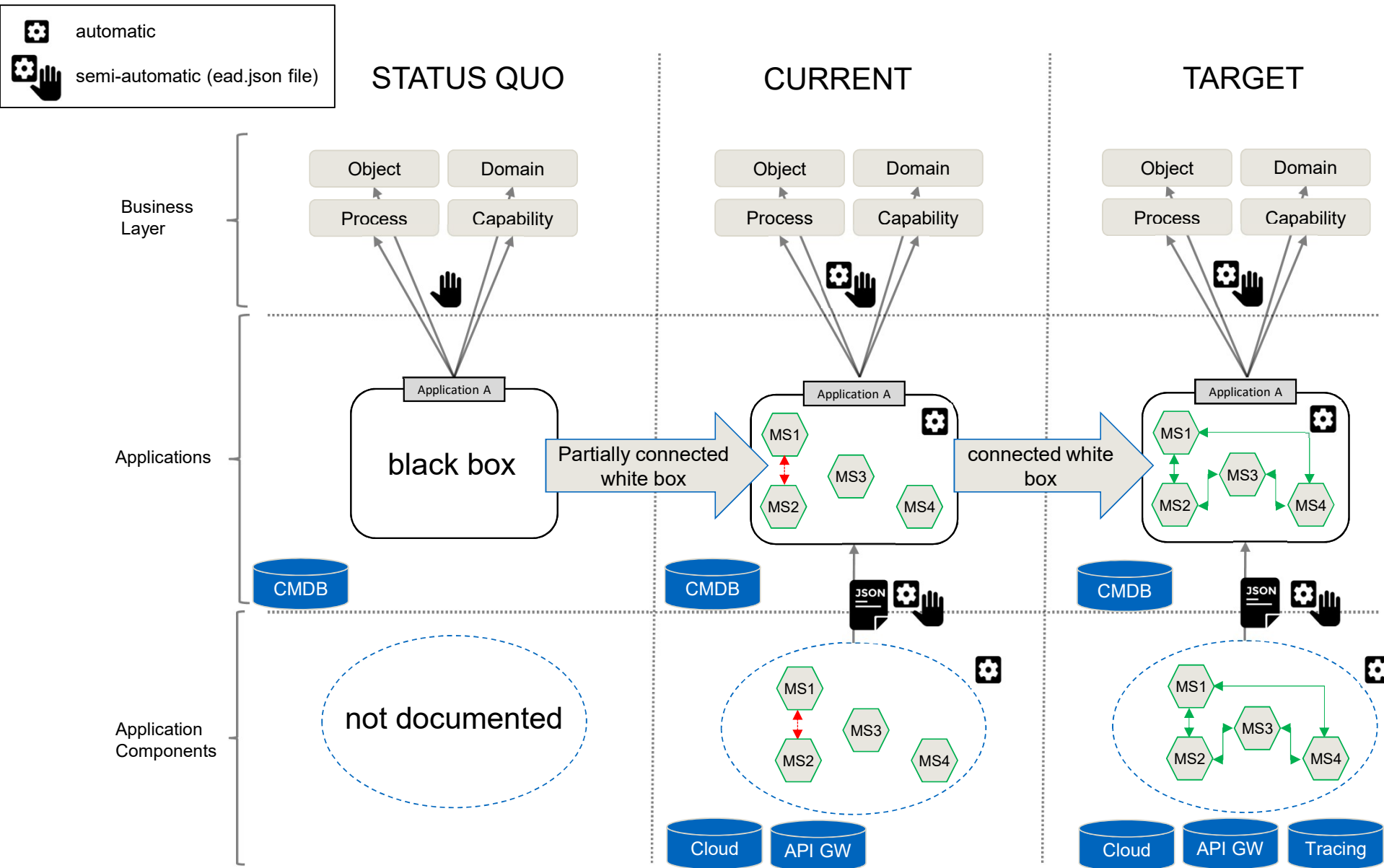


Achievements – Limitations due to a lack of distributed tracing

- Agile Team A**
- 9 / 9 Microservices discovered
 - 5 / 5 exposed Services discovered
 - 4 / 12 consumed Services discovered
 - 1 / 6 connected DBs discovered
 - 5 / 6 Service Consumers discovered

- Agile Team B**
- 5 / 5 Microservices discovered
 - 4 / 4 exposed Services discovered
 - 3 / 7 consumed Services discovered
 - 0 / 3 connected DBs discovered
 - 6 / 9 Service Consumers discovered





Easy two-step integration procedure

1. fill in config file template

Necessary steps:

1. Create a new file in the code repo
2. Copy&paste the template
3. Fill-in the template (see example below)

Example:

```
{
  "application_component_name": "ProposalService",
  "description": "reads and stores proposals [...]",
  "superordinate_application": "Offering-Services",
  "business_domains": [
    "Domäne A",
    "Domäne B"],
  "business_process": ["Process A"],
  "business_units": [
    "Unit A",
    "Unit B"],
  "business_objects": [
    "Offering",
    "Proposal",
  ]
  "<federated_information_source_1>": "<URL>",
  "<federated_information_source_2>": "<URL>",
}
```

2. integrate EAD library into the pipeline

Necessary steps:

1. Add ead-library to the jenkins (using system settings)
2. Import the library into the pipeline script (see example below)
3. Copy&Paste the ead-stage and set variables (see example below)

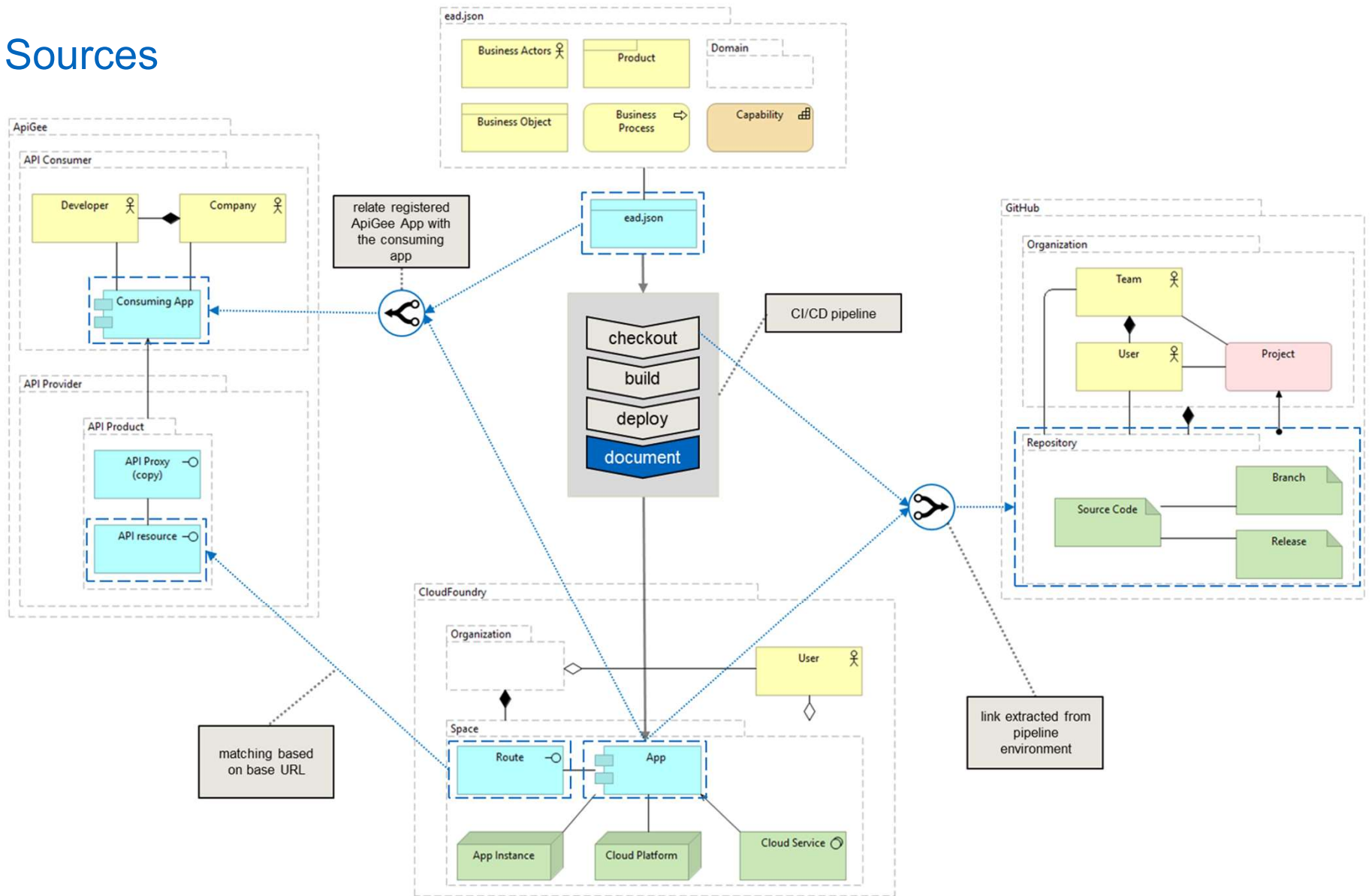
Example:

```
@Library(['ead-jenkins-library@master', 'jenkins-pipeline-library@v2']) _
[...]
stage('EAD documentation process') {
  steps {
    script {
      // read manifest.yml
      def manifest = readFile "${WORKSPACE}/manifest.yml"

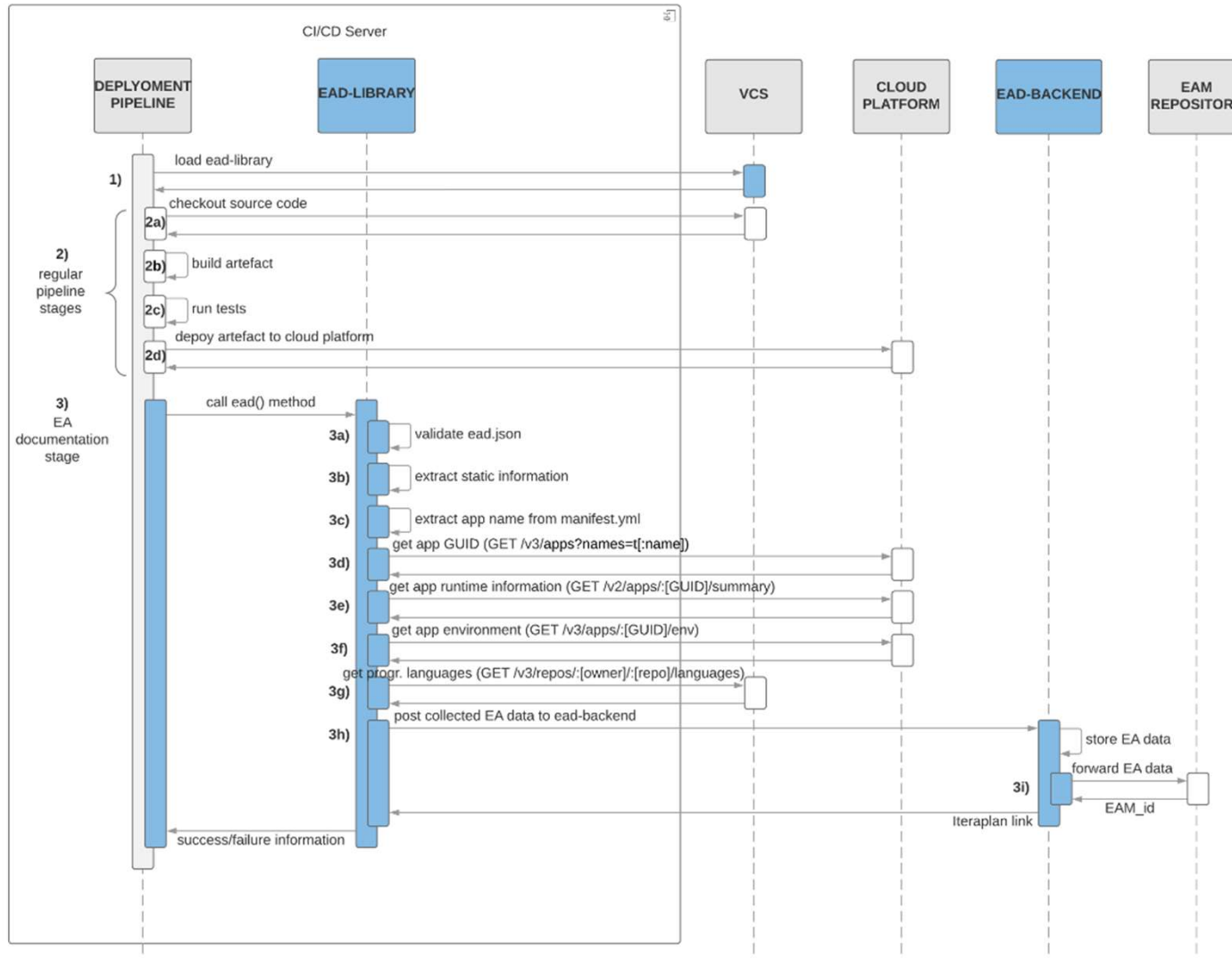
      // read ead.json to a JSONObject
      def eadjson = readJSON file: 'ead.json'

      //call the documentation method
      eadprocess.ead(eadjson: eadjson, file: manifest, pcfApiUrl: "${apiUrl}",
        pcfCredentialsID: "${CF_CREDENTIALS_ID}", org: "${ORG}", space:
        "${SPACE}")
    }
  }
}
```

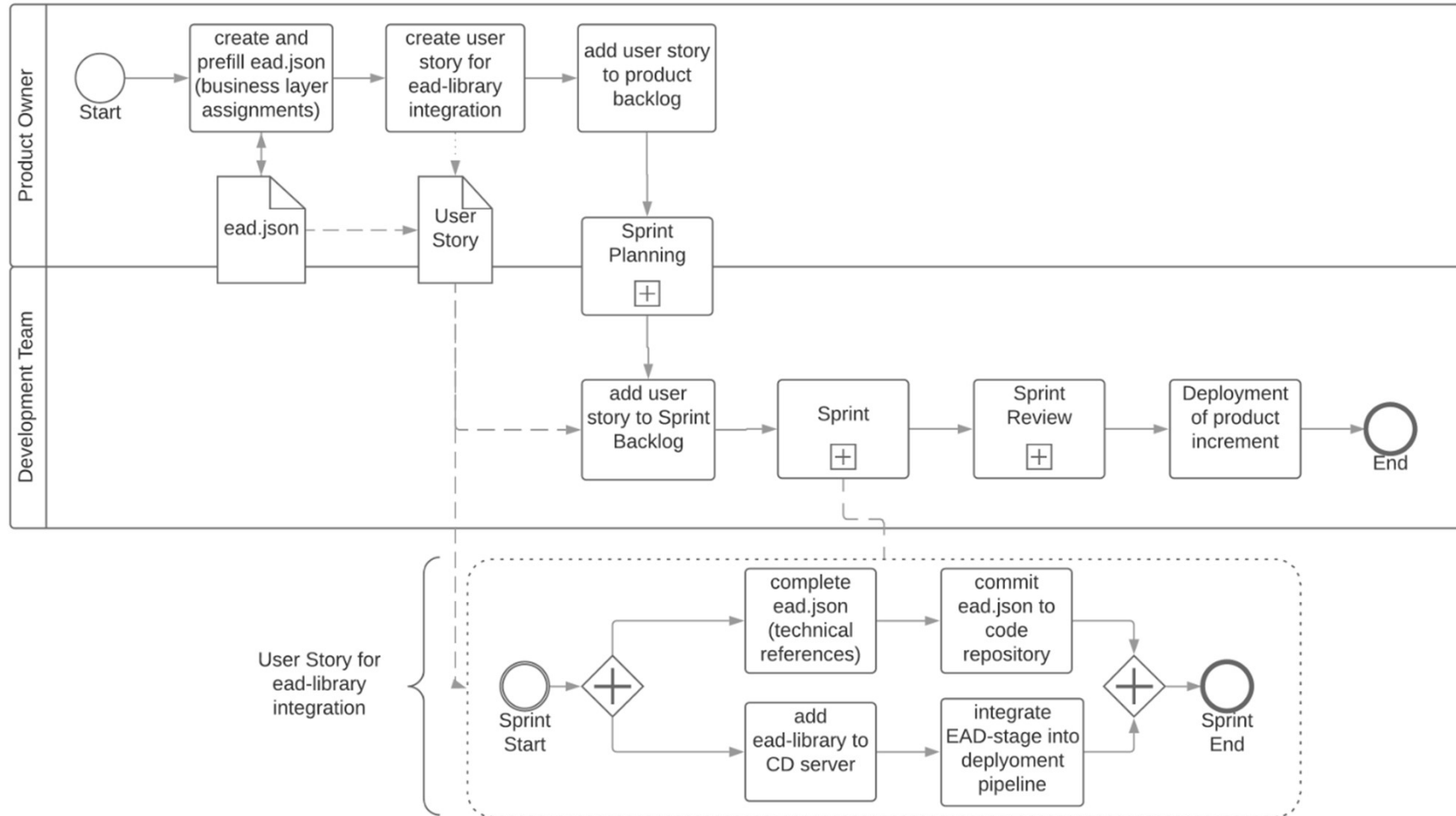
Information Sources



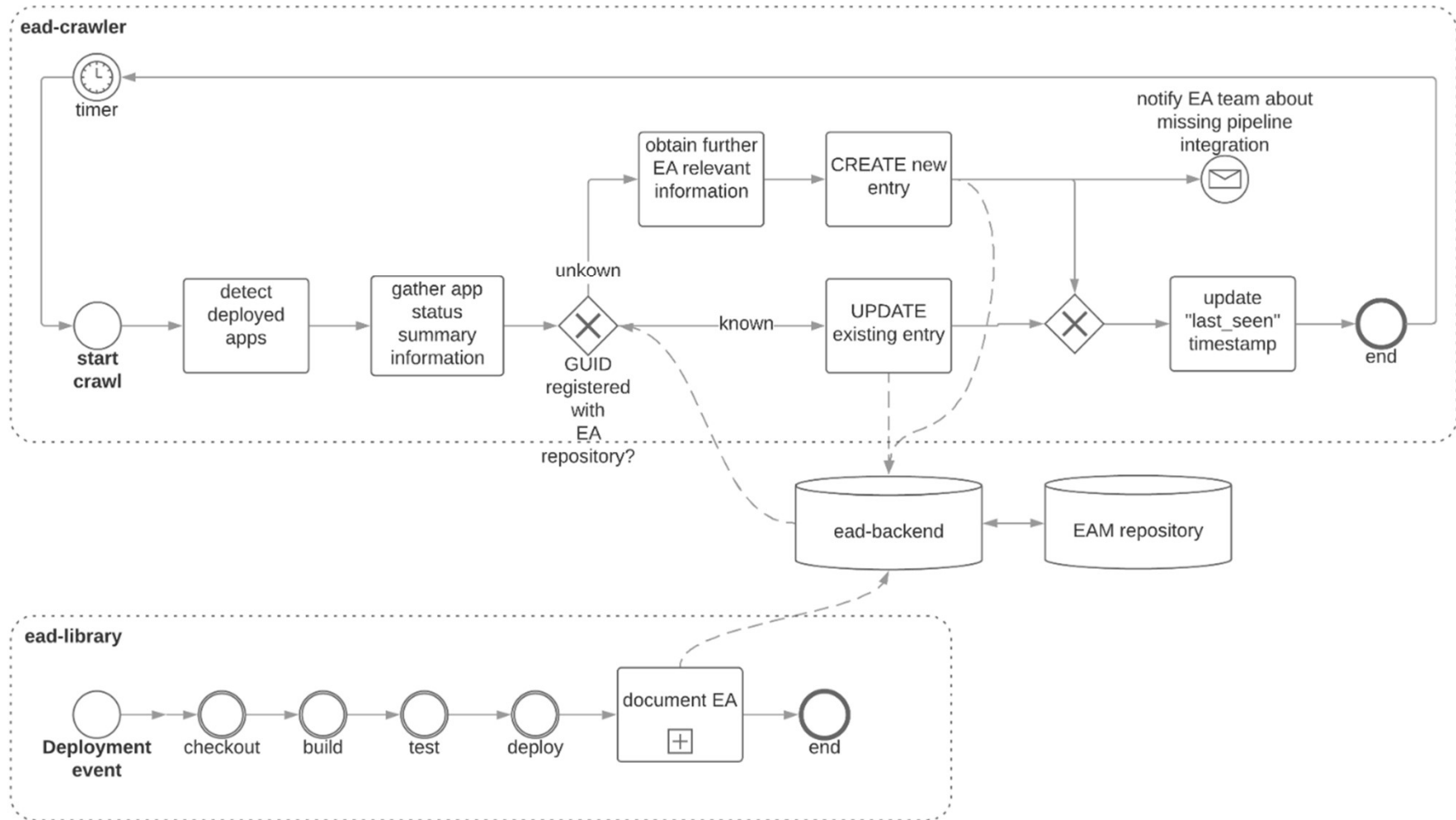
EAD pipeline stage sequence diagram



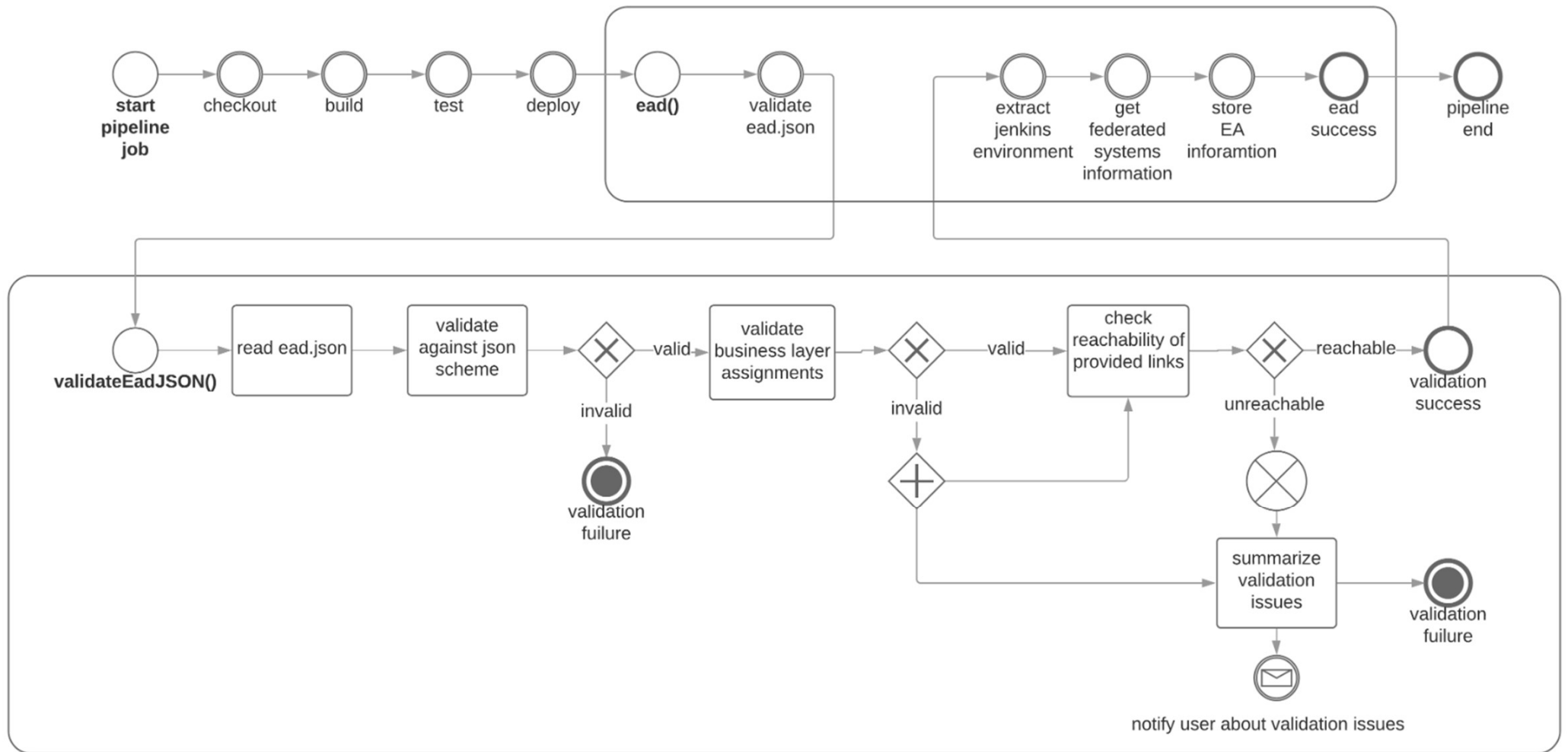
Integration into agile development



EAMM process



Ead.json validation



Automation Priorities / EA contribution

EA Element / Attribute	EA Layer	Avg. Score	Score EA - IT focus	Score EA - Business focus	Difference	Rank
Application component - instance	Relationship	17,92	17,5	18,3	0,83	1
Interface (external application behavior)	Application	17,71	17,2	18,1	0,96	2
Data flow and dependencies	Application	17,64	17,8	17,5	0,33	3
Business function - application component	Relationship	17,33	16,5	18,2	1,67	4
Intrapecific relationships (within application layer)	Application	17,20	18,0	17,0	1,00	5
Product - application component	Relationship	17,17	16,5	17,8	1,33	6
instance (running process)	Technology	17,08	17,3	16,8	0,50	7
Application (logical aggregate of components)	Application	17,00	17,5	16,8	0,67	8
Actor - application component	Relationship	16,83	15,5	18,2	2,67	9
Business domain - application component	Relationship	16,71	16,5	16,9	0,38	10
Business process - application component	Relationship	16,71	16,0	17,3	1,25	10
Project - application component	Relationship	16,57	16,0	17,0	1,00	12
Software dependencies	Technology	15,75	16,0	15,5	0,50	13
Cost structure (TCO, running costs, licenses)	Technology	15,25	12,3	18,2	5,83	14
Lifecycle state	Application	15,17	14,3	16,0	1,67	15
Compliance and data protection	Application	15,17	14,3	16,0	1,67	15
Event data (Incidents, MTTR, MTTF, etc.)	Technology	14,60	15,7	13,0	2,67	17
Physical IT resource (server, router, network device)	Technology	14,50	14,0	15,0	1,00	18
Version	Application	14,33	13,3	15,3	2,00	19
Technical domain	Application	14,25	16,5	13,5	3,00	20
Communication technology (e.g. protocols)	Technology	14,25	13,5	15,0	1,50	20
Intrapecific relationships (within technology layer)	Technology	14,25	13,0	14,7	1,67	20
Technology (NodeJs, JEE, .Net, etc.)	Technology	14,25	14,2	14,3	0,17	20
Application component	Application	14,13	13,5	14,3	0,83	24

EA artefacts / attributes	Layer	Automation Priority Rank												
		ead.json	manifest.yml	docker file	docker compose file	SCM (GitHub)	PPM (JIRA SOWftware)	code inspection (SonarQube)	CI/CD pipelines (Jenkins)	BRM (Artifactory, Docker Hub)	cloud platforms (CloudFoundry)	api gateway (ApiGee)	distributed tracing (Dynatrace)	service mesh (Istio)
interface (external application behavior)	L2	2												
data flow and dependencies	L2	3												
intrapecific relationships (within applicati	L2	5												
application (logical aggregate of compone	L2	13												
application component	L2	16												
Compliance und Datenschutz	L2	21												
lifecycle state	L2	21												
version	L2	26												
technical domain	L2	27												
last deployment/update	L2	38												
application component - instance	Rel	1												
business function - application componen	Rel	4												
product - application component	Rel	6												
actor - application component	Rel	8												
business domain - application component	Rel	9												
business process - application component	Rel	9												
project - application component	Rel	12												
instances (running process)	L3	7												
software dependencies	L3	18												
cost structure (TCO, running costs, license	L3	20												
event data (Incidents, MTTR, MTTF, etc.)	L3	24												
physical IT resource	L3	25												
communication technology (e.g. protocol	L3	27												
technology (NodeJs, JEE, .Net, etc.)	L3	27												
intrapecific relationships (within technolo	L3	27												
virtualisation technique	L3	31												
complexity	L3	33												
database (Mysql, MongoDB, etc.)	L3	34												
runtime data (saturation, availability, req	L3	34												
runtime environment (OS, host, cloud plat	L3	36												
usage classification (business vs. utility)	L3	36												
average adequacy:		2,00	4,00	3,38	3,20	2,36	2,00	1,50	1,50	1,00	2,31	1,44	1,14	1,23
unweighted Rank:		7	12	11	10	9	7	5	5	0	8	3	1	2
Rank weighted by automation priority:		4	12	8	9	6	7	10	13	11	1	5	2	3

References



#	Title	Authors	Year
[1]	Enterprise Architecture Documentation: Current Practices and Future Directions	Sascha Roth; Hauder, Matheus; Farwick, Matthias; Breu, Ruth; Matthes, Florian	2013
[2]	Automation Processes for Enterprise Architecture Management	Farwick, Matthias; Agreiter, Berthold; Breu, Ruth; Ryll, Steffen; Voges, Karsten; Hanschke, Inge	2011
[3]	Towards Integrating Microservices with Adaptable Enterprise Architecture	Bogner, Justus; Zimmermann, Alfred	2016
[4]	Enterprise Architecture Documentation: Empirical Analysis of Information Sources for Automation	Farwick, Matthias; Breu, Ruth; Hauder, Matheus; Roth, Sascha; Matthes, Florian	2013
[5]	A Requirements Based Approach for Automating Enterprise IT Architecture Modeling Using Multiple Data Sources	Valja, Margus; Lagerstrom, Robert; Ekstedt, Mathias; Korman, Matus	2015
[6]	Towards Living Landscape Models: Automated Integration of Infrastructure Cloud in Enterprise Architecture Management	Farwick, Matthias; Agreiter, Berthold; Breu, Ruth; Häring, Matthias; Voges, Karsten; Hanschke, Inge	2010
[7]	13th State of Agile Report	https://www.stateofagile.com/#ufh-i-521251909-13th-annual-state-of-agile-report/473508	2018
[8]	IT Landscape Discovery via Runtime Instrumentation for Automating Enterprise Architecture Model Maintenance	Martin, Kleehaus; Matheus, Hauder; Ömer, Uludag; Matthes, Florian; Nicolas Corpancho Villasana	2019