



Nanjing University

International Partnership in Information Technology

He (Jason) Zhang

4 June 2018 @ NTNU

Nanjing · China

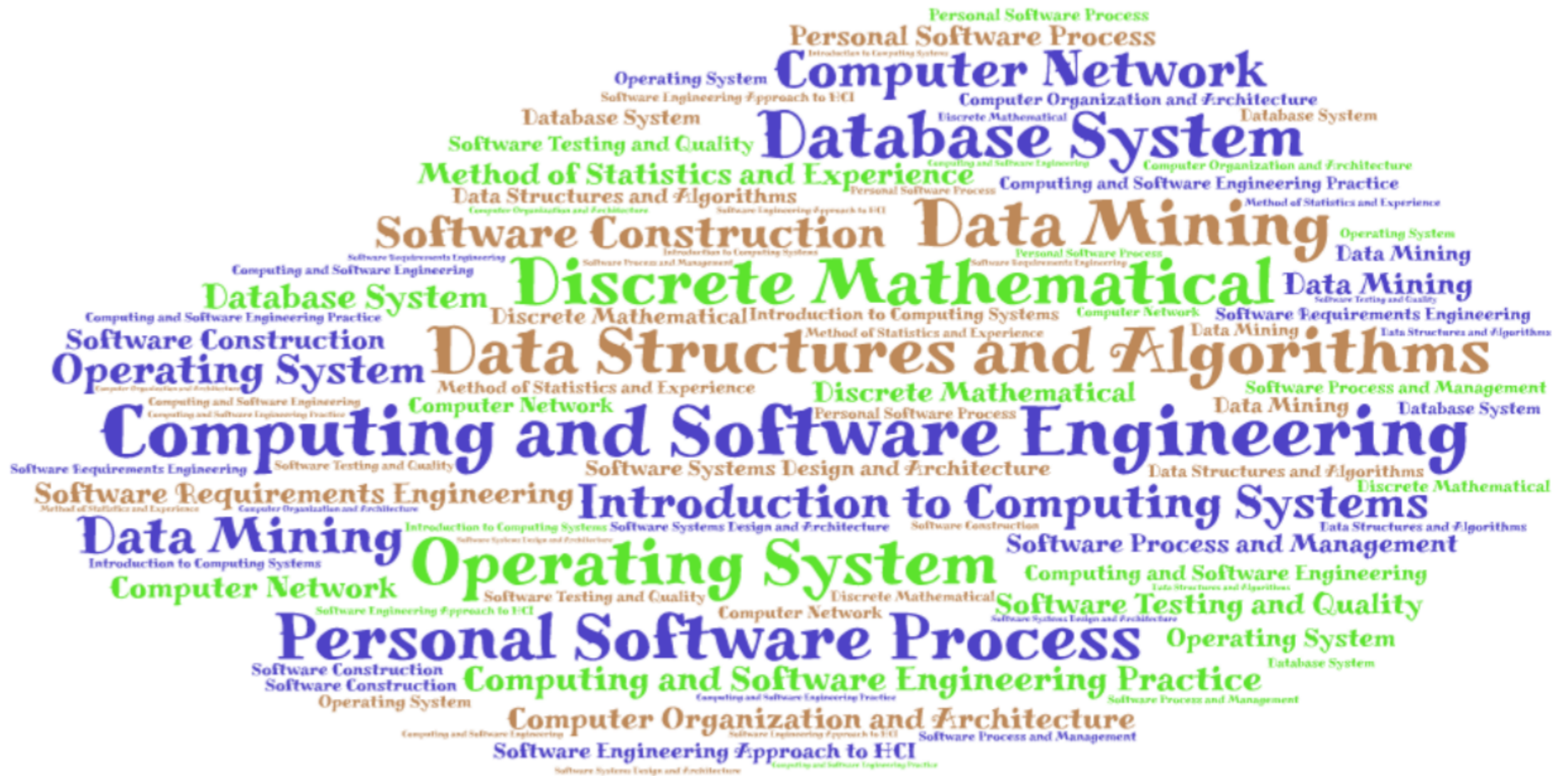
- ❖ A cultural city with 2,600 years history
 - ❖ the capital of China for ten dynasties, including the Republic of China
- ❖ A city of excellent specialists for scientific education
 - ❖ 53 general higher universities with over 820,000 college students
 - ❖ 540 various scientific research organisations with 530,000 research staffs
 - ❖ No.1 among all Chinese cities in terms of the portion of population receiving higher education



Nanjing University

- ❖ The first Chinese modern university with the combination of education & research established in 1902
- ❖ 29 schools, institutes, or departments, 3 of which are the Department of Computer Science & Technology, Software Institute, and Artificial Intelligence Institute
- ❖ The top ranked State Key Research Laboratory of Novel Software Technology in all 32 state key research laboratories in information sciences in past 15 years

Curricula @ Software Institute



Nanjing University · DevOps Research Centre

- ❖ Software Institute
- ❖ Faculty Members
 - ❖ Prof. He (Jason) Zhang
 - ❖ Assoc. Prof. Dong Shao
 - ❖ Dr. Guoping Rong
 - ❖ Dr. Zheng Li
- ❖ Students
 - ❖ 8 Ph.D Students
 - ❖ 20+ Master & Thesis Students

Traditional Research Interests

- ❖ Software Engineering Process
- ❖ Empirical Software Engineering
- ❖ Quality Assurance
- ❖ Software Architecture
- ❖ Service-Oriented Computing

Why DevOps?

- ❖ “Through 2016, ~80% of outages impacting mission-critical services will be caused by people and process issues, and more than 50% of those outages will be caused by change / configuration / release integration and hand-off issues.”

– Gartner Report

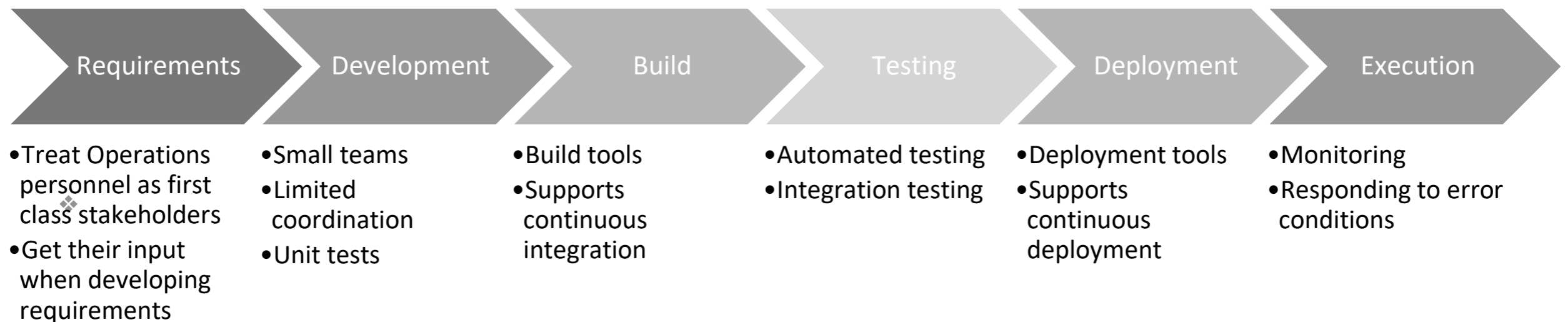
- ❖ “The Knight Capital Group was an American global financial services firm [...].[...] Knight was the largest trader in U.S. equities, with a market share of 17.3% on NYSE and 16.9% on NASDAQ. The company agreed to be acquired by Getco LLC in Dec 2012 after a trading error lost \$460 million”

– Knight Capital from Wikipedia

- ❖ This took 45 minutes and was an upgrade error.

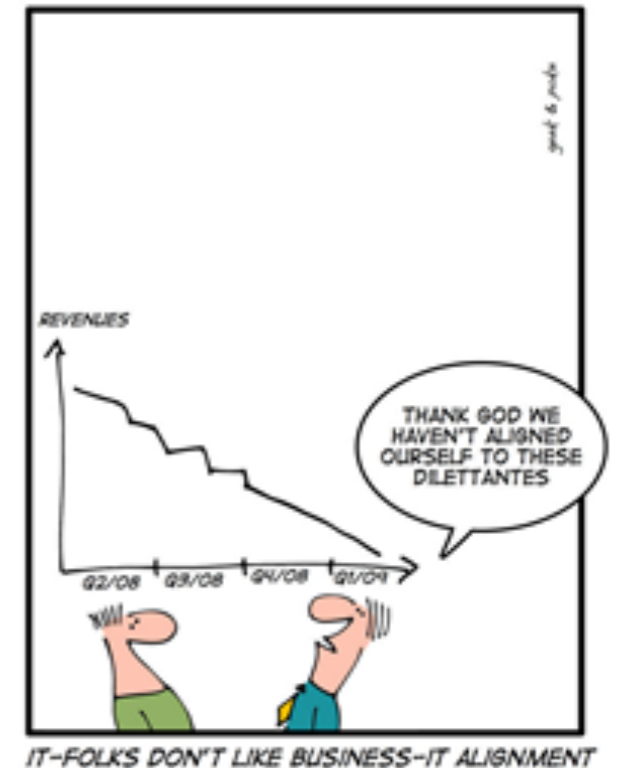
DevOps is about...

- ❖ “DevOps is a set of practices intended to reduce the time between committing a change to a system and the change being placed into normal production, while ensuring high quality.”
- ❖ DevOps is about...
 - ❖ Bringing “agile” methods to operation
 - ❖ Encouraging collaboration between development and operations staff, get them talking
 - ❖ Shared goals and teams of Devs and Ops



DevOps Influences...

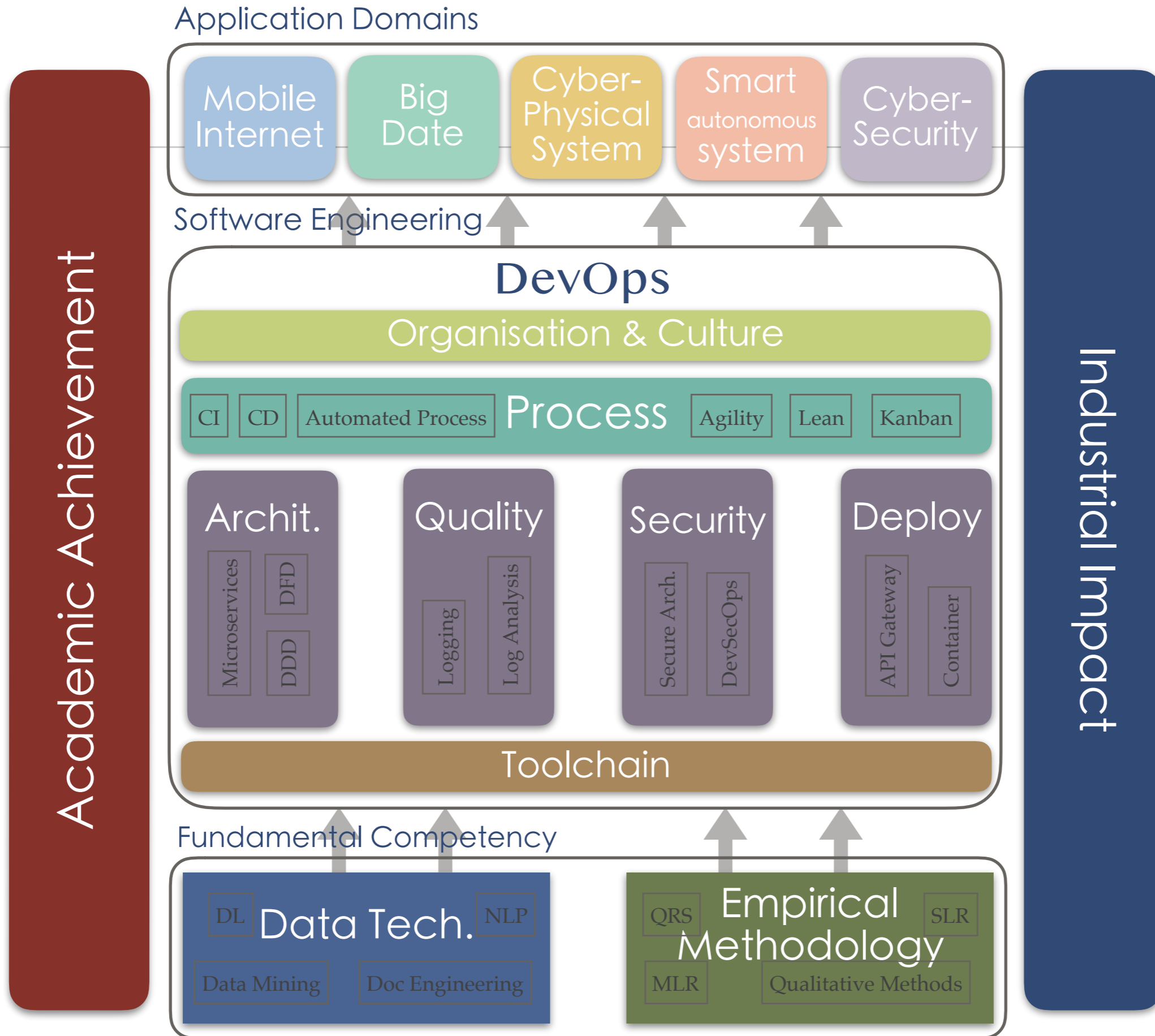
- ❖ DevOps practices will influence industry
 - ❖ the way you organise teams
 - ❖ the way you build systems
 - ❖ even the structure of the systems that you build
- ❖ DevOps practices will influence research
 - ❖ Software Architecture
 - ❖ split application into small, well-scoped microservices
 - ❖ Software Process
 - ❖ Ops as first-class citizens throughout the lifecycle



Grand Questions of Interest

- ❖ What are the impacts of DevOps on software industry in general, or software practitioners in particular?
- ❖ How to support software organisations to adopt or migrate to DevOps?
- ❖ How to reengineer software technologies and advance the state-of-the-art of DevOps?

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Fundamental Competency

- ❖ Empirical Methodologies

- ❖ Evidence-Based Software Engineering (Systematic Reviews)

- ❖ methodological issues: data synthesis, quality assessment, validity ...

- ❖ Qualitative Research in Software Engineering

- ❖ ethnography, field study, grounded theory ...

- ❖ qualitative data analysis and synthesis

- ❖ Grey Literature in Software Engineering

- ❖ evidence extraction & assessment of grey literature

- ❖ multivocal literature review

- ❖ Data Technologies

- ❖ Data Mining

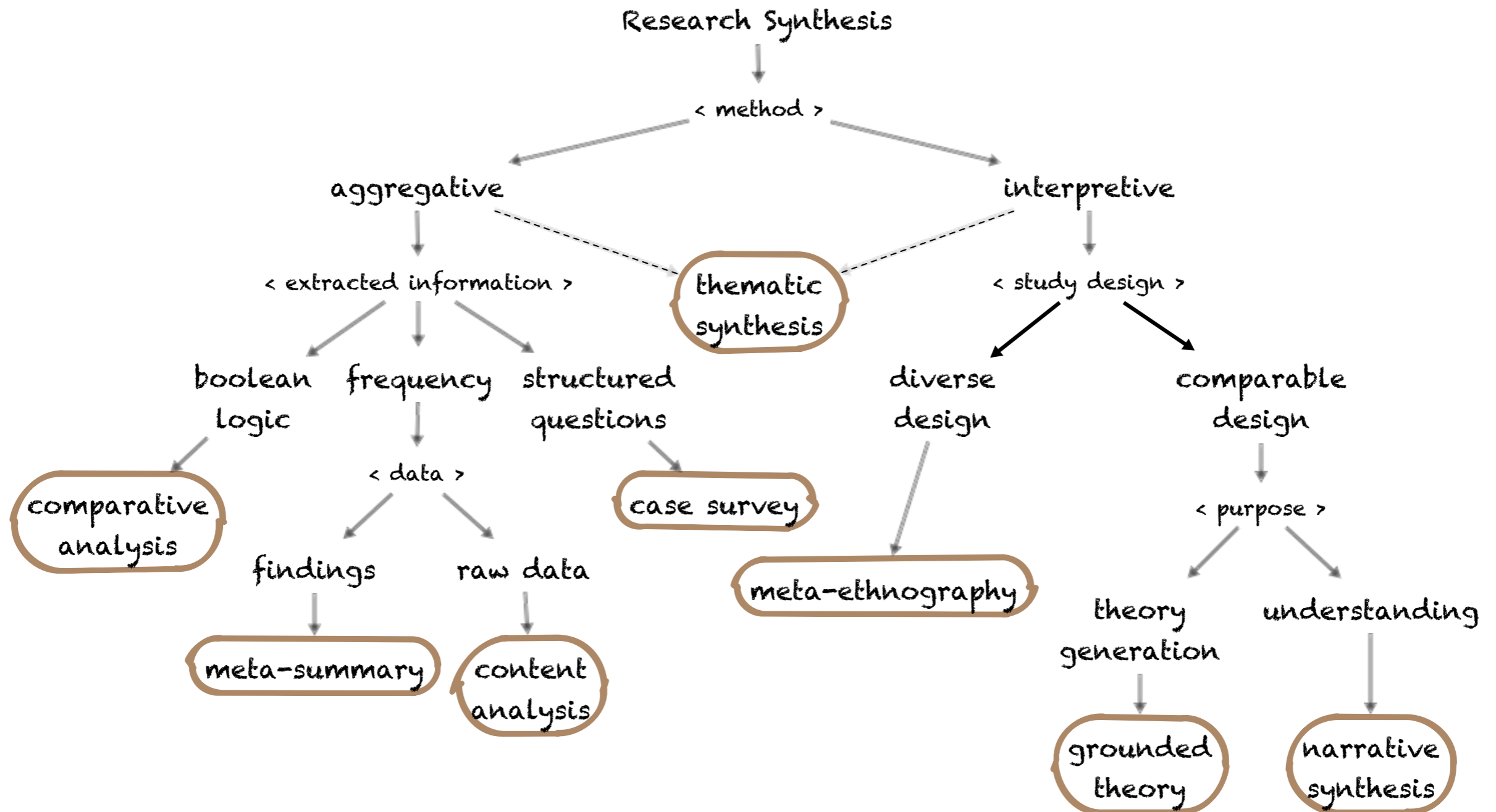
- ❖ mining software process from repository

- ❖ mining software metrics for process modelling

- ❖ Natural Language Processing

- ❖ NLP in support of qualitative analysis & synthesis

Qualitative Evidence Synthesis

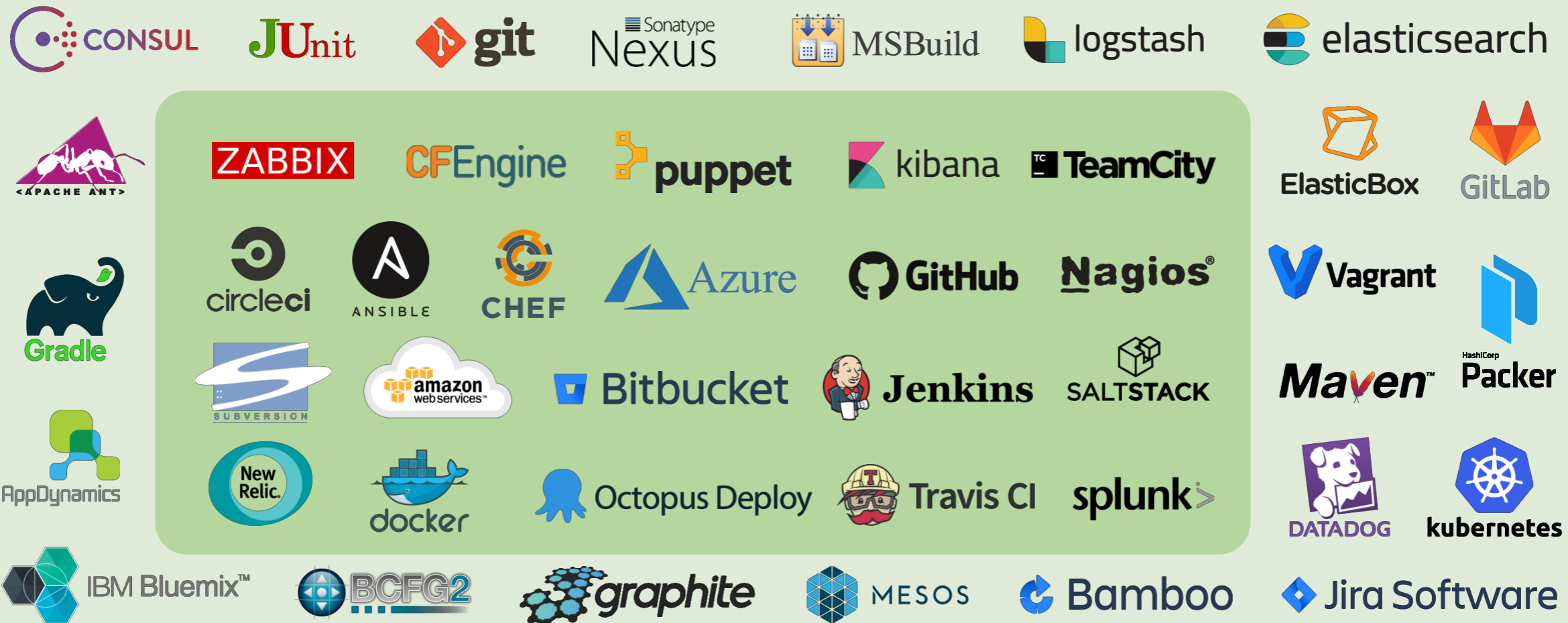


DevOps Oriented Software Engineering

- ❖ Toolchain
 - ❖ “DevOps Tooling Technical Report”
- ❖ Microservices Architecture
 - ❖ Impacts on Quality Attributes
 - ❖ Microservice Granularity
 - ❖ Migration from Monolith to Microservice System
 - ❖ Decomposition for Microservices
 - ❖ constraints
 - ❖ domain-specific design
 - ❖ data-flow diagram
 - ❖ Benchmark Example for Performance Evaluation
 - ❖ pet-store project

DevOps Tooling

 **stackoverflow** : 178



CONSUL JUnit git Sonatype Nexus MSBuild logstash elasticsearch

ZABBIX CFEngine puppet kibana TeamCity ElasticBox GitLab

circleci ANSIBLE CHEF Azure GitHub Nagios Vagrant Packer

Subversion amazon web services Bitbucket Jenkins SALTSTACK Maven HashiCorp Packer

New Relic docker Octopus Deploy Travis CI splunk> DATADOG kubernetes

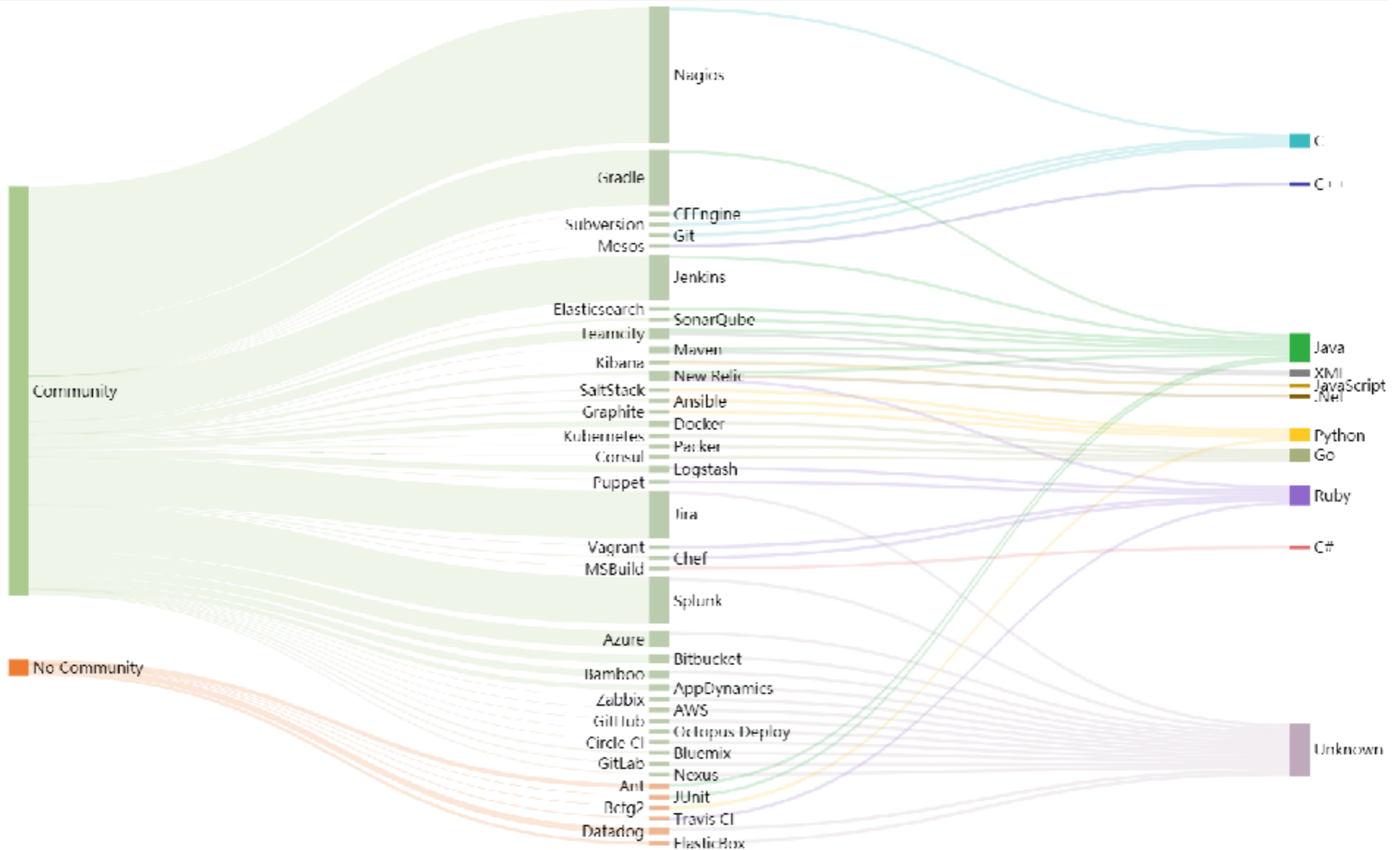
IBM Bluemix™ BCFG2 graphite MESOS Bamboo Jira Software

Gartner: 76

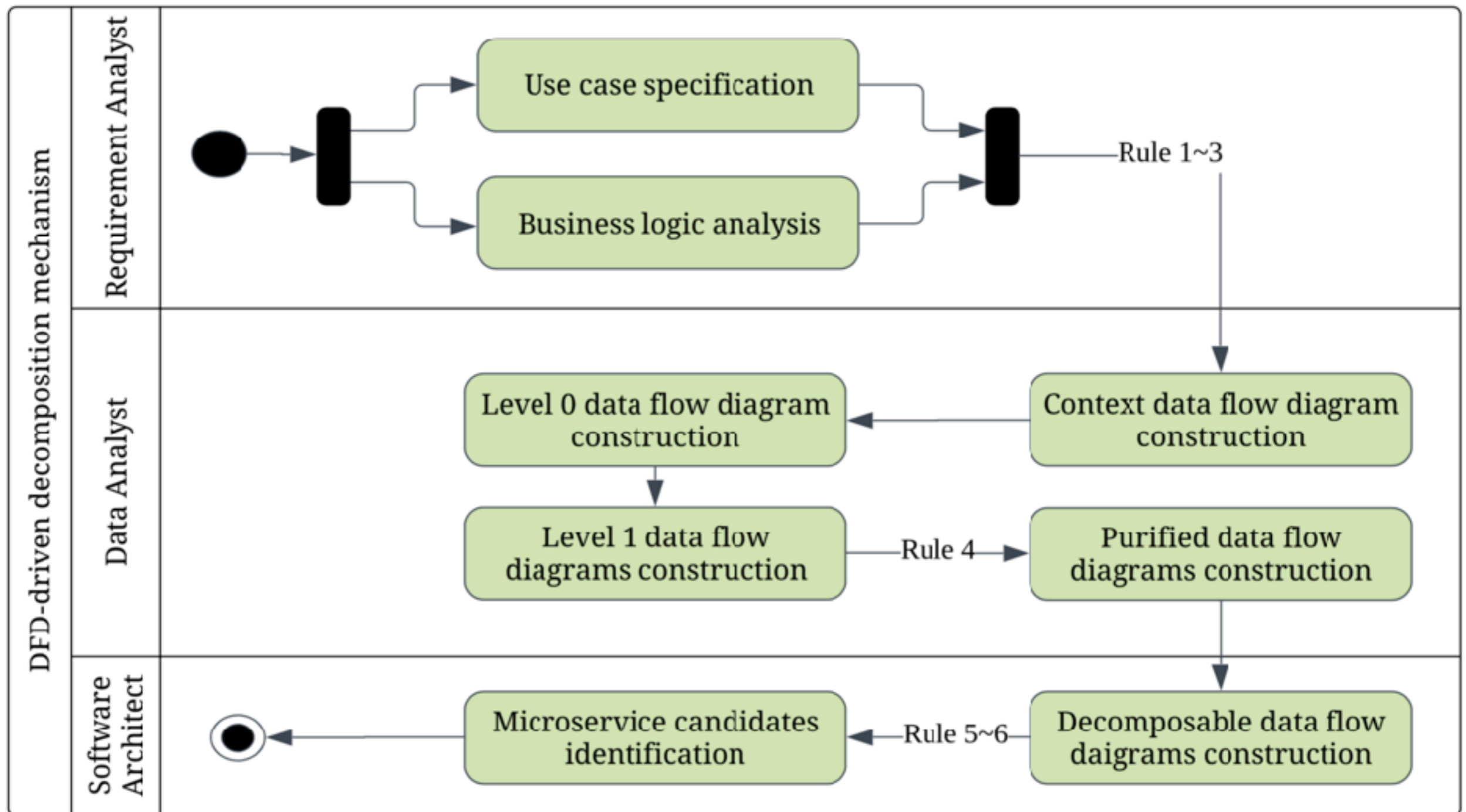
Xebialabs
Enterprise DevOps : 117

 Academic Literature: 144

DevOps Tooling



Data-Flow Driven Service Decomposition



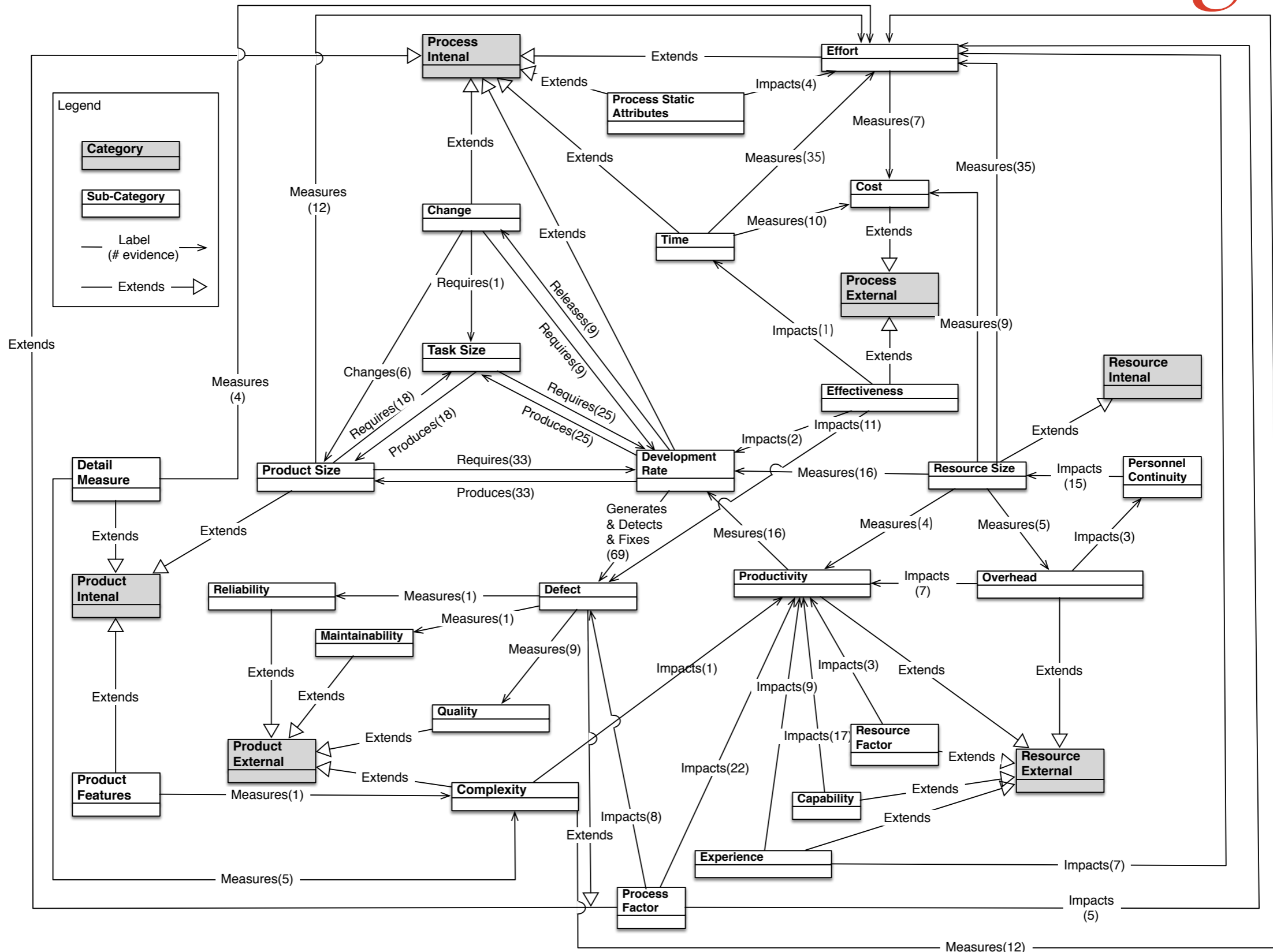
DevOps Oriented Software Engineering

- ❖ Quality
 - ❖ Logging Practices
- ❖ *Security
 - ❖ Secure Architecture
 - ❖ DevSecOps
- ❖ *Deployment & Operation
- ❖ Process & Agility
 - ❖ Automated Software Process
 - ❖ Mining Software Process
 - ❖ Software Process Simulation Modelling
 - ❖ hybrid simulation modeling
 - ❖ model verification & validation
 - ❖ Agile / Lean / Kanban Development
 - ❖ Interplay between Process and Product
- ❖ Organisation & Culture

Metrics for Process Modelling

| | | | | | | | | | | |
|---------------------|--|---|---|--|--|---|--|---|---|---------------------------------|
| Process | New Requirements Feedback Delay Months | Domain Discovery Delay Months | Fix Duration Hours Days | Review Duration Hours Days | Test Duration Hours Days Weeks Months | Lead time Days | Interval between Releases Hours Days | Risk Start/End Date Date | ... | |
| | Requirement Selection Time Days/Req. | Analysis Discover Delay Months | Coding Duration Days | Issue Assessment Duration Hours | | Delivery time Days | Answer time Days | Project Duration Hours Days Weeks Months | Task Duration Days | |
| | Interval between Requirements Days | Design Filling Delay Months | Rework Duration Hours Days Weeks | | | | | | Work Time Weeks/Day Hours/Week | |
| Time(270) | Requirement | Design | Implementation | Review | Test | Delivery & Maintenance | | Phase Independent | | |
| Defect (246) | # Injected Requirement Defects Defects | Injection Rate during Design NA | # Fixed Defects Defects | Percentage Fixed Defects % | Defects Detected in Reviews % % | Rate of Defect Delivered NA | Defect Detection Rate Defects/Hour | Defects Injection Rate Defects/Hour Defects/Month | ... | |
| | Percentage of Fixed Requirement Defects % | # Design Defects Defects | Injection Rate during Coding Defects/LOC Defects/Hour Defects/Month Defects/Task Defects/Unit | Fix Rate Defects/Month | # Detected Defects Defects | # Detected Defects after Test Defects | Defect Density Defects/LOC Defects/Unit | Defect Severity Dimensionless | Defect Type Dimensionless | |
| | | Design Defect Density NA | # Injected Code Defects Defects | Overlap of Detection of Reviewers % | Overlap of Detection of Reviewers % | Detected Defects in Test Defects/LOC Defects/Test Case | Released Defect Density Defects/FP | # Remaining Defects Defects | | |
| | Requirement | Design | Implementation | Review | Test | Delivery & Maintenance | | Phase Independent | | |
| Task Size (112) | Demand for New Features Features/Time | Amount of Implementation Work Tasks User Stories | Amount of Rework Units | Task Size per Inspection Pages LOC | # Inspections Inspections | Test Task Size Requirements | Delivery Times Dimensionless | Task Size Person Weeks/Task Hours/Task | Task Required Resource Resources/Task | |
| | | | | | | | # Maintenance Requests Requests | Total Tasks Tasks | Required Tasks Tasks/User Story | |
| | Requirement | Implementation | Review | Test | Delivery & Maintenance | | Phase Independent | | | |
| Change (48) | # Requirement Changes Changes | Rate of Requirement Changes Changes/Time | Change request acceptance Rate % | Change Request Time Span % | # Design Changes Changes | # Code Changes Changes | | | | |
| | Requirement | | | | | | | Design | Implementation | |
| Effort(143) | Design Effort Hours | Coding Effort Person Hours | Rework Effort Person Days | Review Effort NA | Test Effort Person Days | Effort per Test Case Person Weeks | Total Effort Person Hours Person Days Person Weeks Person Months FPs | Meeting Effort NA | Effort Allocation Percentage % | Preparation Effort NA |
| | | | | Fixing Effort Person Weeks Person Days/Defect | Test Effort Rate Hours/Unit | | | | | |
| | Design | Implementation | Review | Test | Phase Independent | | | | | |
| Process Factor(106) | New Requirements Feedback Factor Dimensionless | Domain Discovery Factor Dimensionless | Time Pressure Dimensionless | # Periodical Reviews Reviews | Maintenance Adjustment Factor Dimensionless | Policy Dimensionless | ... | | | |
| | New Requirements Scaling Policy Dimensionless | Analysis Discovery Factor Dimensionless | Coding Method Dimensionless | Review Adjustment Policy Dimensionless | Release Policy Dimensionless | Quality Strategy Dimensionless | Risk Impact Dimensionless | | | |
| | Requirements Volatility Dimensionless | Design Discovery Acceptance Factor Dimensionless | Task Priority Dimensionless | | Test Method Dimensionless | | | | | |
| | Requirement | Design | Implementation | Review | Test | Delivery & Maintenance | Phase Independent | | | |
| Development | Design Rate Documents Documents/Month | Discover Rate NA | Rework Rate Hours/Defect Tasks/Day | Implementation Rate LOC/Day | Review Rate NA | Test Rate LOC/Day | Delivery Rate Units/Time | Development Rate DSI/Day LOC/Day FPs/Day Tasks/Iteration | | |
| | | | | | | | | | | |
| | Requirement | Design | Implementation | Review | Test | Delivery & Maintenance | Phase Independent | | | |

Metrics for Process Modelling



Industrial Impacts

- ❖ Synergy by combining research, industry, and education
 - ❖ «DevOps: Theory, Method, and Practice» (1st DevOps textbook in China)
 - ❖ DevOps curricular and teaching / training platform
 - ❖ Industrial Collaborations on DevOps: Huawei, ZTE, Transwarp, DaoCloud ...
 - ❖ «DevOps · China 2016 Report»
 - ❖ «DevOps · China 2018 Report» (available soon)
 - ❖ «DevOps Tooling Technical Report»
 - ❖ «Software Architecture for Practitioners» @ GeekTime
 - ❖ ArchSummit 2017 / 2018 (Shenzhen)
 - ❖ Keynotes & invited talks at CNUTCon 2017 / NASAC 2017 / NJSD 2018 / DOIS 2018 ...
 - ❖ DevOps tracks at IAS 2017 & NJSD 2018
 - ❖ DevOps Special Group of CCF · Software Engineering & System Software Committees