Software Construction

RWTH AACHEN UNIVERSITY

Werkzeugunterstützte Projektprognose

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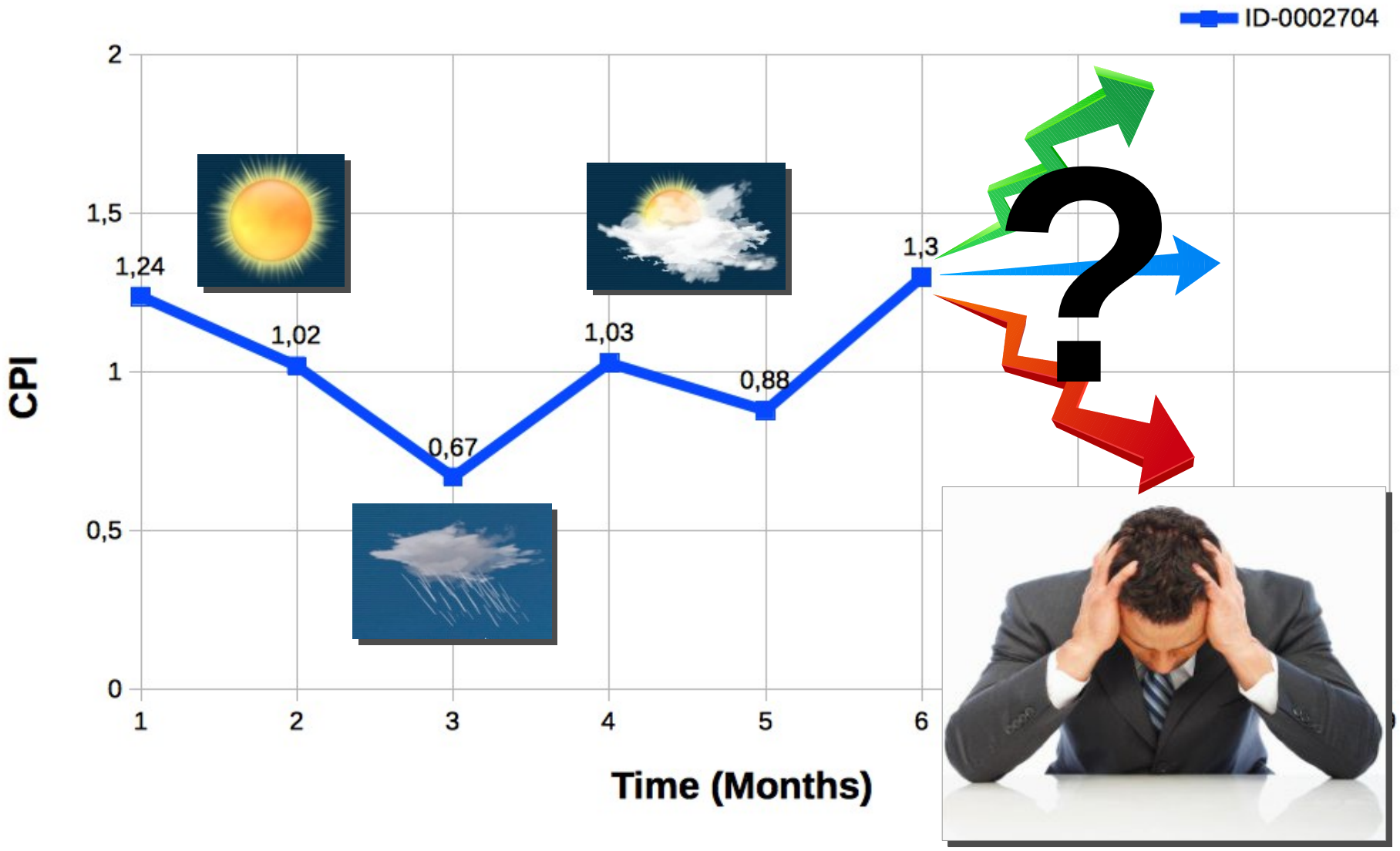
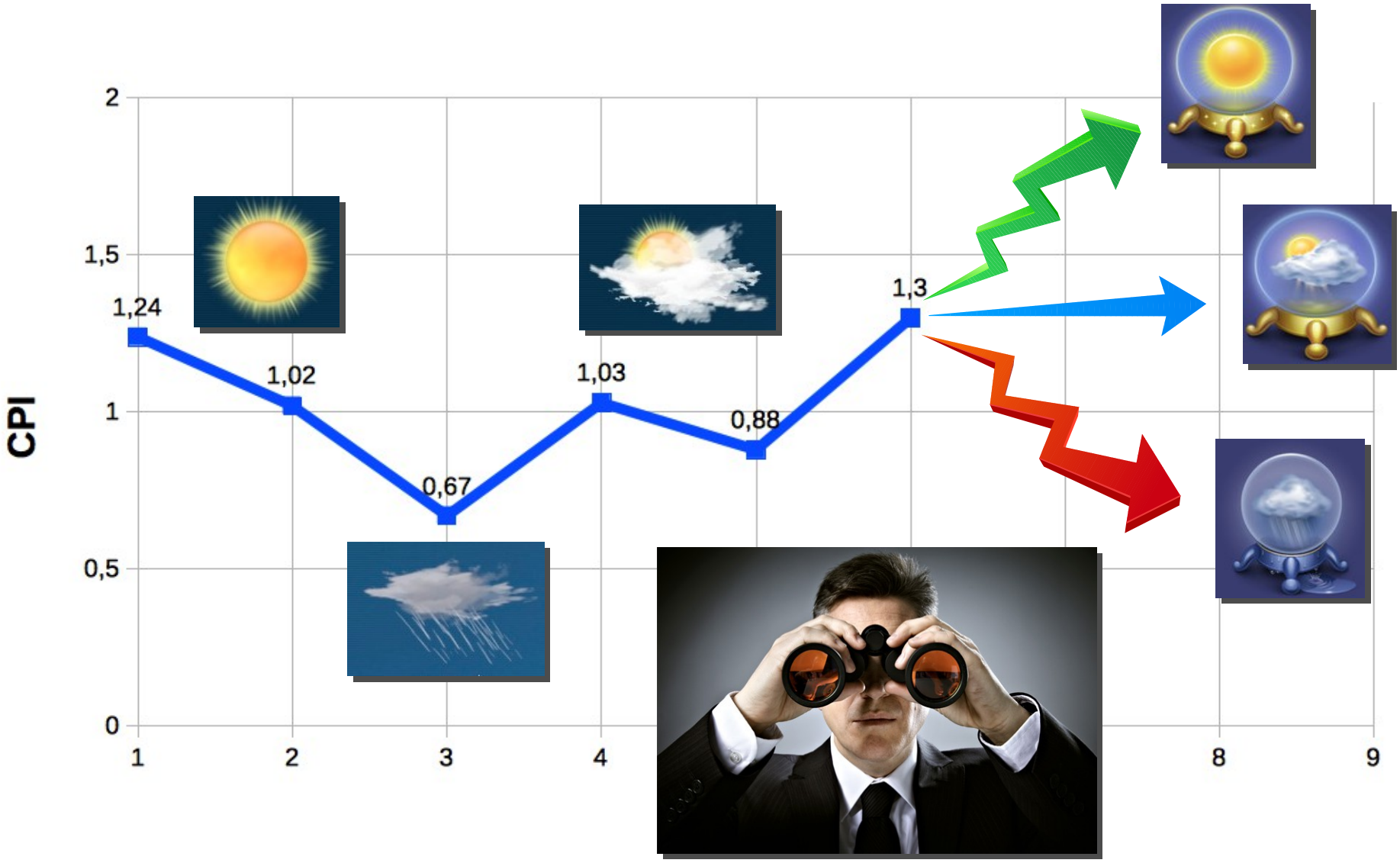
Motivation

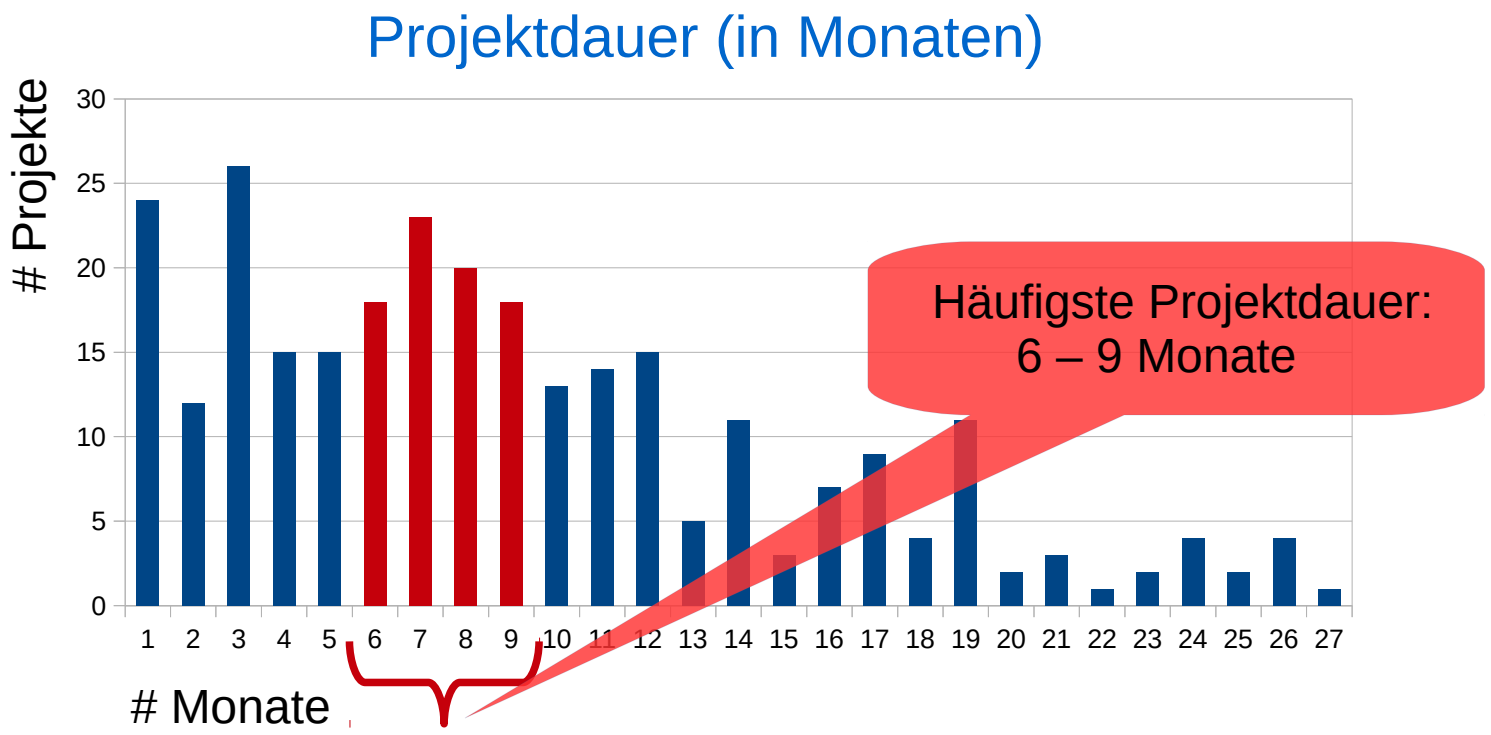

ID-0002704
CPI
Time (Months)
1,24
1,02
0,67
1,03
0,88
1,3
0
0,5
1
1,5
2
1
2
3
4
5
6

Motivation



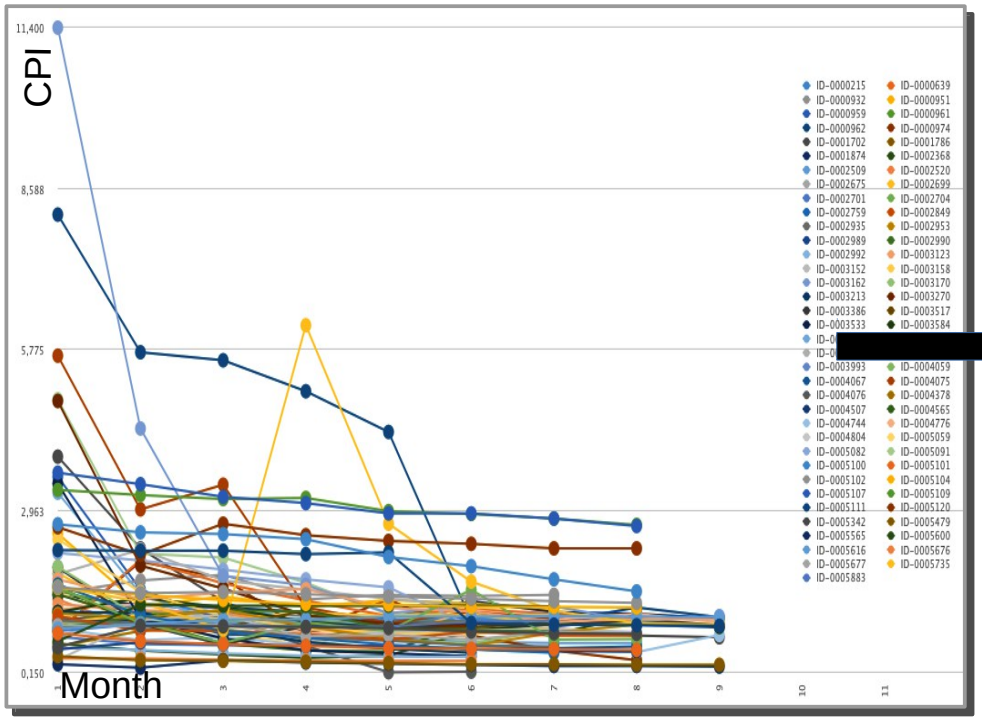
Motivation

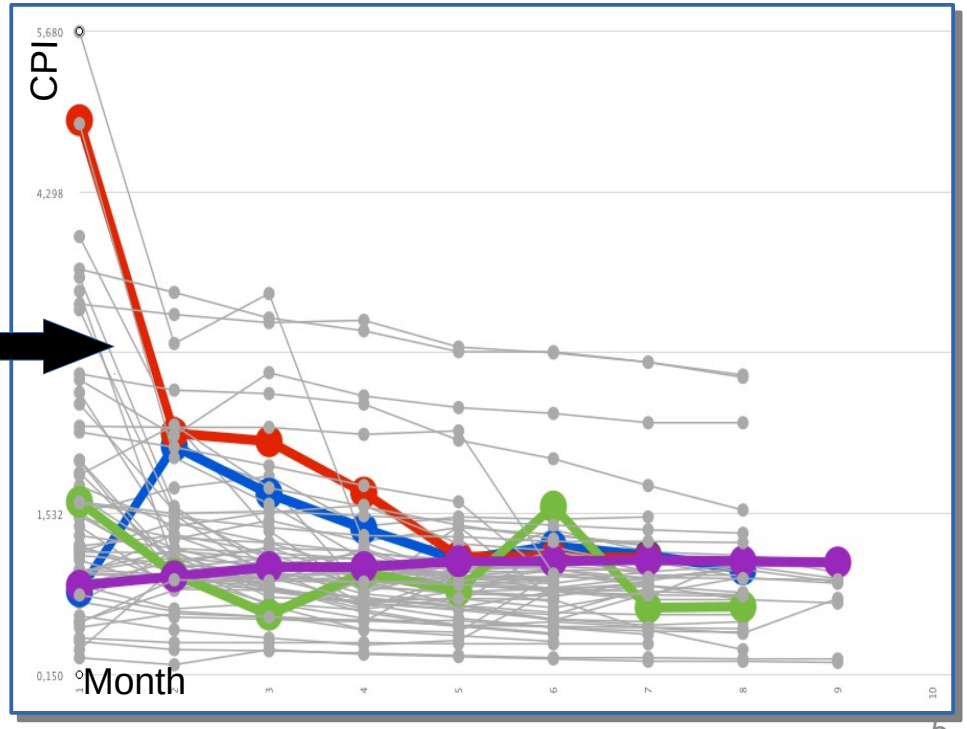
- Daten von externem Kooperationspartner:



Motivation

- Erste Versuch Muster zu identifizieren





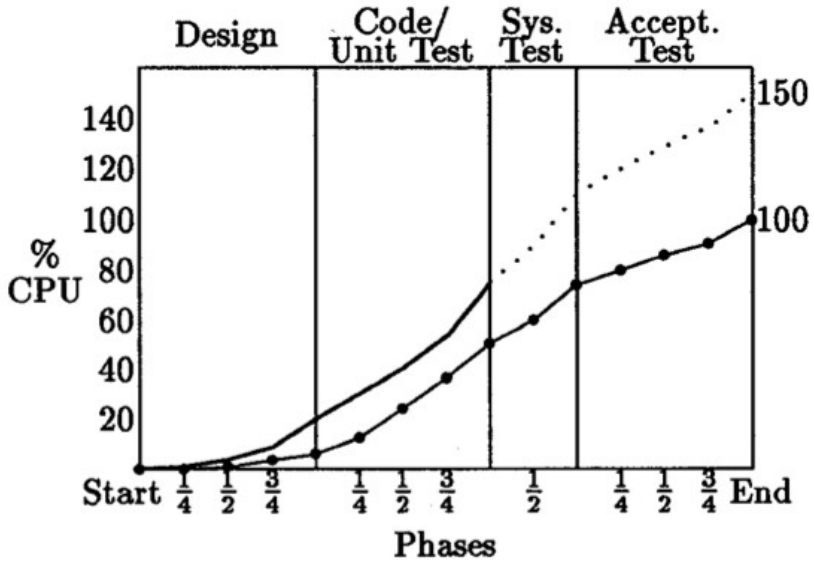
Motivation

Source [1]

Verwandte Arbeiten

- T. Vi Bach, 2014 [2]
  - **Ansatz:** Konzept des Frameworks zur Projektprognose
  - **Daten:** Historische Daten von großem IT-Unternehmen (CPI, SPI)
  - **Implementierung:** nur Konzept, keine Instrumentalisierung!
  - **Evaluation:** Fehlerrate über 100%

- M.V. Zelkowitz et al., 1993 [4]
  - **Ansatz:** Konstruktion des Prognose-modells für Software Projekte
  - **Daten:** über 100 NASA Projekten (LOC, Reported Errors, CPU, etc.)
  - **Implementierung:** keine Information!

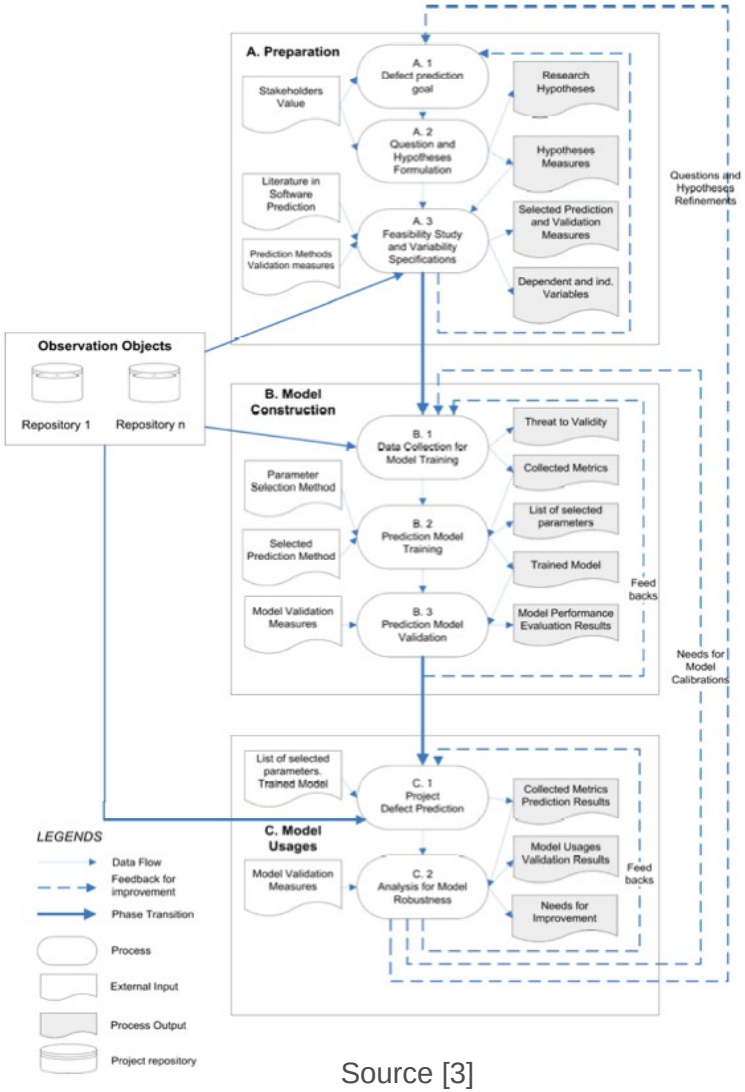


Vorhersage für CPU

Source [4]

Verwandte Arbeiten

- R. Ramler et al., 2008 [3] and 2009 [5]
  - **Ansatz:** Framework für Vorhersage von Software Defekten basierend auf Data Mining Methoden
  - **Daten:** 6 Versionen von Software System, ca.157 Komponenten / 639 KLOCs
  - **Implementierung:** Definiert 3 Phasen, aber keine Info über Instrumentalisierung!
  - **Evaluation:** 22% < Fehlerrate < 33%

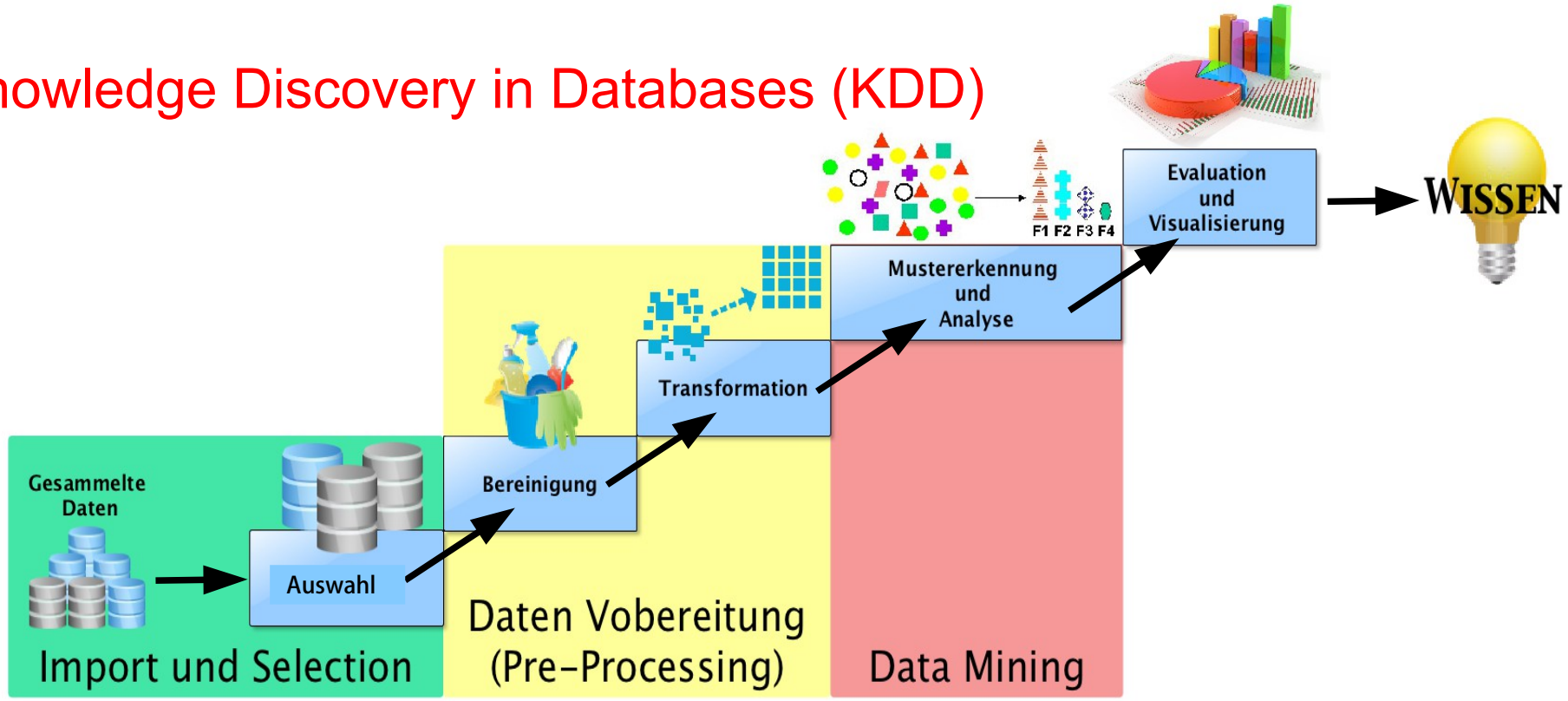


Source [3]

Data Mining Prozess

- Was ist Data Mining?
  - Entdecken und Extrahieren von Information
  - Finden von Muster / Wissensgewinnung

- Knowledge Discovery in Databases (KDD)



Data Mining

Cluster-Analyse (Clustering)

Klassifikation

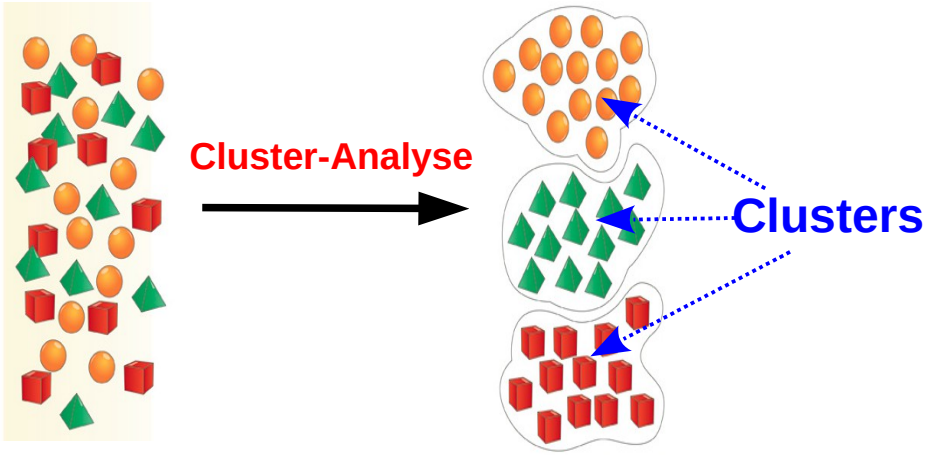
- Zusammenfassen von Objekten zu **Klassen**
- **Klasse** = Gruppe von Objekten mit einer logischen Eigenschaft (Regel)
- Benennung der Klassen

Data Mining

Cluster-Analyse (Clustering)

Klassifikation

- Entdeckung von **Ähnlichkietsstrukturen**
- **Cluster** = Gruppe von “ähnlichen” Objekten gemäß eines Ähnlichkeitsprinzips (Distanzmaß)

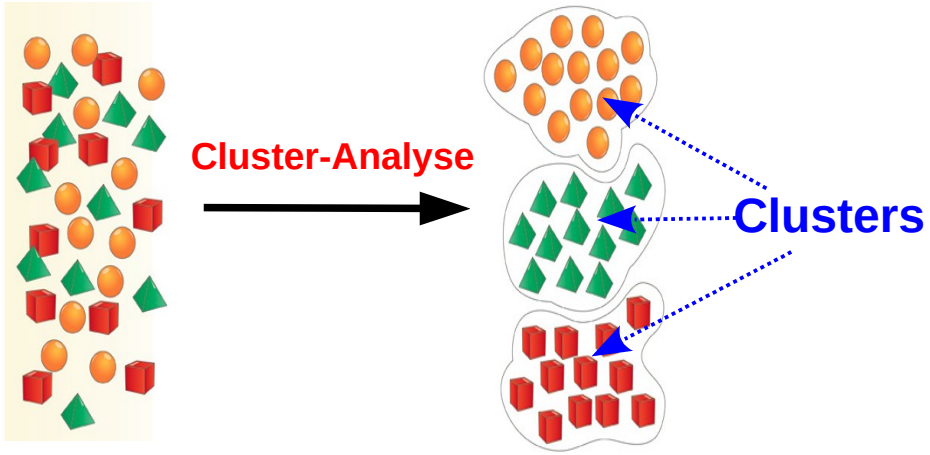


Cluster-Analyse (Clustering)

Klassifikation

Clustering-Parameter

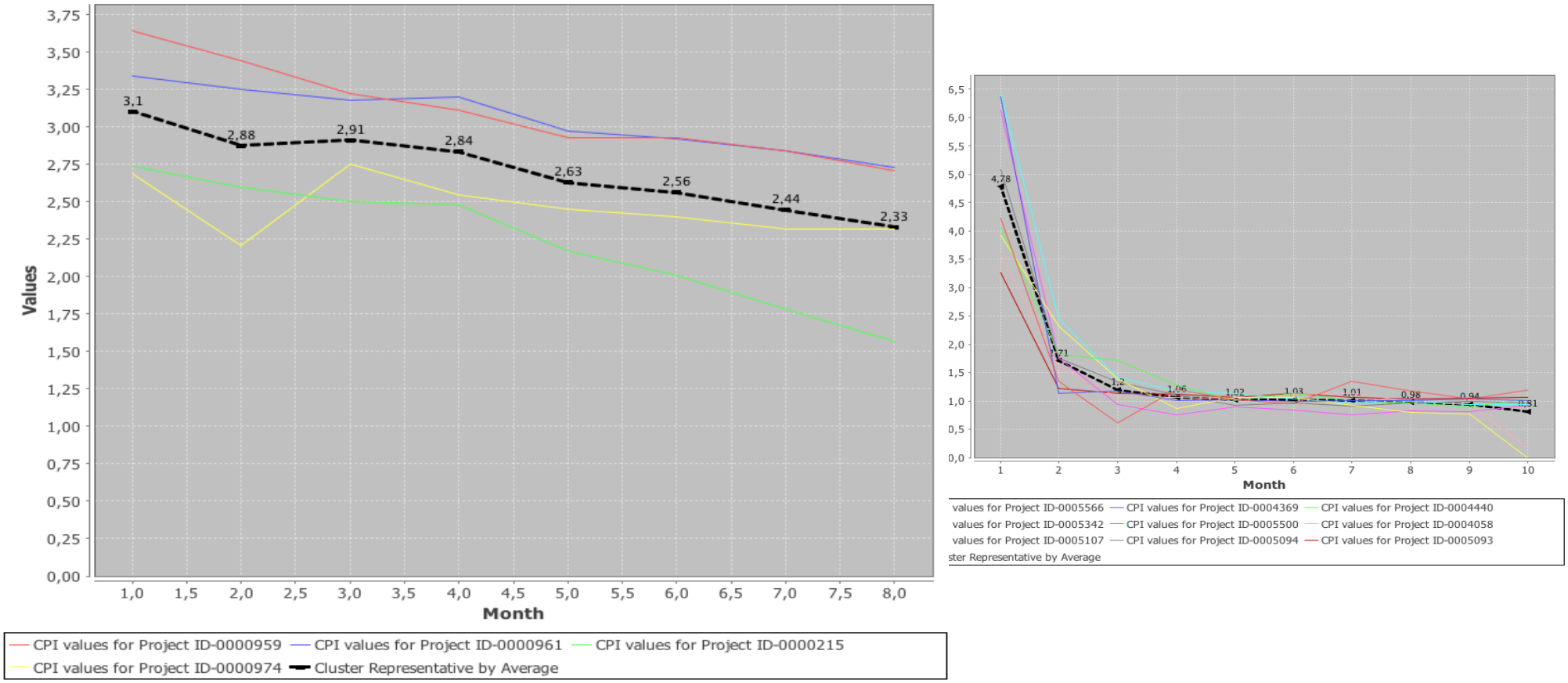
- Clustering-**Verfahren** (k-Means, Hierarchical Clustering)
- Anzahl von Clusters **k**
- **…**



Data Mining

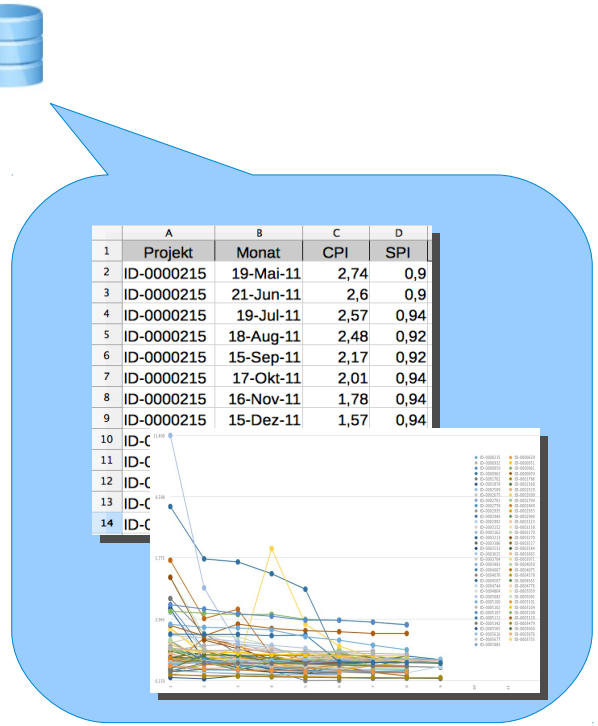
- Ähnlichkeitsprinzip und Cluster-Repräsentant

Beispiel: Ergebnis der Cluster-Analyse



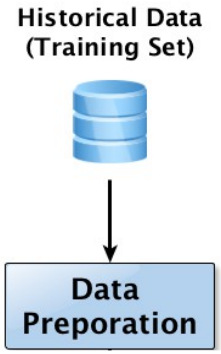
Idee und Konzept

Historical Data
(Training Set)

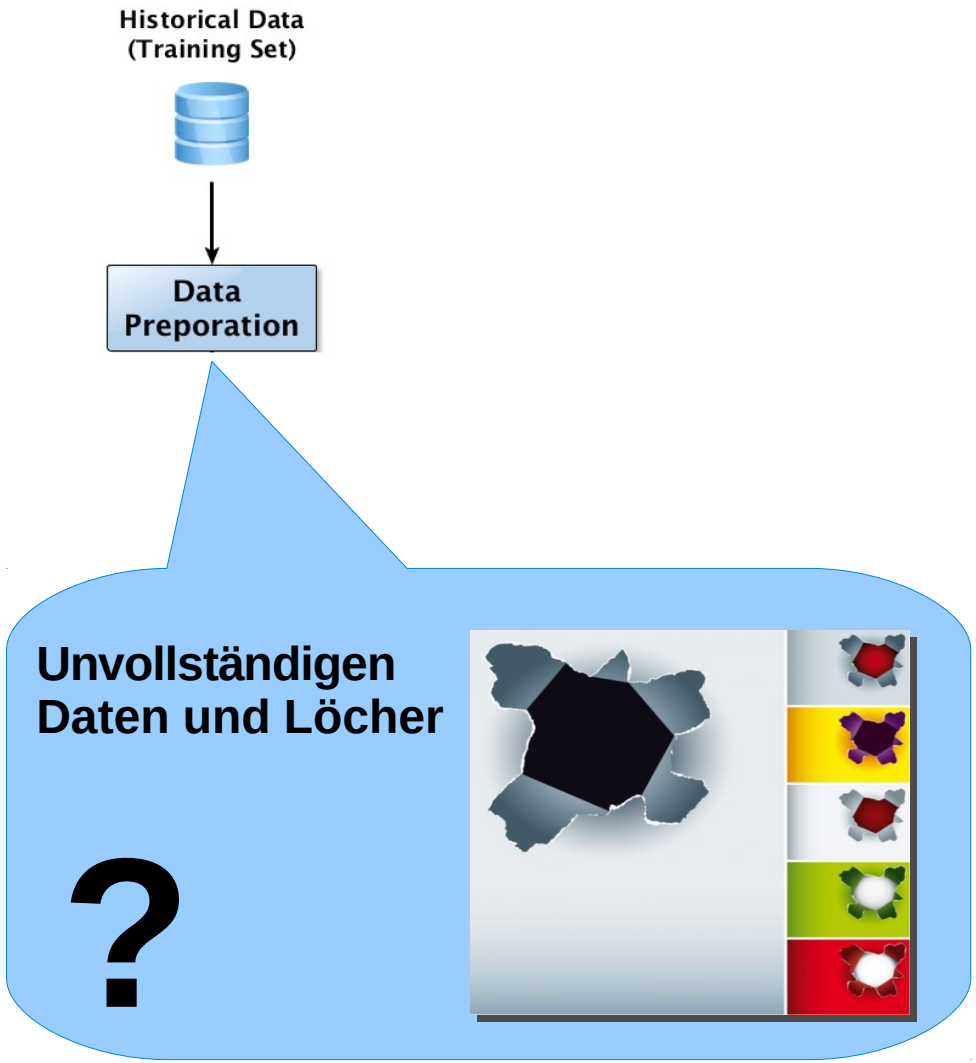


	A	B	C	D
1	Projekt	Monat	CPI	SPI
2	ID-0000215	19-Mai-11	2,74	0,9
3	ID-0000215	21-Jun-11	2,6	0,9
4	ID-0000215	19-Jul-11	2,57	0,94
5	ID-0000215	18-Aug-11	2,48	0,92
6	ID-0000215	15-Sep-11	2,17	0,92
7	ID-0000215	17-Okt-11	2,01	0,94
8	ID-0000215	16-Nov-11	1,78	0,94
9	ID-0000215	15-Dez-11	1,57	0,94
10	ID-(			
11	ID-(			
12	ID-(			
13	ID-(			
14	ID-(			

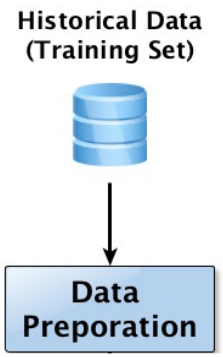
Idee und Konzept

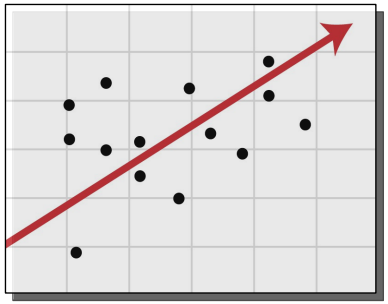


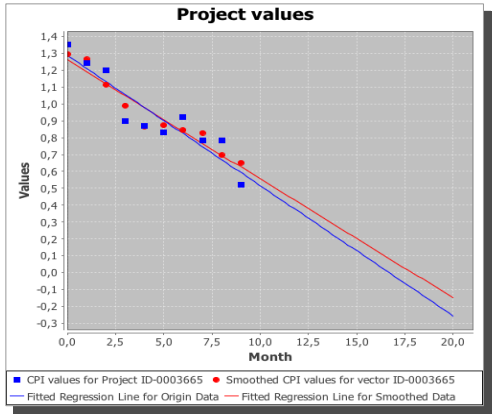
Idee und Konzept



Idee und Konzept





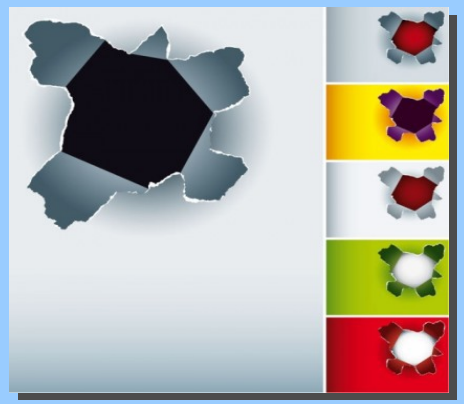


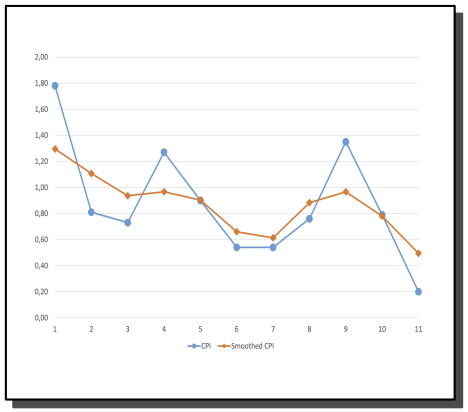
Regression

Smoothing

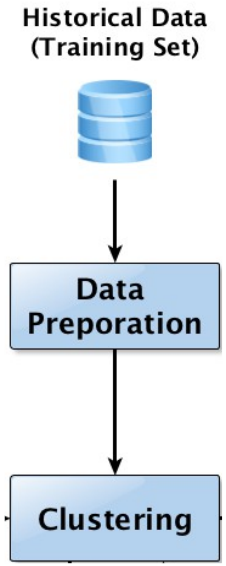
Unvollständigen Daten und Löcher

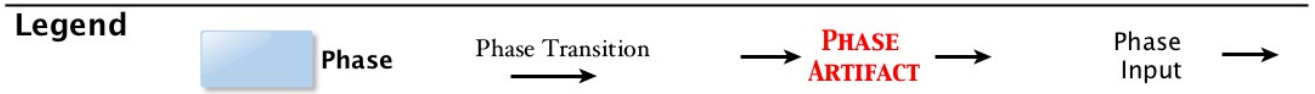
?



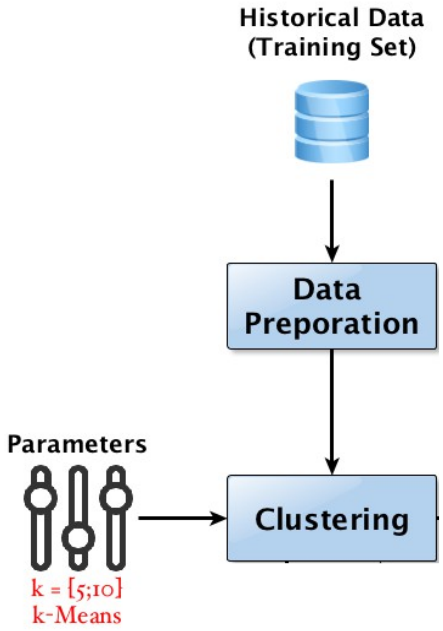


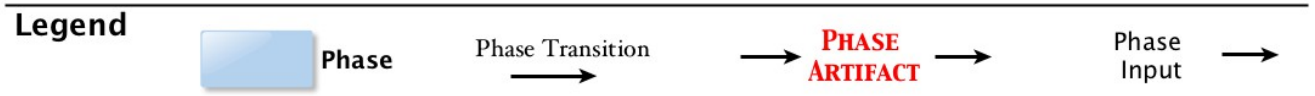
Idee und Konzept



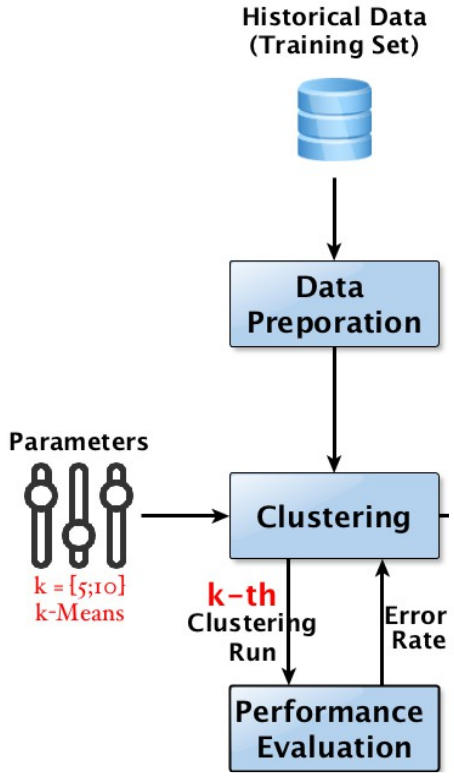


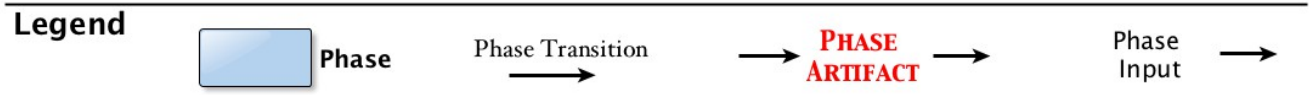
Idee und Konzept



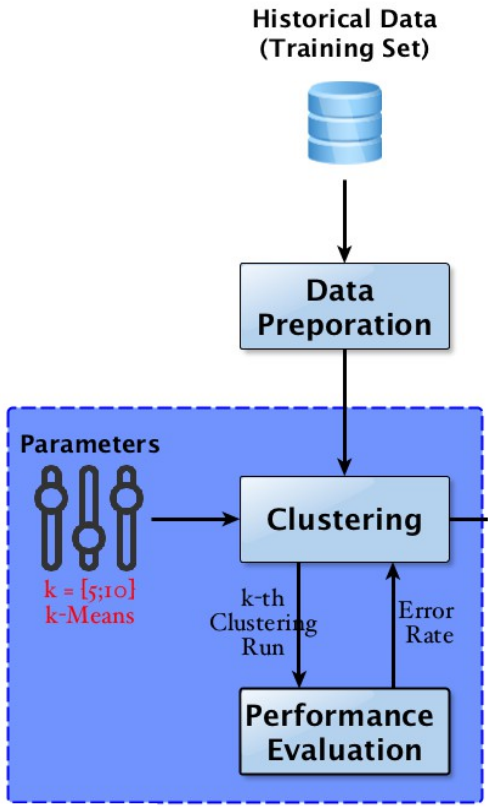


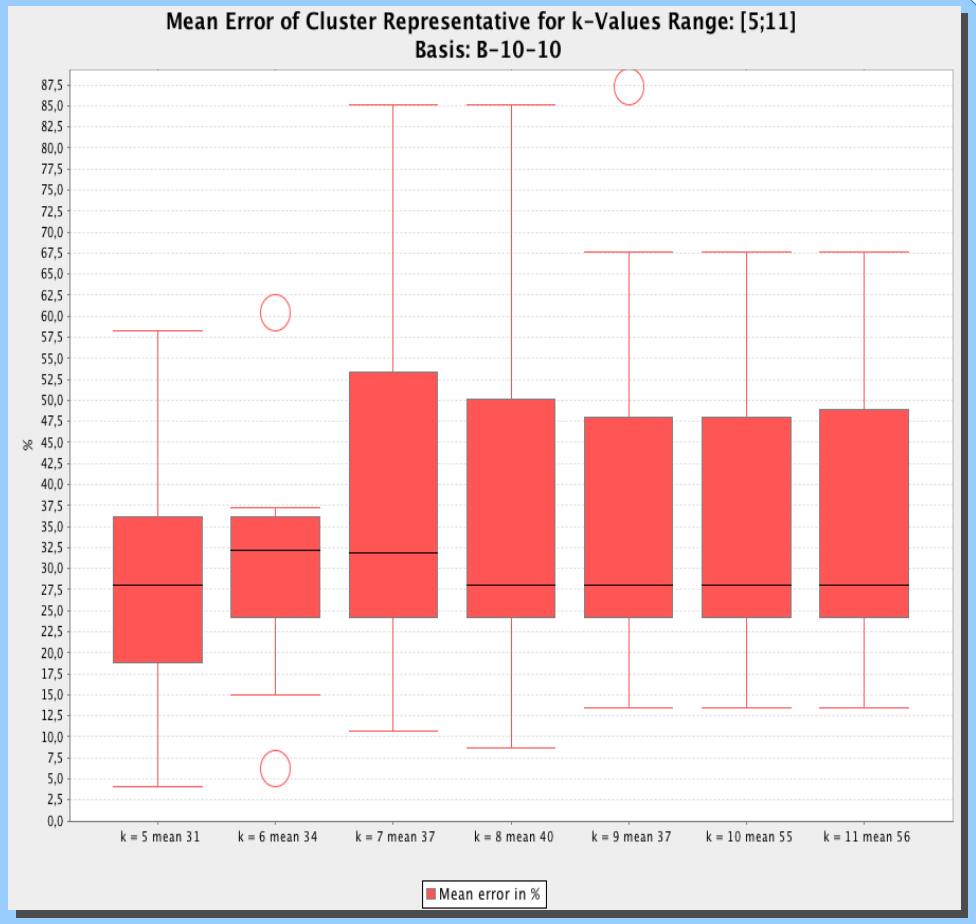
Idee und Konzept



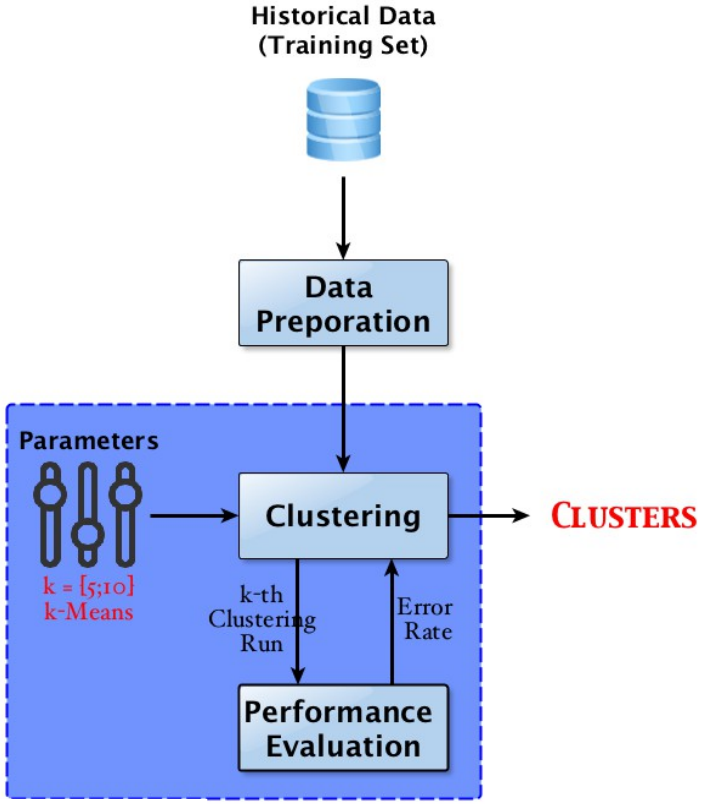


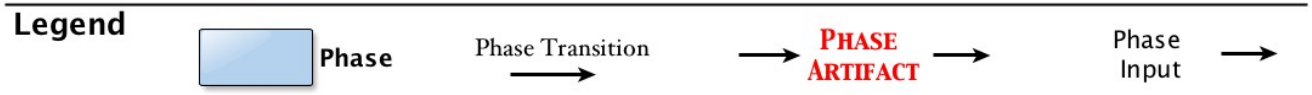
Idee und Konzept



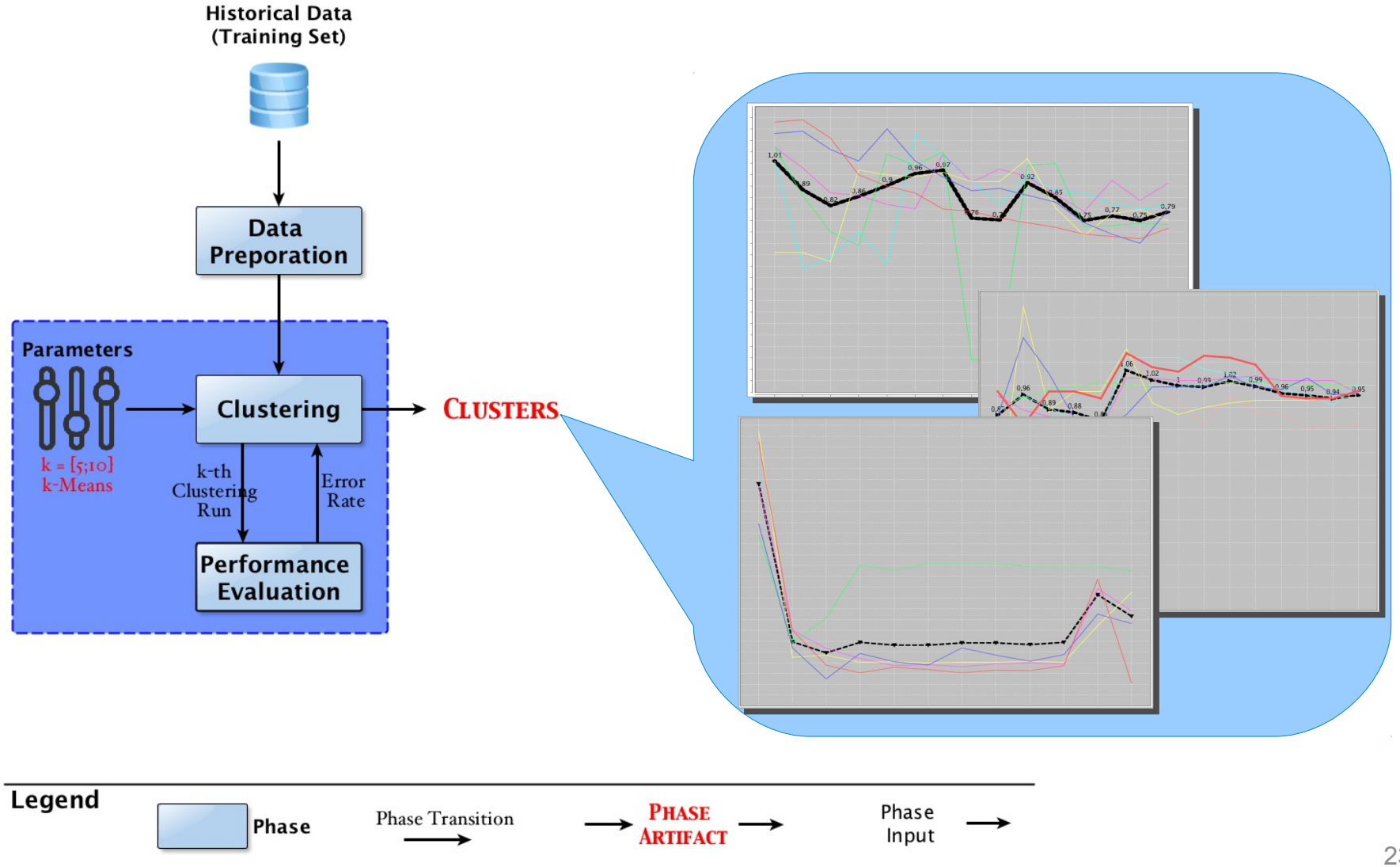


Idee und Konzept





Idee und Konzept



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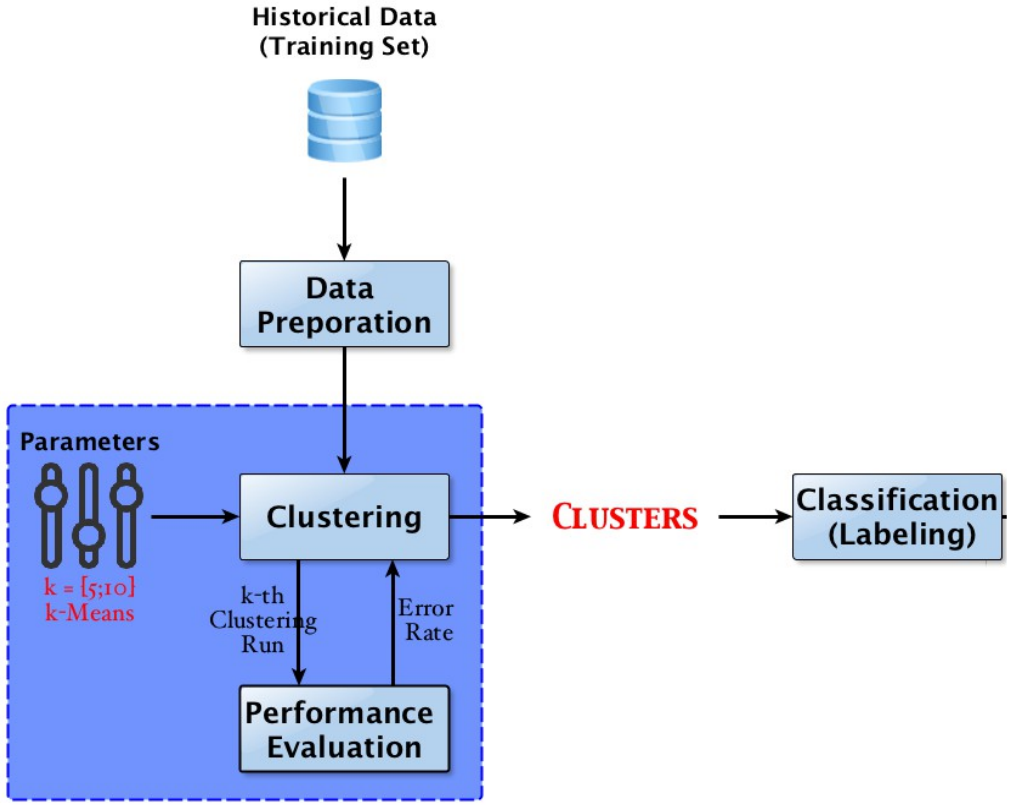

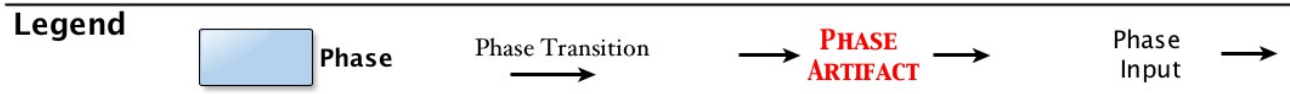

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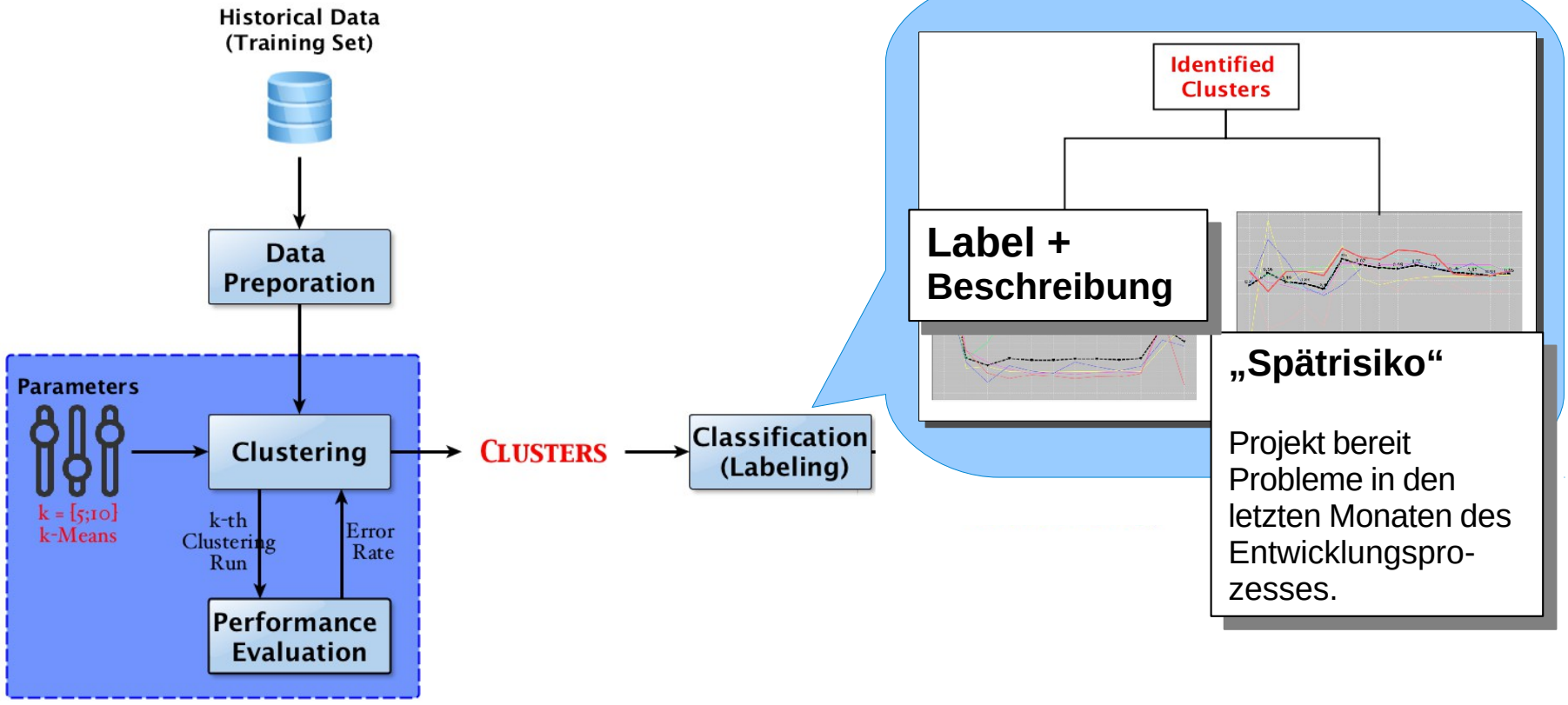
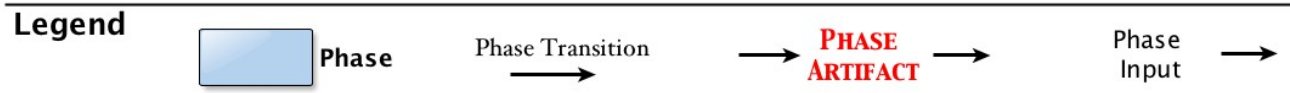
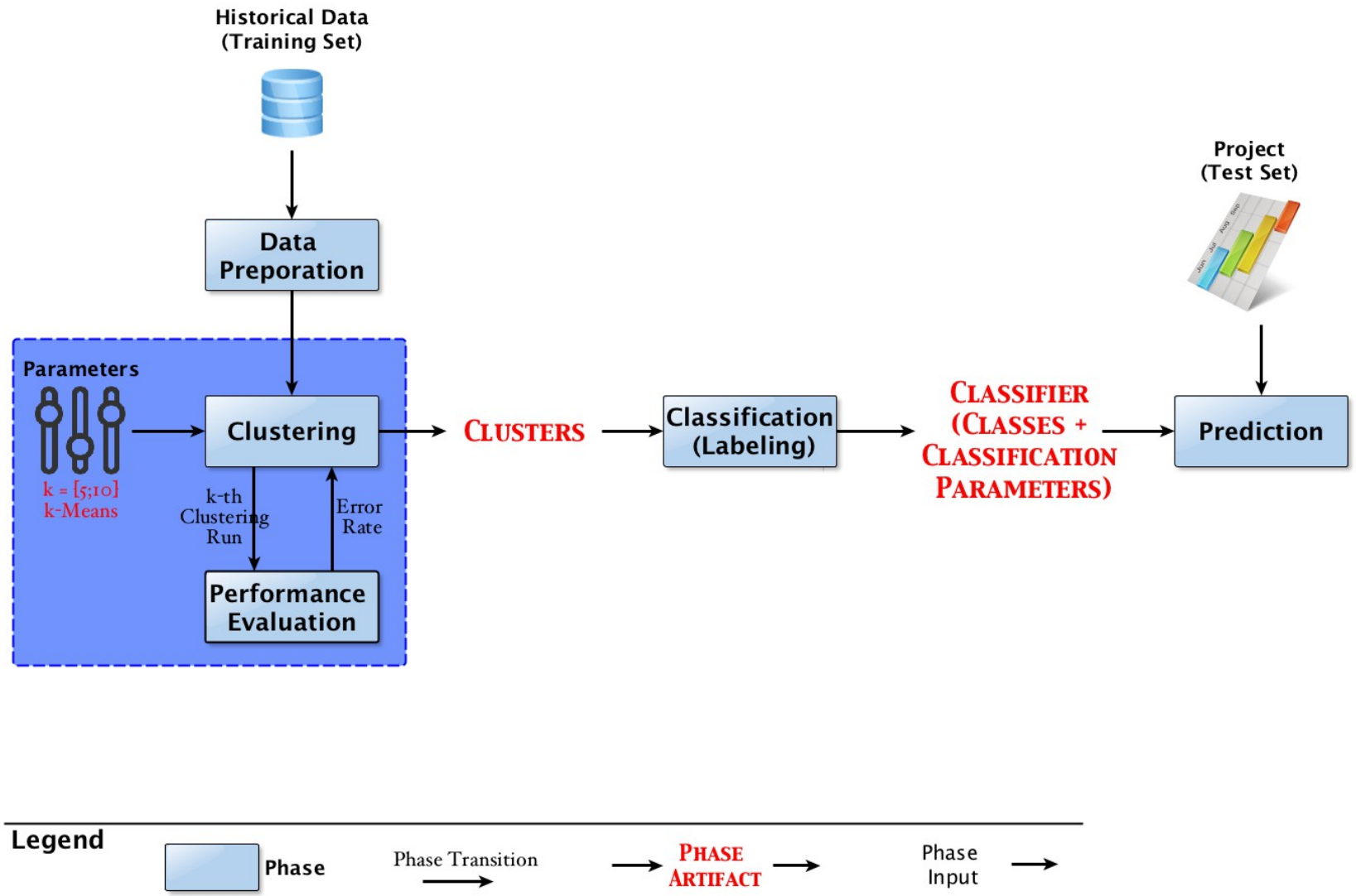




Idee und Konzept



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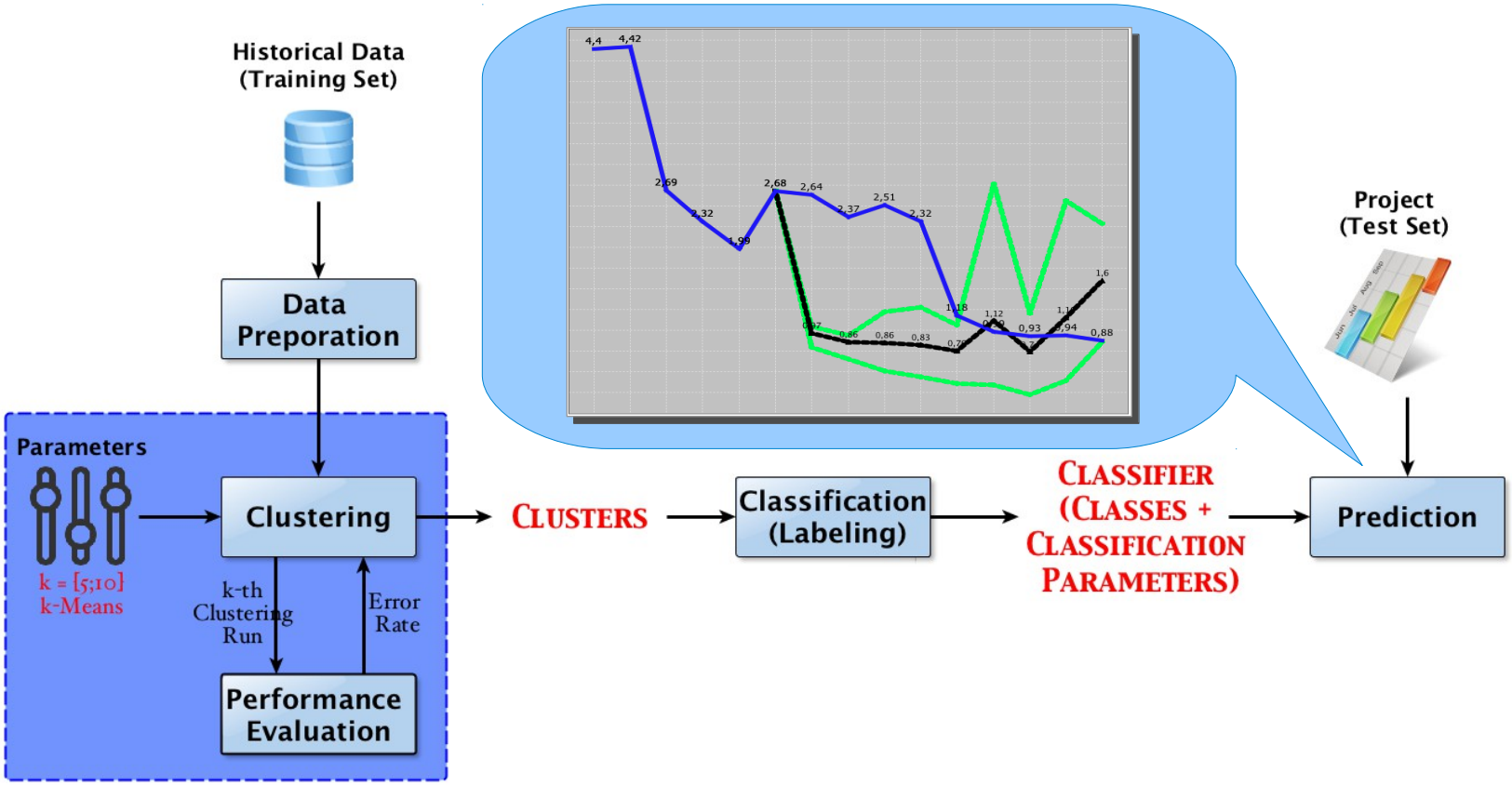
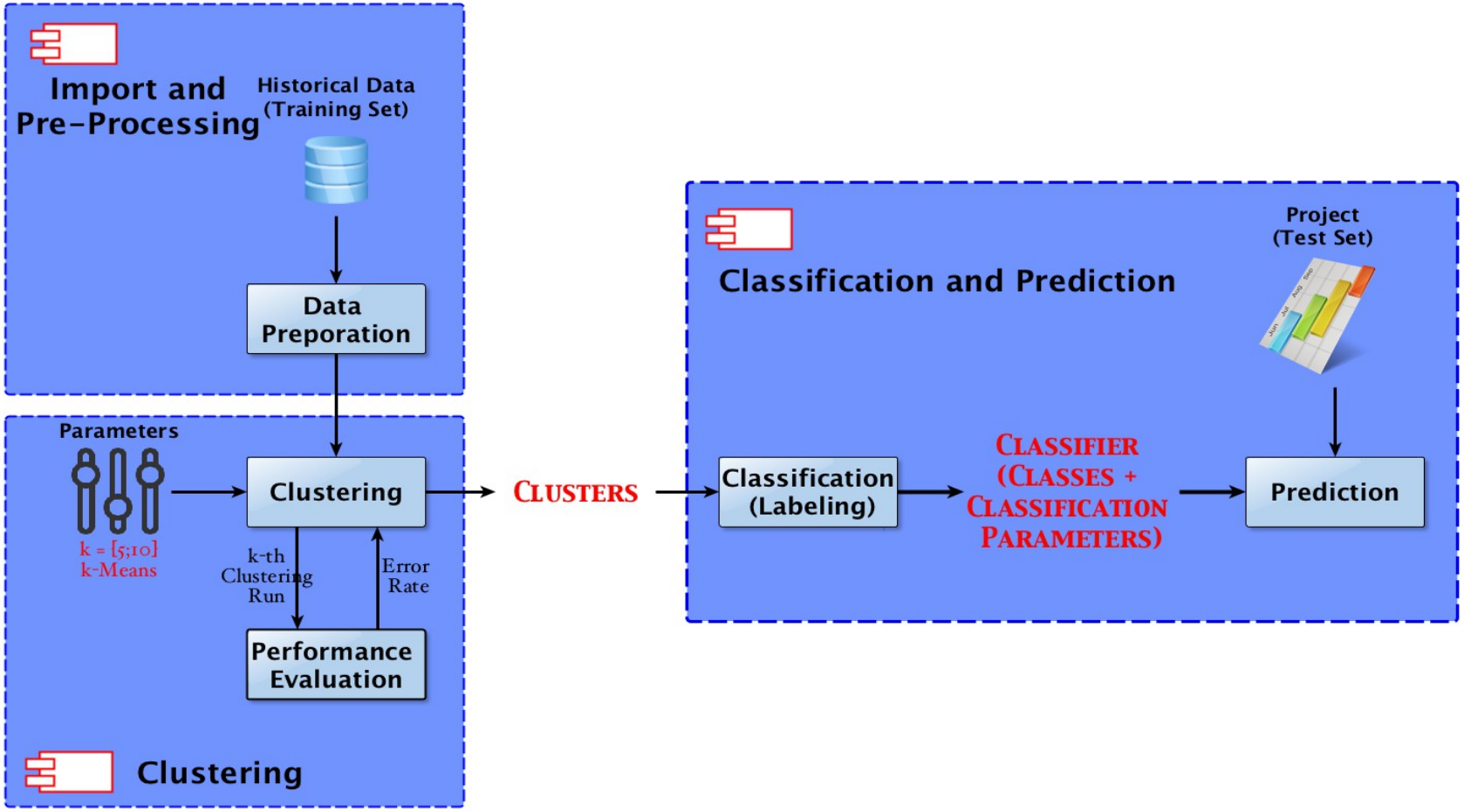


Idee und Konzept

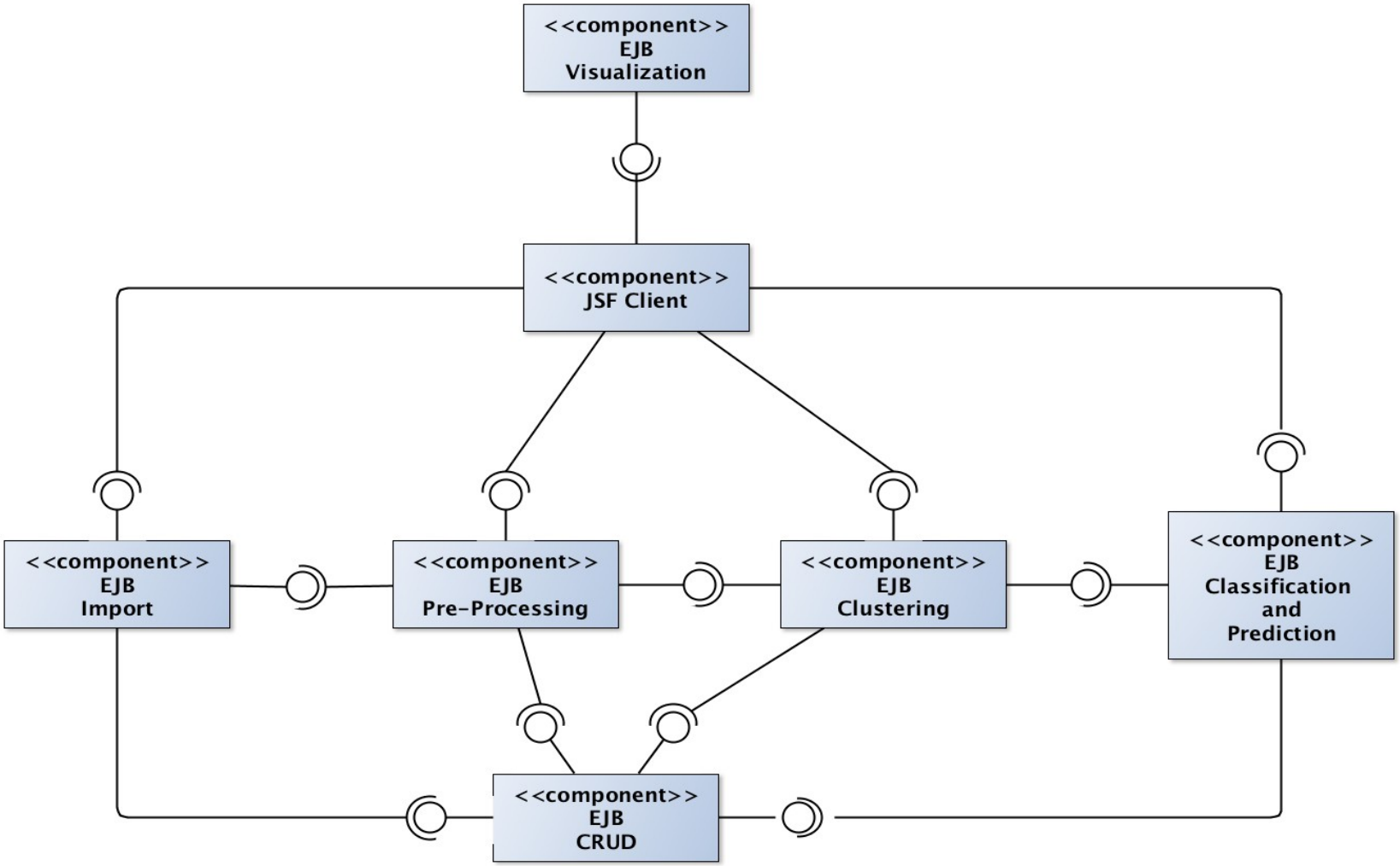


Ziele und Anforderungen

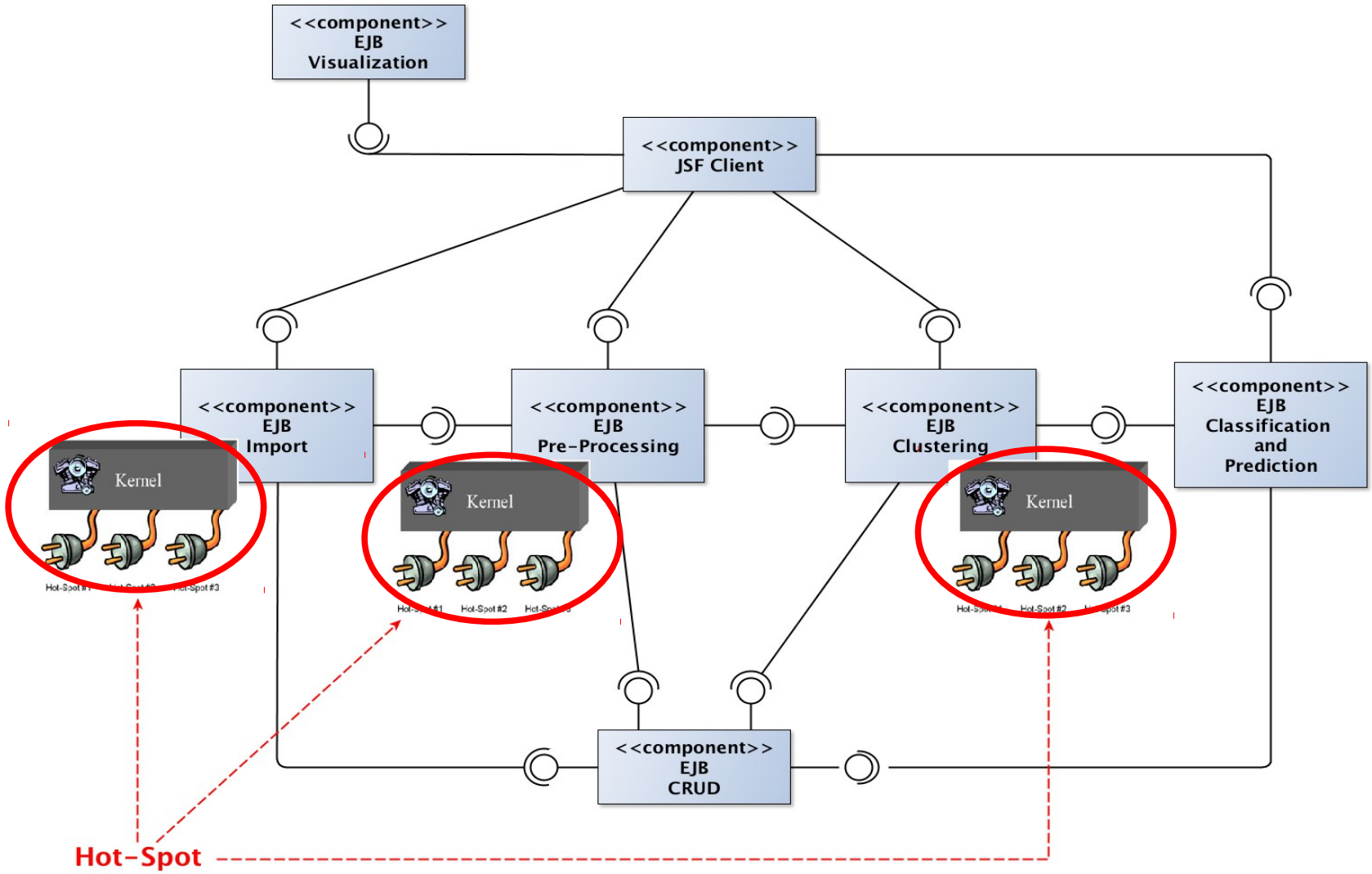
- Entwicklung von Framework
  - Lose gekoppelte Architektur
  - Vollständige Implementierung von Data Mining Prozesses (Wissensextraktion)
  - Jeder Schritt der Wissensextraktion ist gekapselt in eigene Komponente
  - Unterstützung von Variabilität und Erweiterbarkeit
  - Web-Basierte Anwendung + JavaEE

- Prototyp Implementierung von Projekt-Vorhersage-Tool
  - System “versteht” Daten von externem Kooperationspartner
  - Import, Pre-processing, Clustering
  - Benutzbarkeit und UI
  - Konfiguration ohne Expertenwissen

Realisierung



Hot-Spots


<<component>>
EJB
Visualization
<<component>>
JSF Client
<<component>>
EJB
Import
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EJB
Pre-Processing
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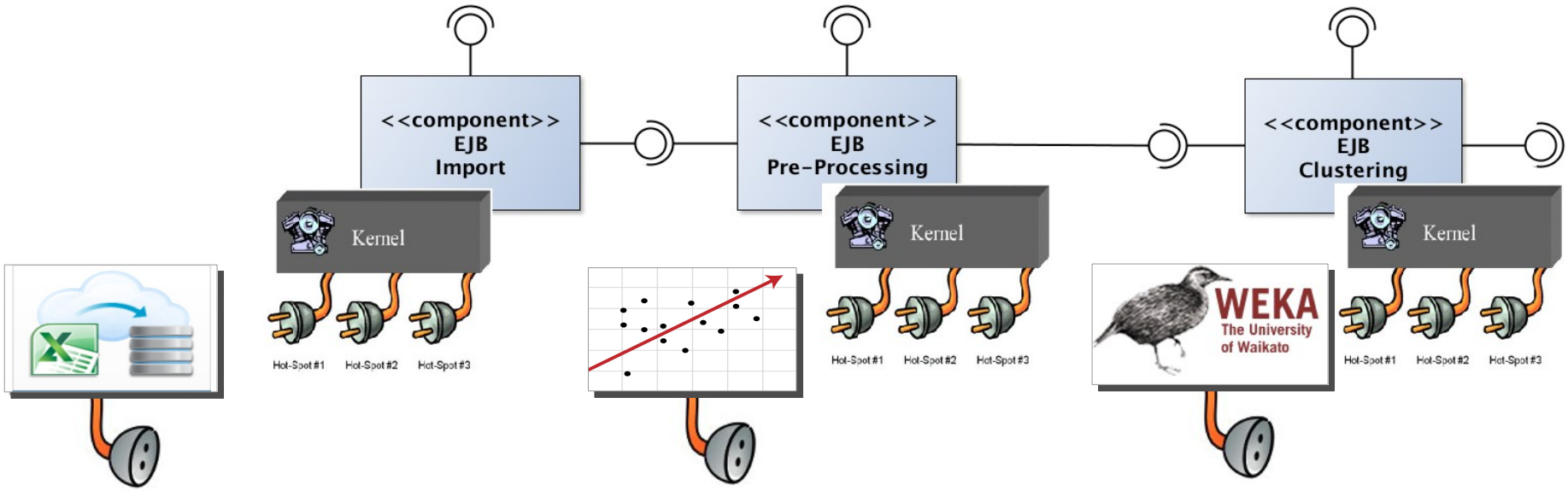
EJB
Clustering
<<component>>
EJB
Classification
and
Prediction
Kernel
Kernel
Kernel
Hot-Spot #1
Hot-Spot #2
Hot-Spot #3
<<component>>
EJB
CRUD
Hot-Spot

Hot-Spots Implementierung



Hot-Spot Implementierung:
Import aus xls/xlsx

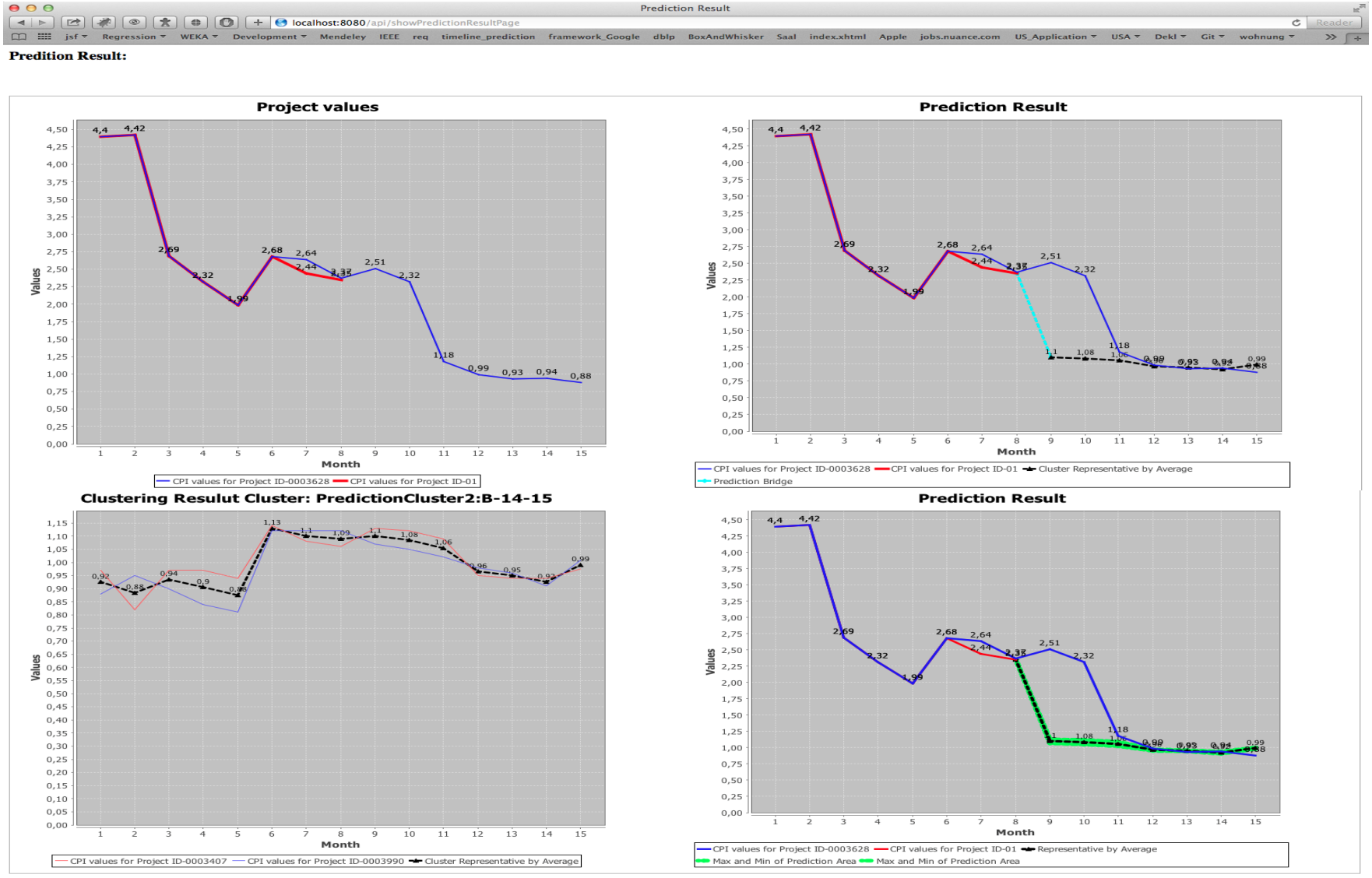
Hot-Spot Implementierung:
Regression Strategies
- Lineare Regression
- Nicht-Lineare Regression

Missing Values Handling

Hot-Spot Implementierung:
Clustering Verfahren
- k-Means
- Hierarchical

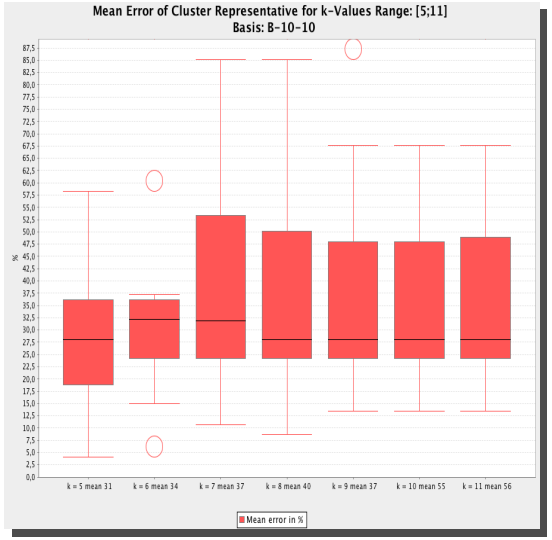
Cluster Repräsentant
- Mittelwert
- Max/Min

Realisierung: Tool Prototyp

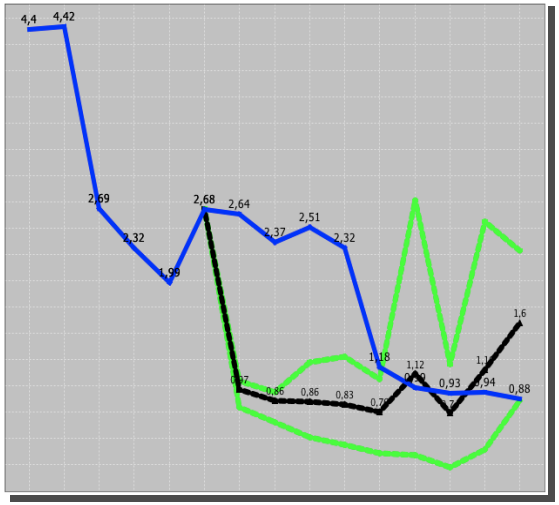


Evaluation

- **Szenario 1:**
  Bewertung von Cluster-Analyse



- **Szenario 2:**
  Bewertung von Vorhersage
  (Prediction)



Evaluation Setup

- Betriebsystem: Mac OS X, Version 10.9.5, Prozessor 2 GHz
- Daten: CPI Werte von 151 Projekten von 5 bis 15 Monaten (≈ 54%)
- Parameter
  - Lineare Regression
  - k-Means
  - Cluster-Zahl *k* aus dem Bereich [5;10]

Evaluation: Szenario 1

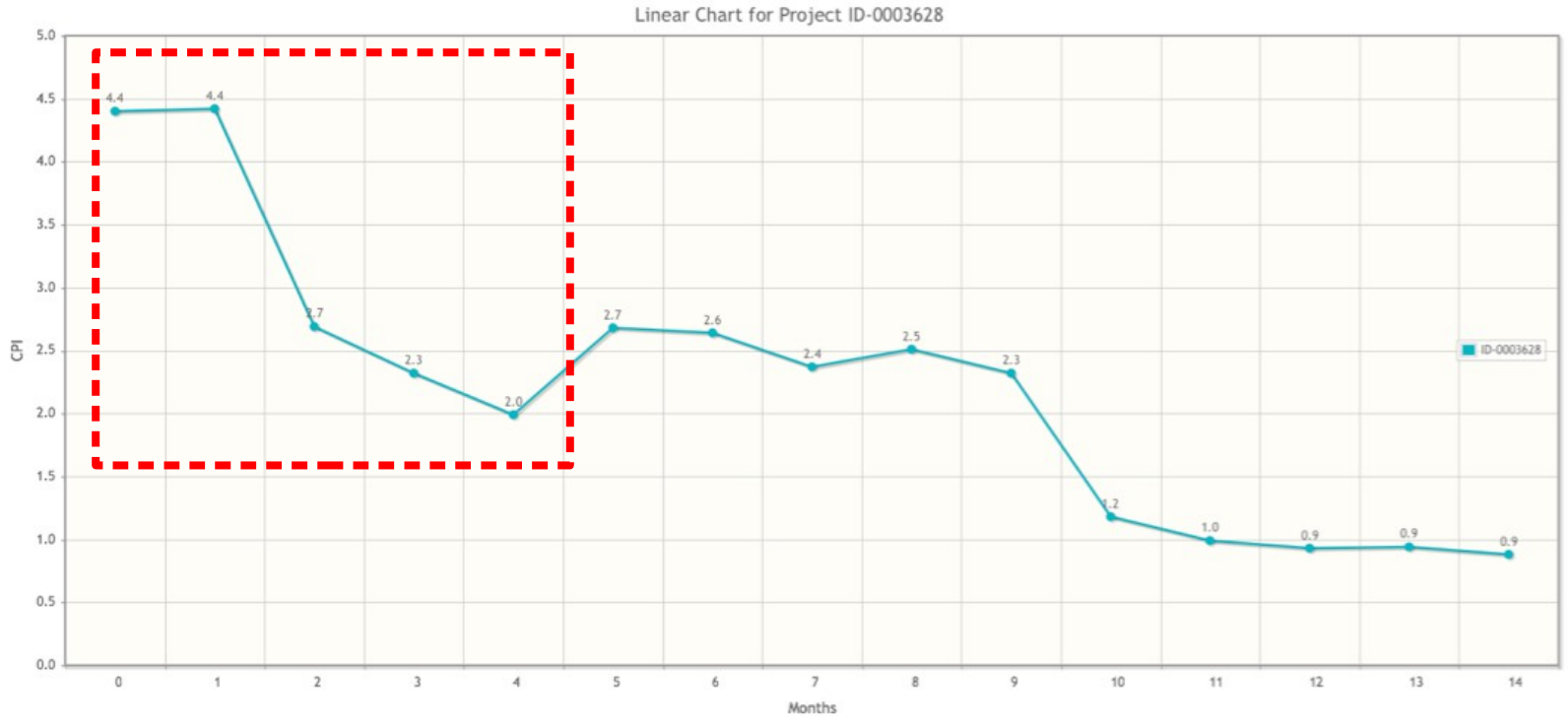
- 10 Datensätze getestet
- **Das beste Ergebnis**
  - Datensatz aus 14 bis 15-monatigen Projekten (12 Proj.)
  - 95% aller Fehler zwischen 3% und 76%
  - Mittelwert der Fehler zwischen 12% und 22%
  - Bestes k = 8
- **Das schlechteste Ergebnis**
  - Datensatz aus 8 bis 15-monatigen Projekten (99 Proj.)
  - 95% aller Fehler zwischen 12% und 322%
  - Mittelwert der Fehler zwischen 94% und 135%
  - Bestes k = 7

Evaluation: Szenario 1
Schlüsse

- Regression als Einflussfaktor auf Qualität des Clusterings
- Für jeden Datensatz existiert einen bestes Cluster-Zahl k
- Sehr heterogene Daten haben negative Auswirkung auf Clustering-Qualität

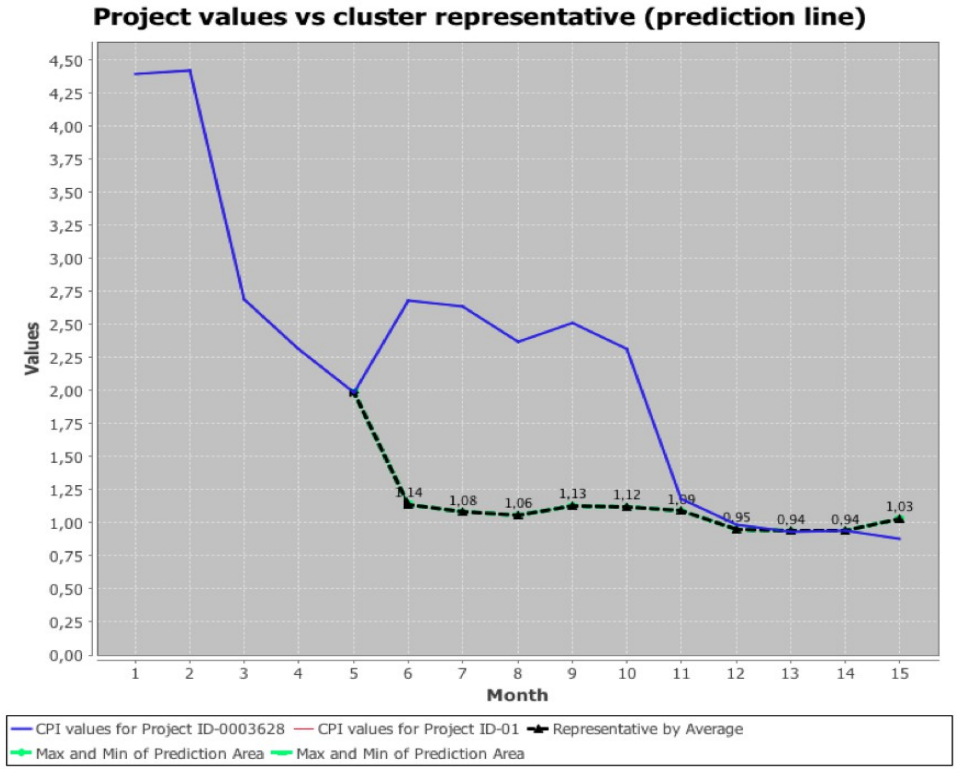
Evaluation: Scenario 2

- 2 Experimente
  - Einfache Vorhersage von einem 15-montigen Projekt
  - Schrittweise Vorhersage



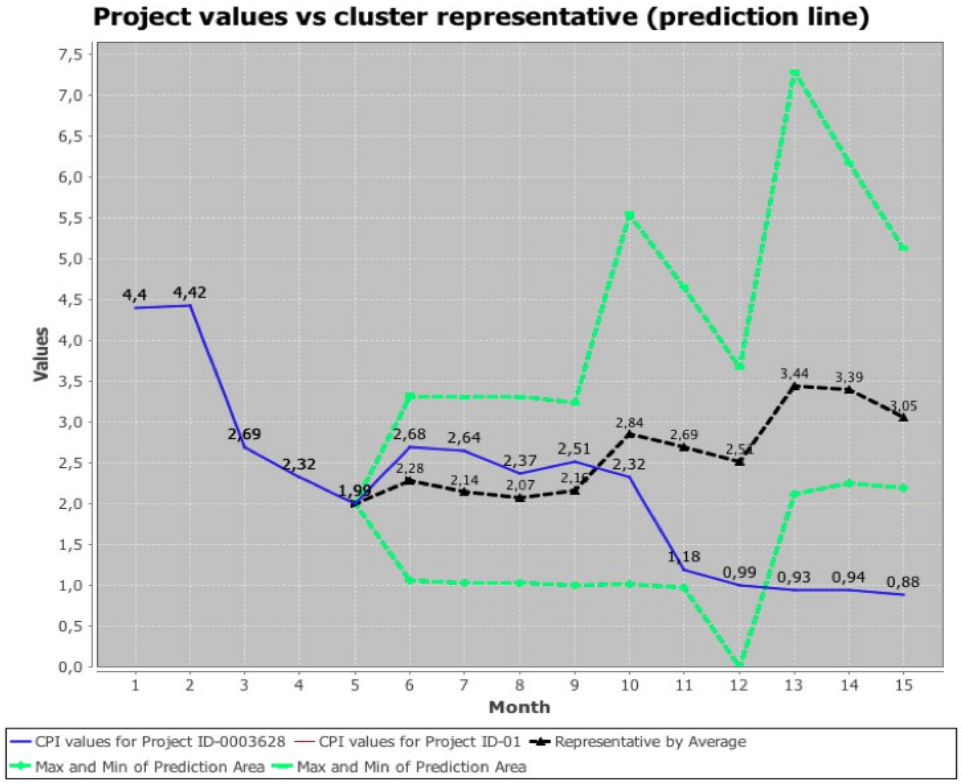
Evaluation: Szenario 2

- Einfache Vorhersage
  - Datensatz: 14 bis 15-monatige Projekte
  - Mittelwert der Fehler: 31,83%



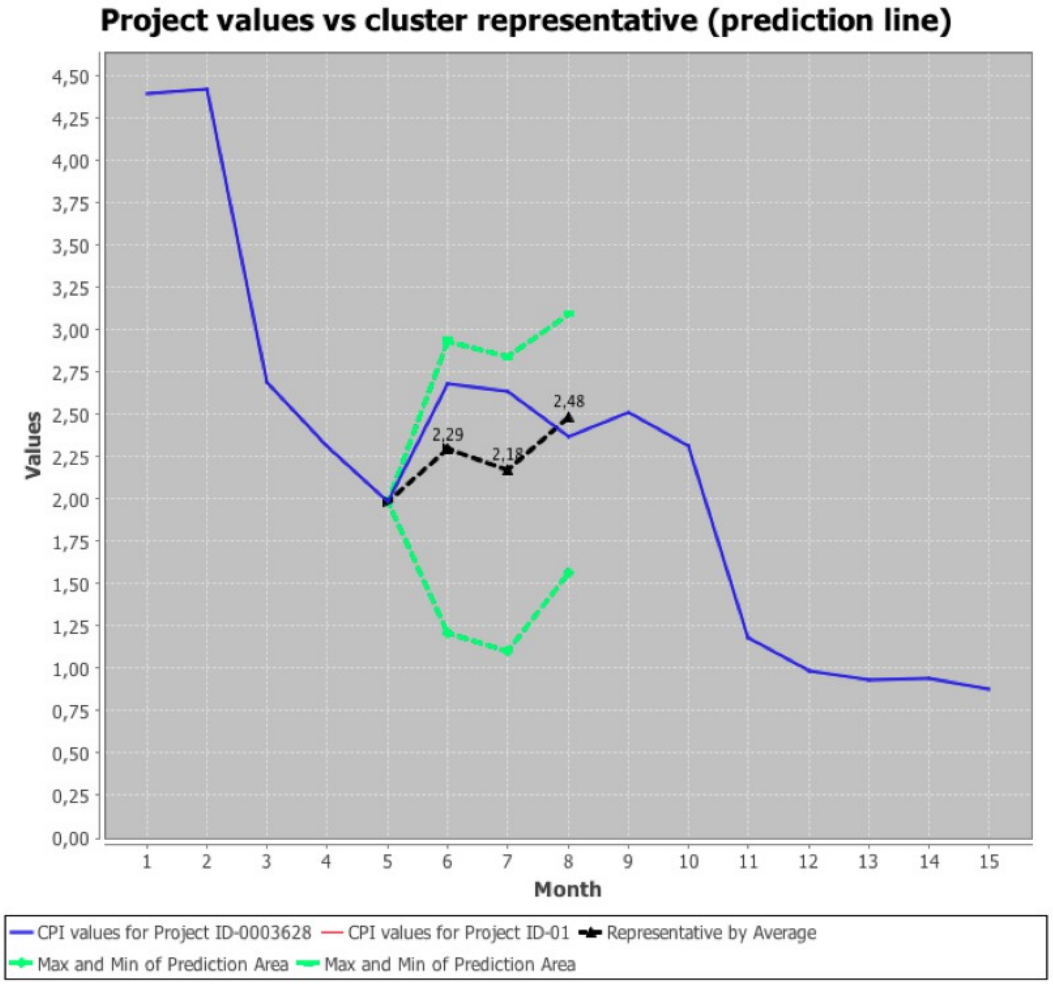
Evaluation: Szenario 2

- Einfache Vorhersage
  - Datensatz: 8 bis 15-monatige Projekte
  - Mittelwert der Fehler: 114,12%



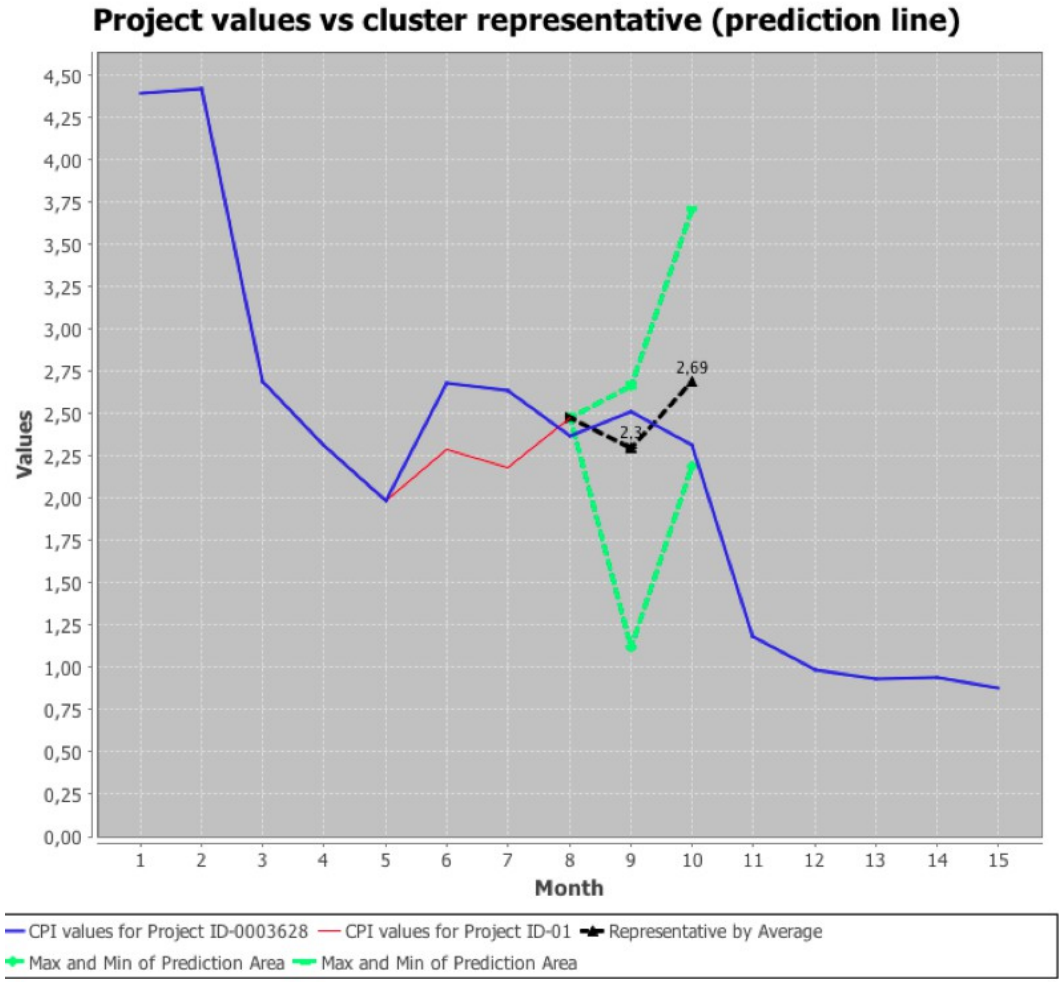
Evaluation: Szenario 2

- Schrittweise Vorhersage



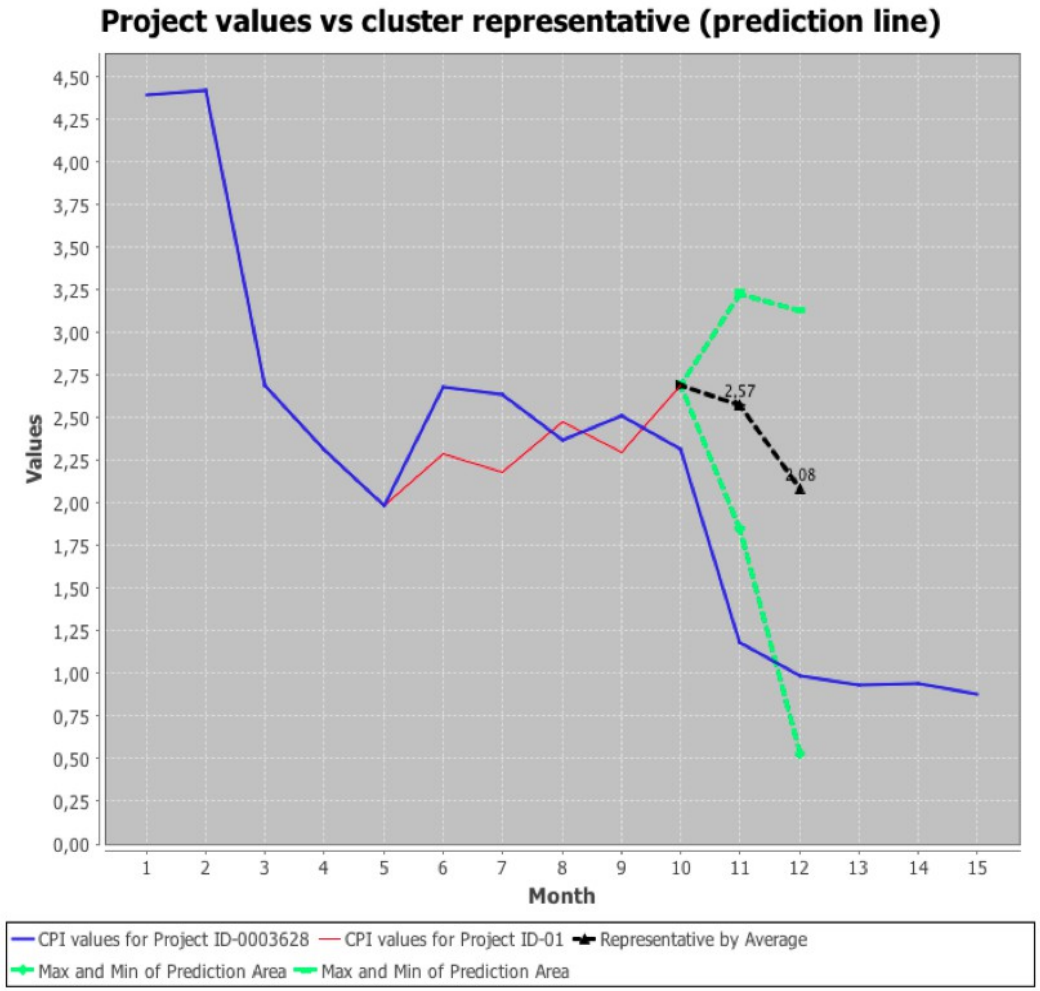
Evaluation: Szenario 2

- Schrittweise Vorhersage



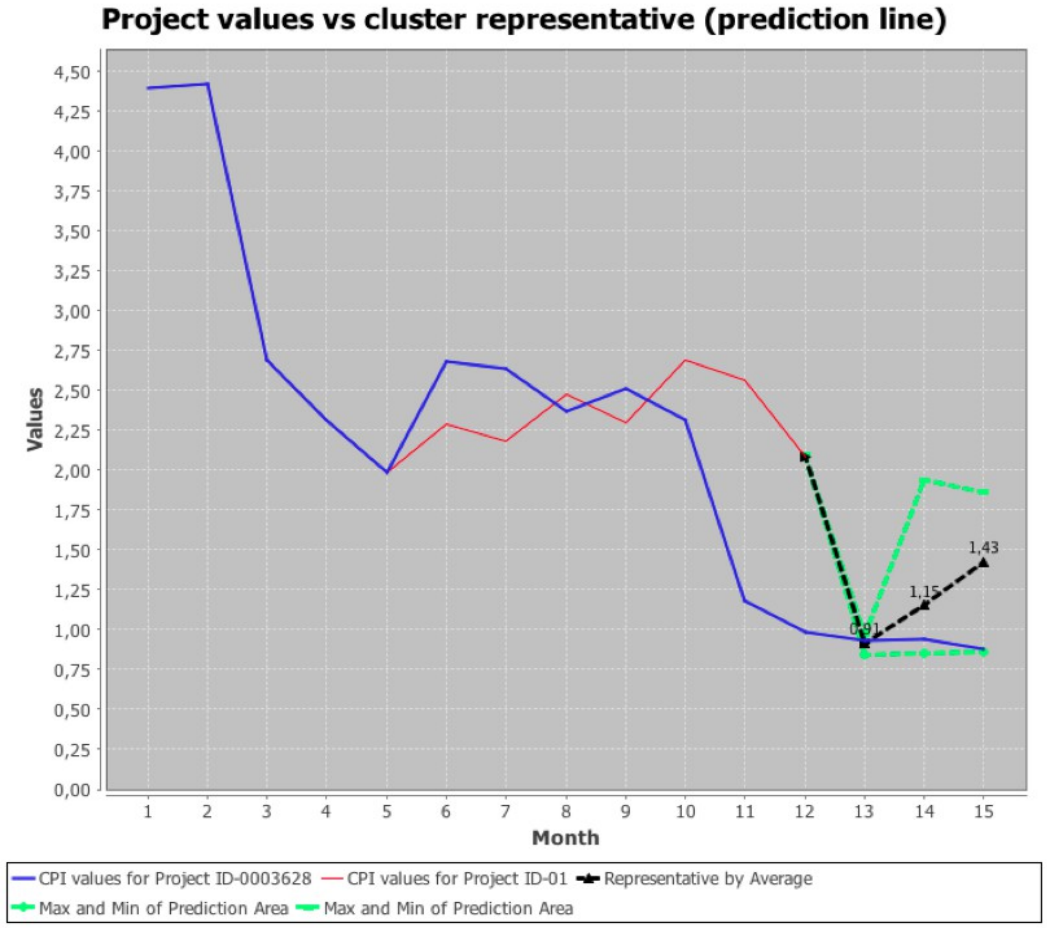
Evaluation: Szenario 2

- Schrittweise Vorhersage



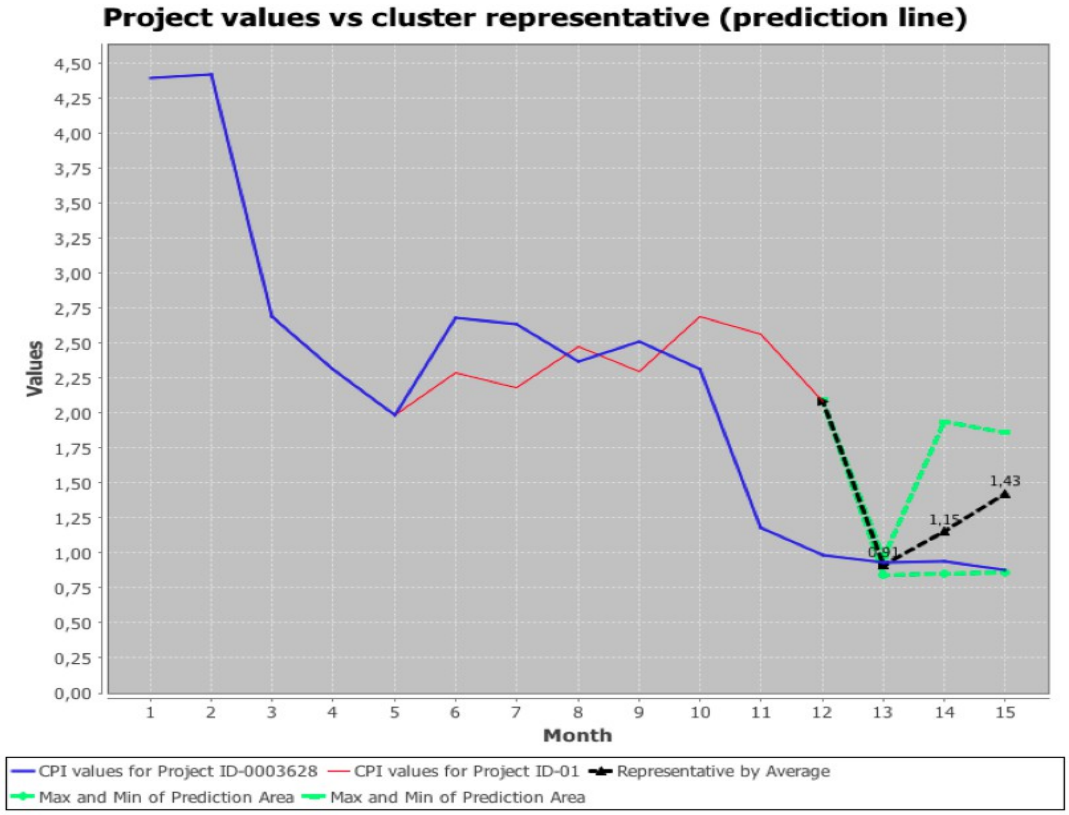
Evaluation: Szenario 2

- Schrittweise Vorhersage



Evaluation: Szenario 2

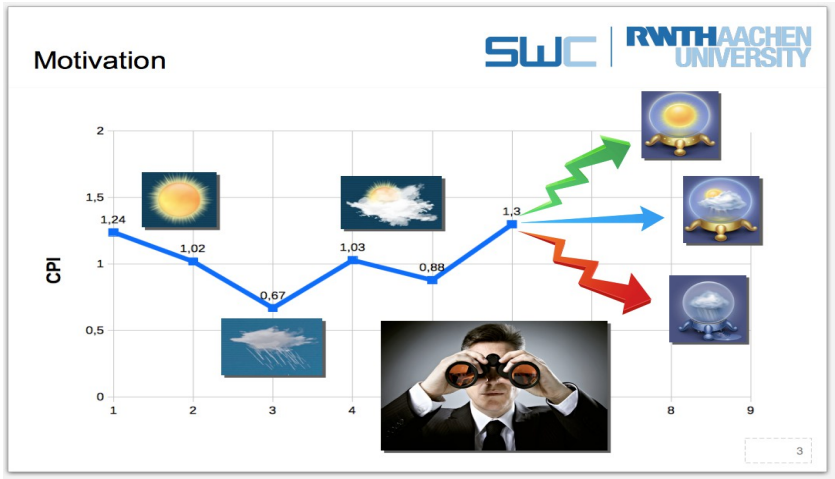
- Schrittweise Vorhersage
  - Mittelwert der Fehler: 37,59%

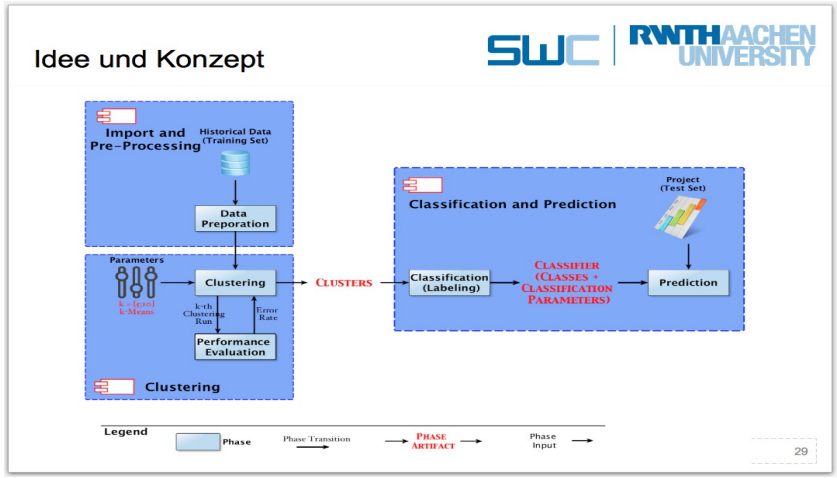


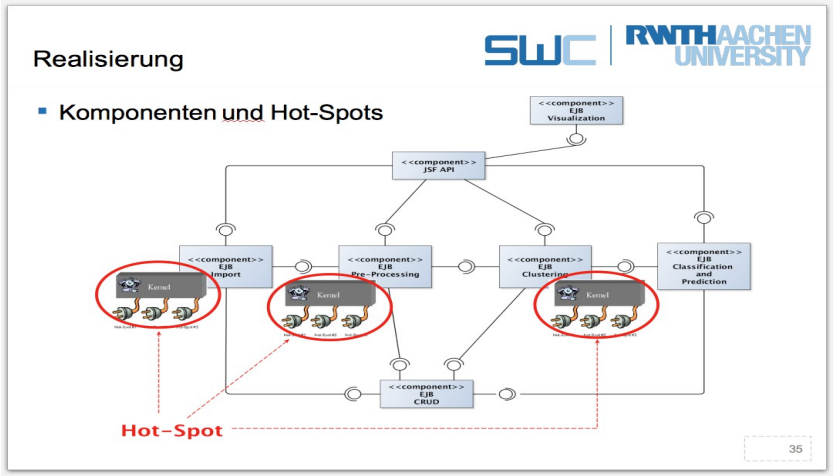
Zukünftige Arbeiten

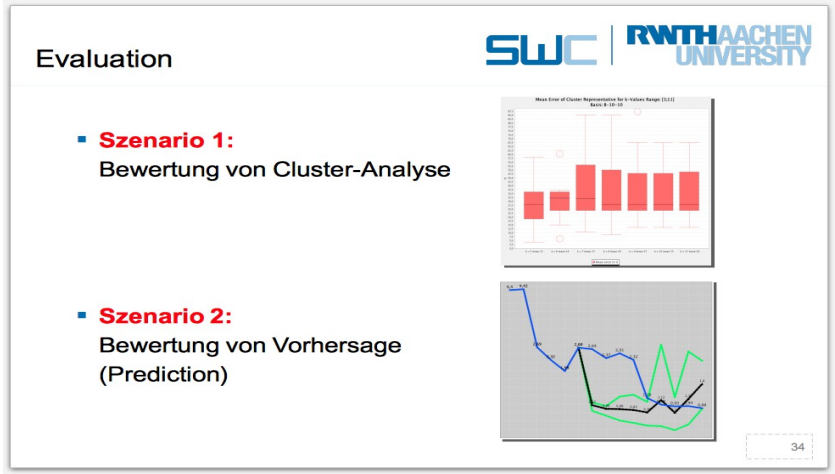
- Weitere Implementierung von Hot-Spots
- Identifizierung von weiteren Einflussfaktoren
- Anwendung und Evaluation in anderen Domänen
- Prototyp-Erweiterung (Client mit AngularJS)
- Integration ins EMI System

Zusammenfassung









Source

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