

Software Performance in DevOps

Performance Models to the Rescue?

Andreas Brunnert



Some „Definitions“

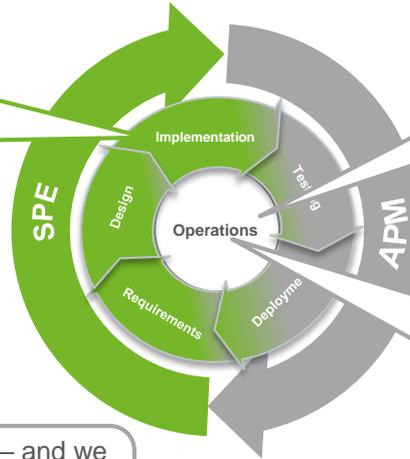
- **Software Performance**
 - A quality factor of software systems described by the metrics:
 - Response time, throughput, resource utilization
- **DevOps**
 - A recent trend towards a tighter integration of development (Dev) and operations (Ops) teams in order to increase the release frequency of software systems to reduce the lead times for new features or bug fixes.

Software Performance in DevOps – Status Quo

Dev Ops

We do load testing!

- Is your test environment representative for your production deployments?
- Do you really have the time to prepare the test data and scripts?



We have a monitoring tool!

- Isn't it a bit too late?
- Does it capture the right metrics? (e.g., the new transactions)
- How do you communicate your findings back to Dev?

We use a cloud provider!

- Is your software architecture able to handle new resources (e.g., VMs, CPU cores, ...) automatically?
- Is auto-scaling covered by your licensing terms (e.g., your middleware or database vendors)?
- How much is your business willing to pay?

Please build feature X – and we assume that the app will still be at least as fast as the current version (or faster)!



Business

Agenda

- Performance Modeling
- Use Cases, Benefits and Examples

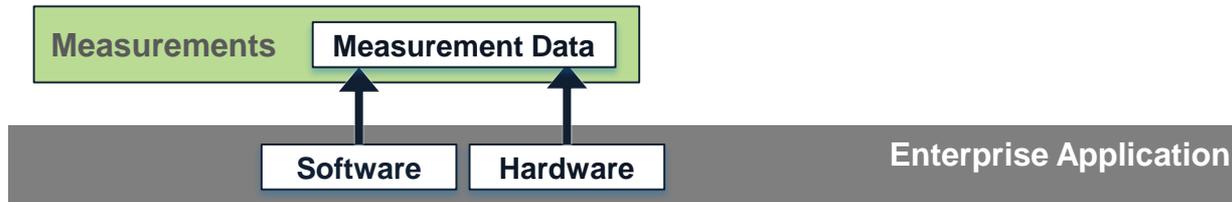
Agenda

- Performance Modeling
- Use Cases, Benefits and Examples

Performance Modeling - Why?

Data collected by APM tools allow you to...

- ... review your current application performance.
- ... evaluate historic performance metrics.
- ... deep dive into single components of your environment.



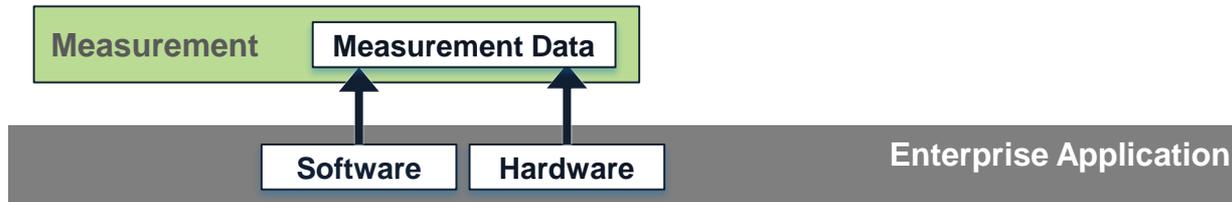
Performance Modeling - Why?



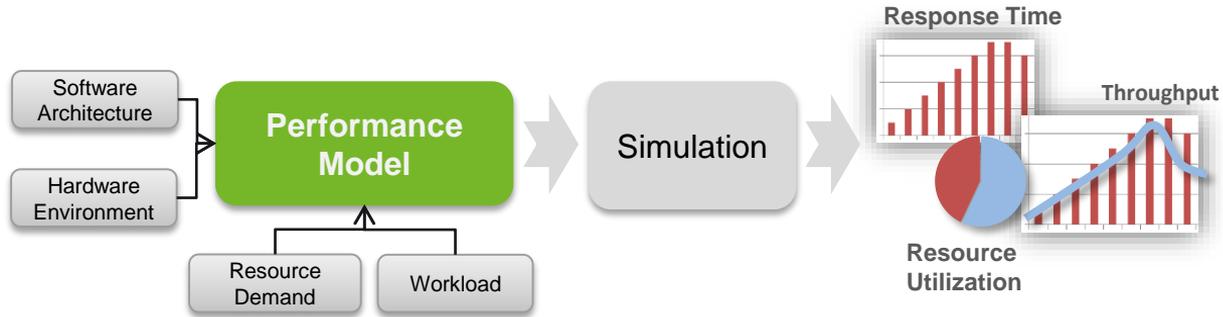
What happens if...



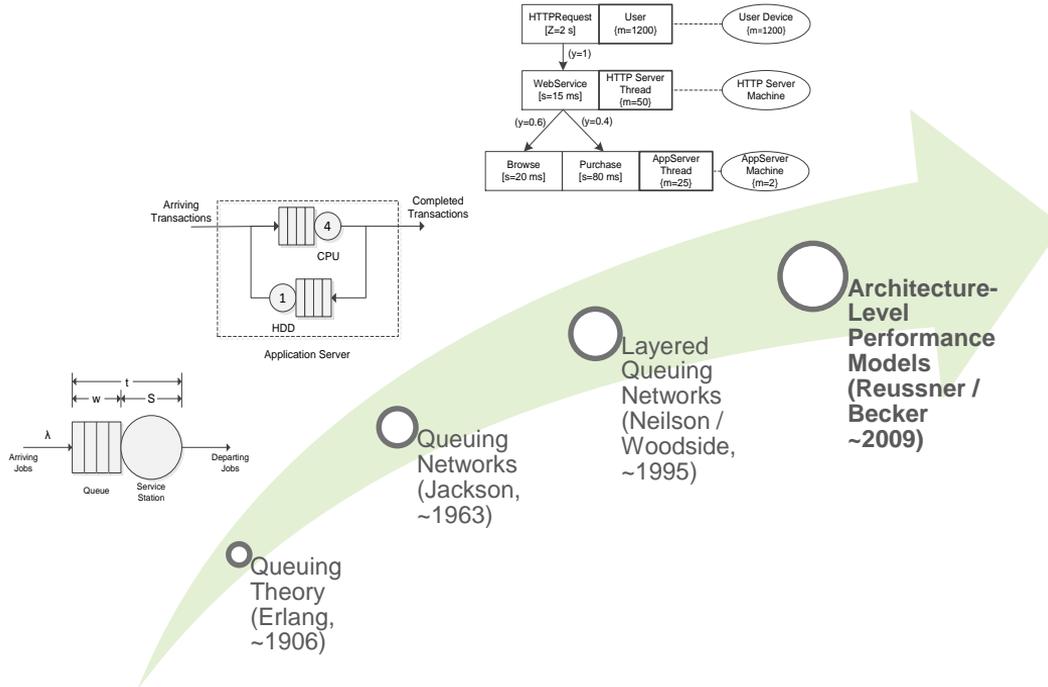
- ... you change your deployment topology?
- ... you migrate to a different hardware environment?
- ... the workload changes?
- ... you add new features or fix bugs?



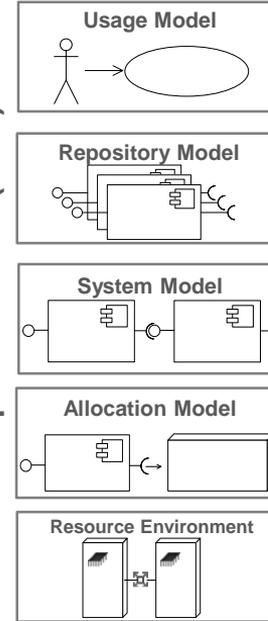
Performance Modeling - What?



A Brief History of Performance Modeling

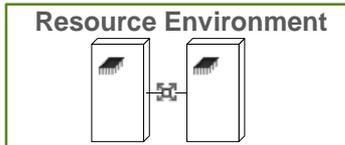
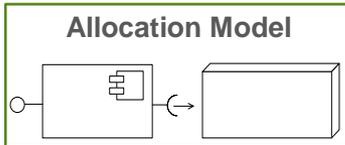
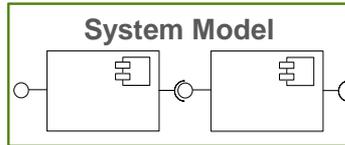
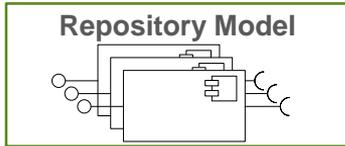
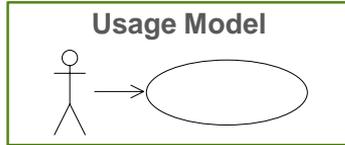


Palladio Component Model (PCM)



Architecture-Level Performance Models

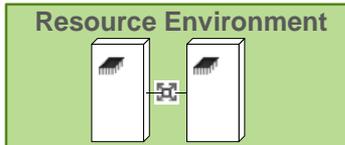
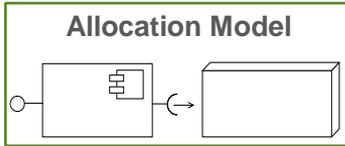
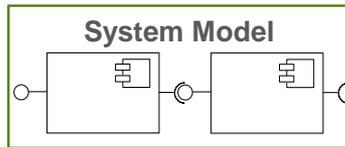
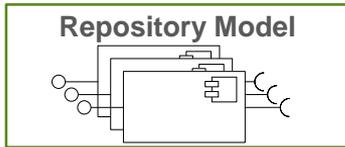
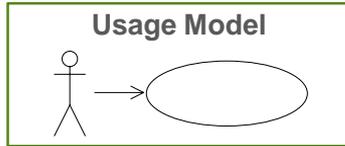
Palladio Component Model (PCM)



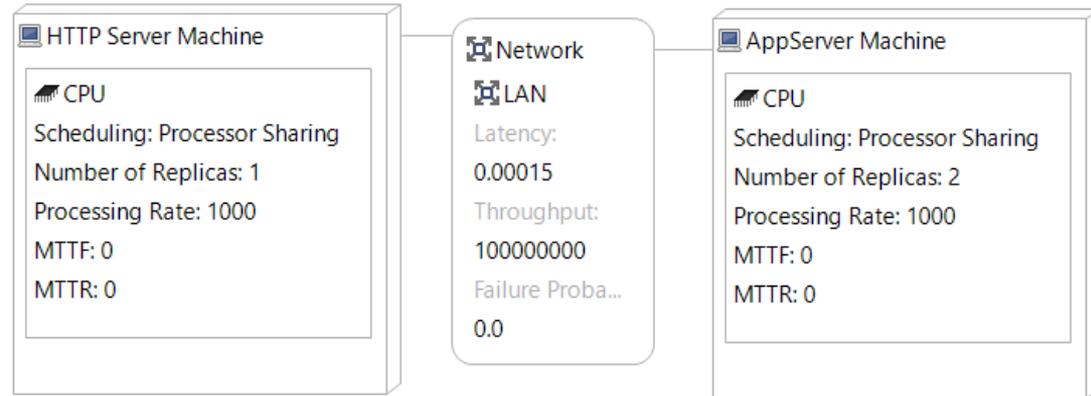
- Workload
- Components, Interfaces, Relationships, Control Flows, Resource Demands
- System composed of components within the repository model
- Mapping of system components to hardware servers
- Specifies available servers, networks, ...

Architecture-Level Performance Models

Palladio Component Model (PCM)

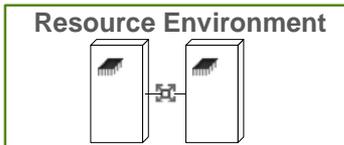
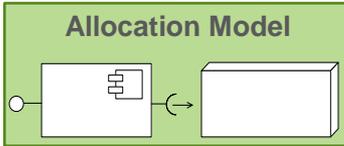
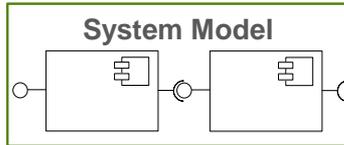
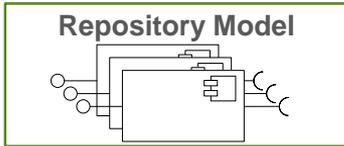
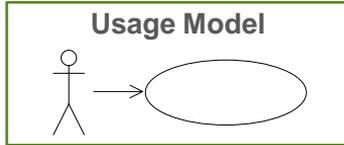


- Resource Environment

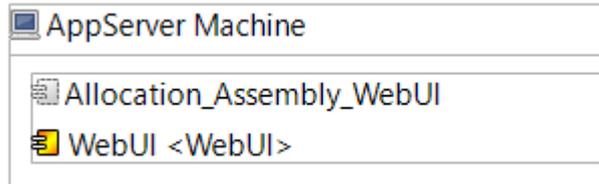
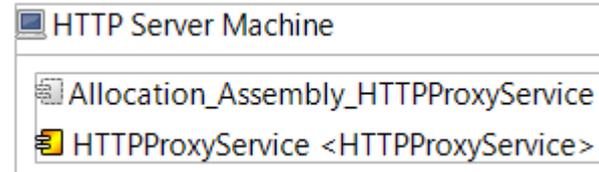


Architecture-Level Performance Models

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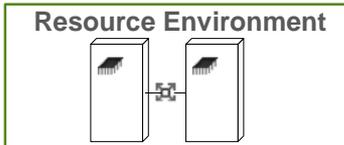
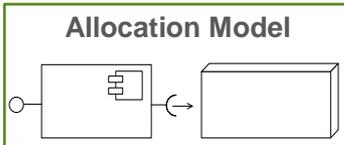
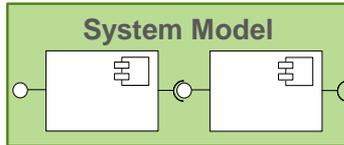
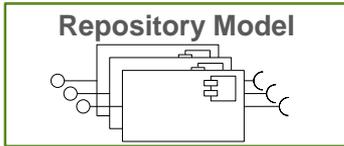
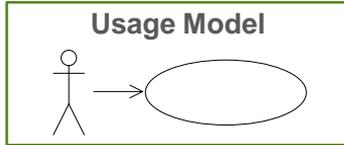


- Allocation

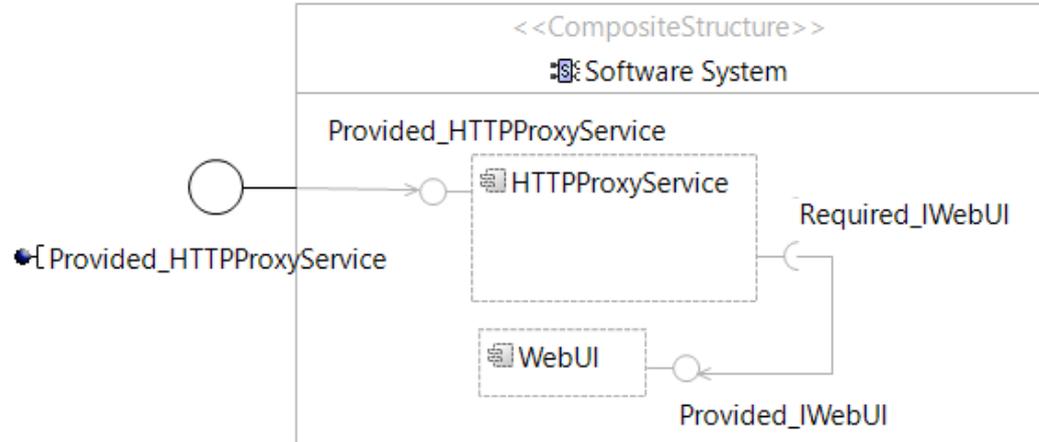


Architecture-Level Performance Models

Palladio Component Model (PCM)

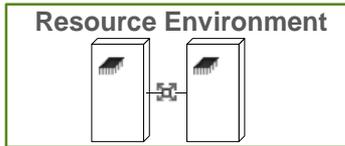
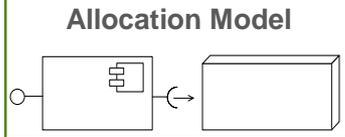
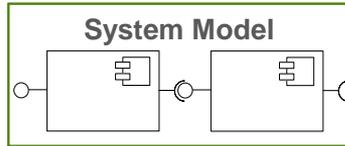
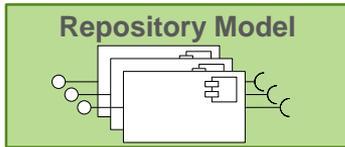
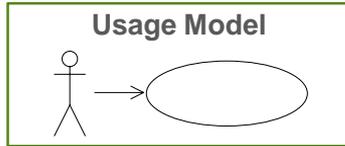


- System

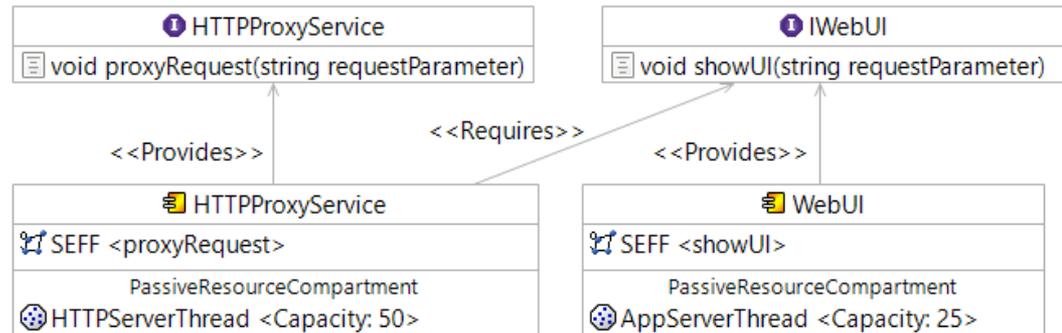


Architecture-Level Performance Models

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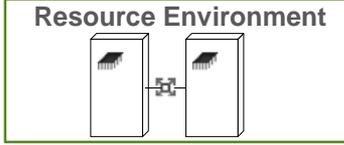
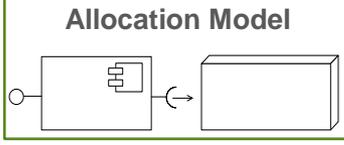
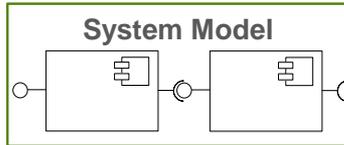
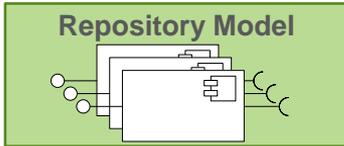
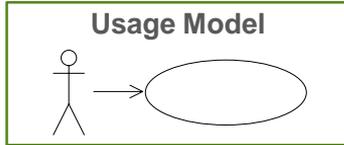


- Repository

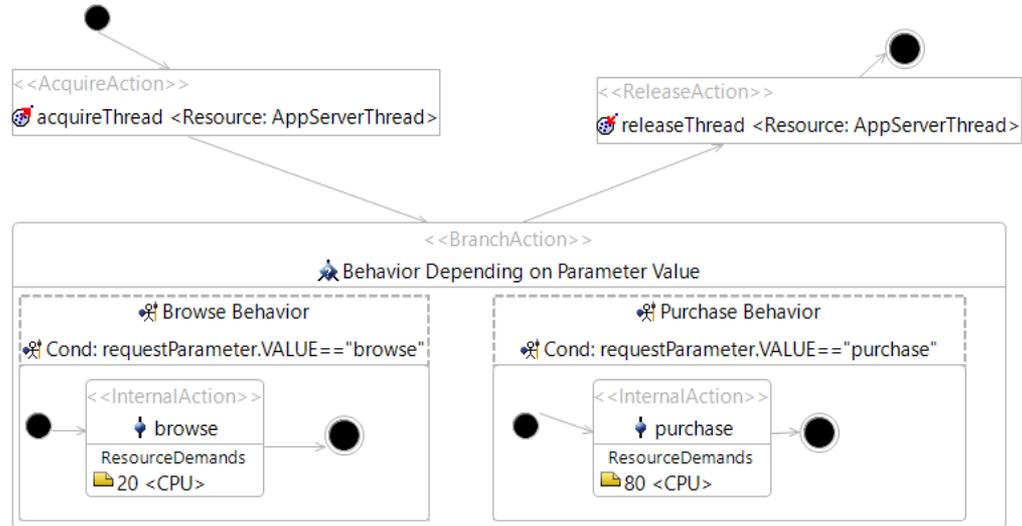


Architecture-Level Performance Models

Palladio Component Model (PCM)

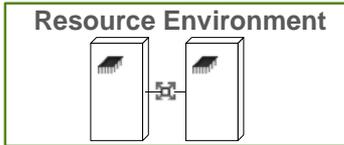
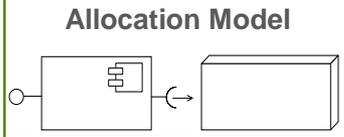
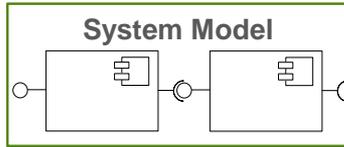
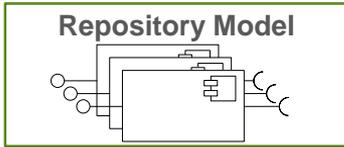
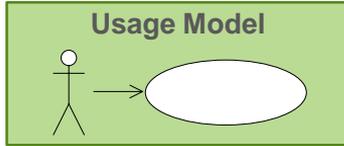


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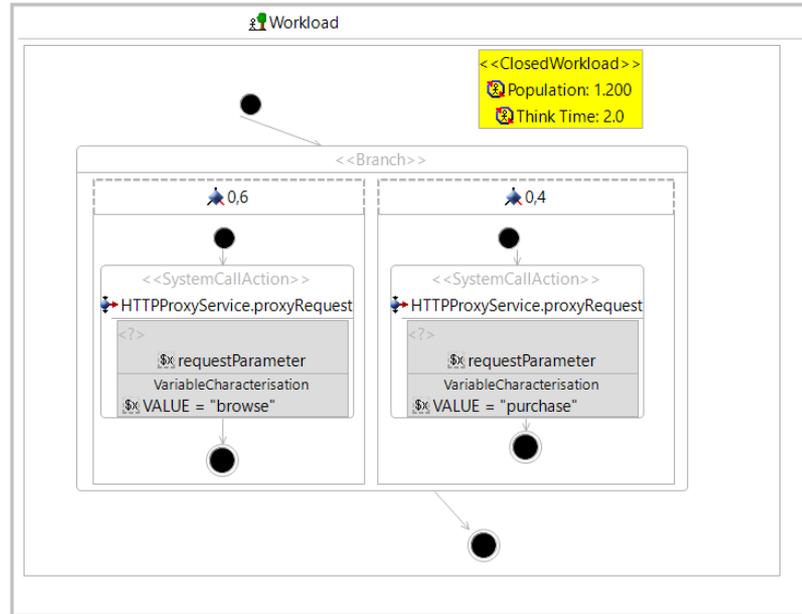


Architecture-Level Performance Models

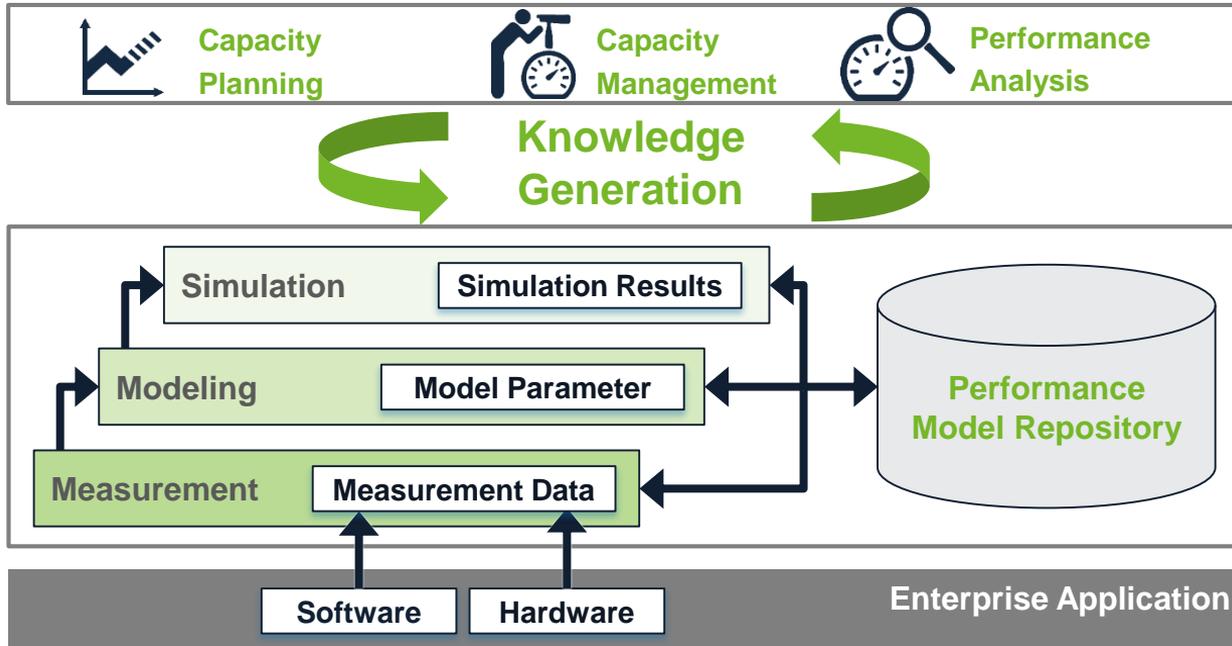
Palladio Component Model (PCM)



- Usage



Performance Modeling – How?

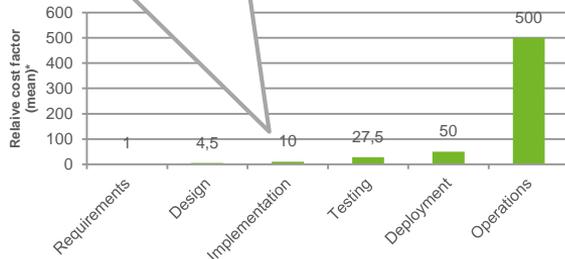


Performance Modeling – When?

Dev Ops

Detect performance change in every version created in a continuous delivery pipeline without the need for expensive performance tests.

Fix performance-related bugs earlier and for less costs by managing performance knowledge using models.



Source: <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100036670.pdf>
 *The cost factor for fixing a performance-related problem is normalized in the different phases relative to the cost of fixing a defect in the requirements phase.

Extrapolate your (load/performance) test results and reduce labor, machinery and license costs by reducing the amount tests.

Provide models along with your application binaries to simplify capacity planning activities.

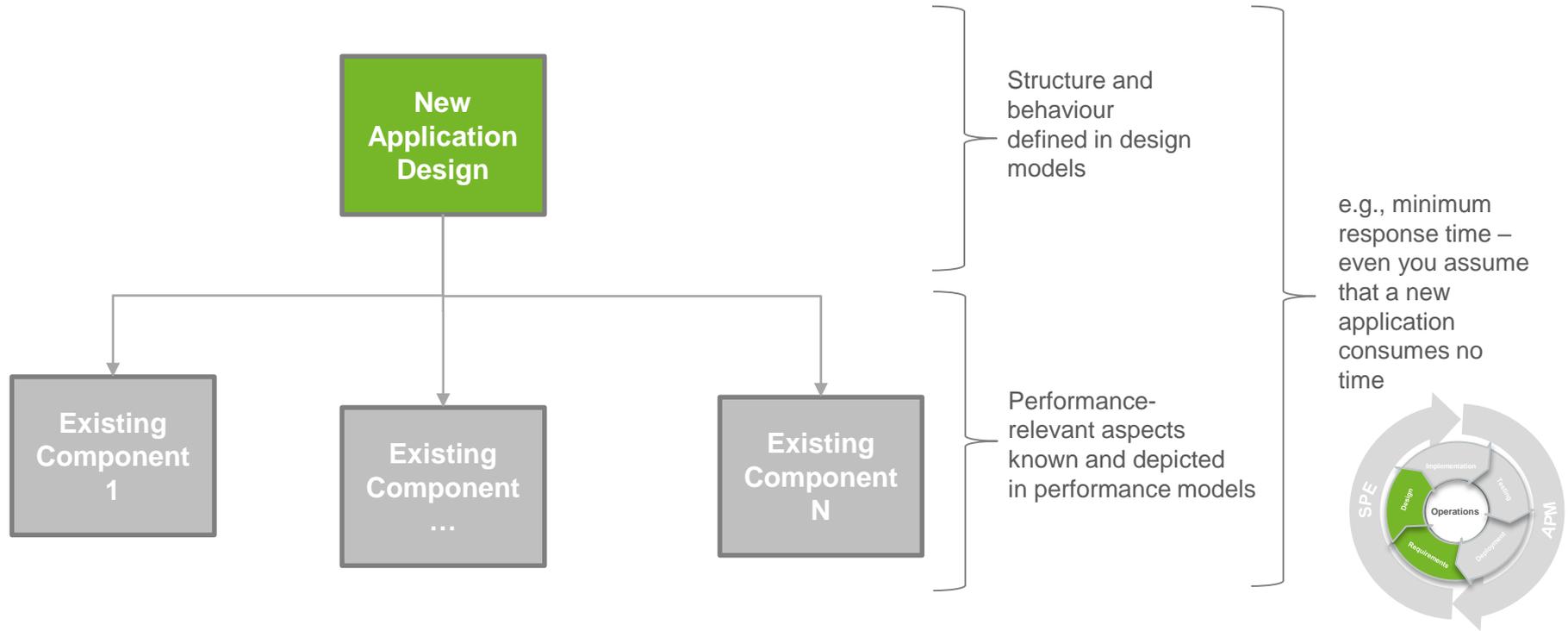
Right-size your environment for seasonal peaks or to reduce license / operating cost (e.g., reduce the amount of cloud instances).



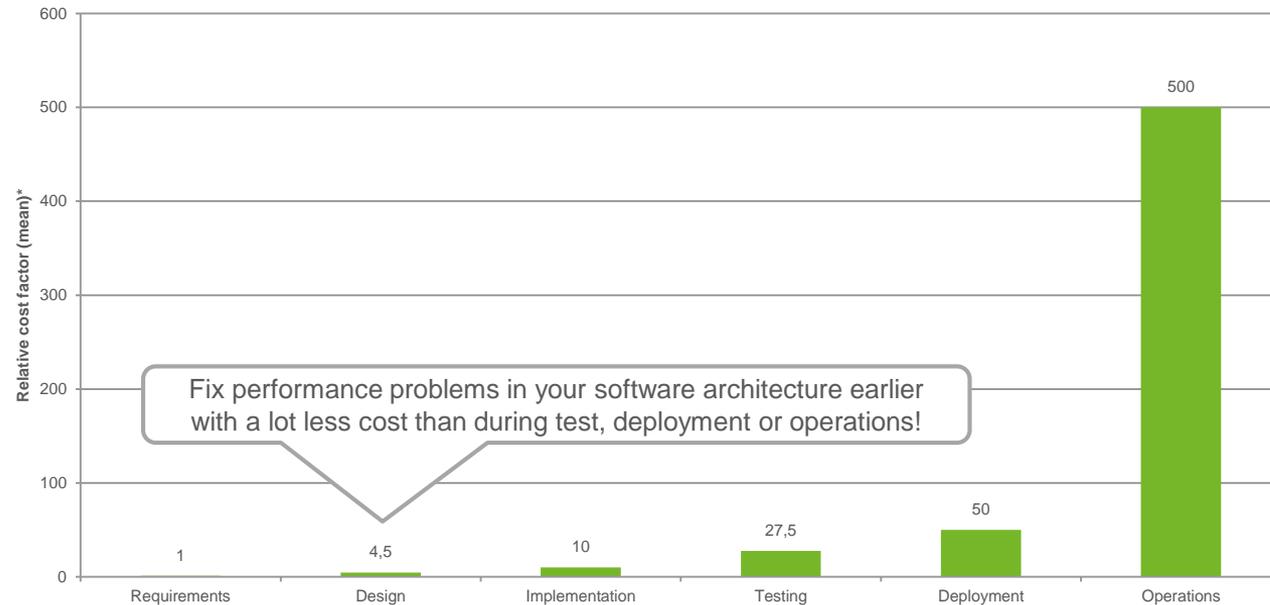
Agenda

- Performance Modeling
- Use Cases, Benefits and Examples

Use Cases – Design Time Performance Evaluations



Benefits – Design Time Performance Evaluations



Source: <http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20100036670.pdf>
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Customer Example - Design Time Perf. Evaluations

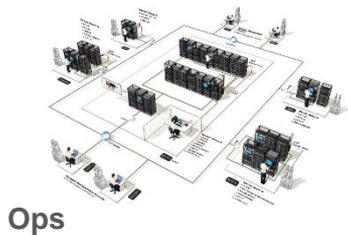
- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**
 - Process-oriented user interfaces
 - Orchestrated by a BPM Engine



- Service-Providers:**
 - Common data sources and application services



Customer Example - Design Time Perf. Evaluations

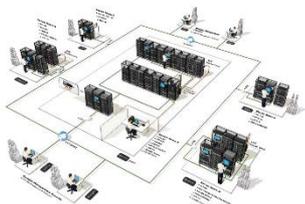
- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**

- Process-oriented user interfaces
- Orchestrated by a BPM Engine

- What happens if we introduce/automate new business processes?
- Can you achieve the required response time and business process lead time goals?
- How much does it cost to increase the IT system performance to improve the business process lead times?



- Service-Providers:**

- Common data sources and application services



Customer Example - Design Time Perf. Evaluations

- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**

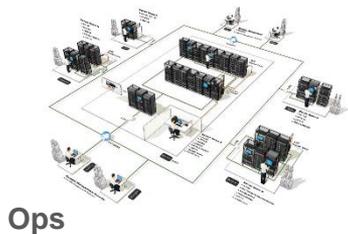
- Process-oriented user interfaces
- Orchestrated by a BPM Engine

- Can we achieve the desired performance and process lead time goals using our existing service-level agreements?
- Which service needs to improve most in order to achieve the business goals?
- Should we negotiate new SLAs with multiple service providers and ask them to improve their performance slightly or with a few providers but as for more radical changes?



- Service-Providers:**

- Common data sources and application services



Customer Example - Design Time Perf. Evaluations

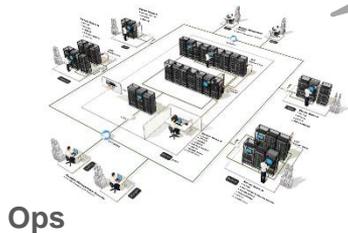
- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**
 - Process-oriented user interfaces
 - Orchestrated by a BPM Engine

- How much additional load will new business processes generate?
- Will the existing systems be able to handle the load?
- Do we need to increase our capacity?
- Who pays for the additional capacity?

- Service-Providers:**
 - Common data sources and application services



Customer Example - Design Time Perf. Evaluations

- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**
 - Process-oriented user interfaces
 - Orchestrated by a BPM Engine

Business
process
descriptions



APM Data



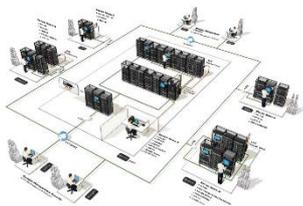
Software
designs for
new processes



APM Data



- Service-Providers:**
 - Common data sources and application services



Ops



Customer Example - Design Time Perf. Evaluations

- Evaluating Performance in a Service-oriented Architecture (SOA)



- Service-Consumers:**

- Process-oriented user interfaces
- Orchestrated by a BPM Engine

• You can achieve the desired business process lead times but it will cost you ...!

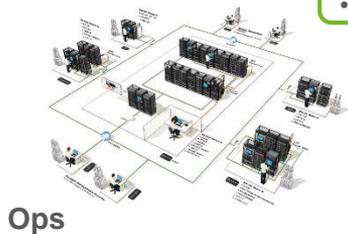


• You should talk to service provider XYZ!

• Your workload will increase by X!
• You should buy ... new servers!

- Service-Providers:**

- Common data sources and application services

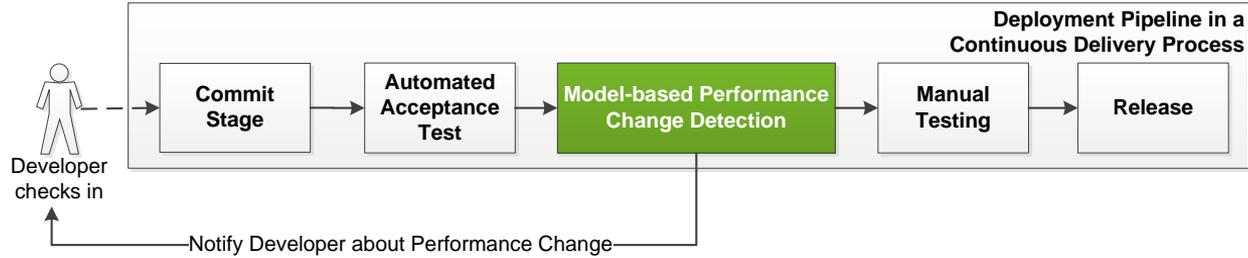


Customer Example - Design Time Perf. Evaluations

- ✓ Modeling **improves** the **collaboration** of all parties involved in the software lifecycle (Business, Dev and Ops)!
- ✓ Business has a level of granularity (business processes) which **eases the communication with the IT department**
- ✓ Service consumers (Dev) can **better estimate the expected response times** for new business processes
- ✓ Service providers (Ops) have **early access to workload information** when new business processes are released



Use Cases – Model-based Evaluations in CD



- ✓ Evaluate the performance impact of feature additions and bug fixes
- ✓ For multiple hardware environments and workloads
- ✓ Without the need to own corresponding test systems!



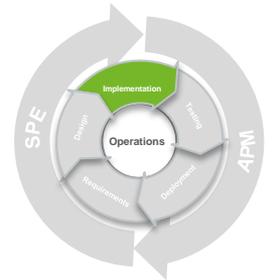
Benefits – Model-based Evaluations in CD

- ✓ Ensure that no version gets released with performance regressions
- ✓ Leverage cost-benefits of fixing performance problems early in the development process
- ✓ Increase the performance awareness of developers by immediate feedback on check-ins
- ✓ Avoid the need to setup and prepare load/performance test environments for each and every project
- ✓ Leverage your existing acceptance/regression testing investments for performance evaluations

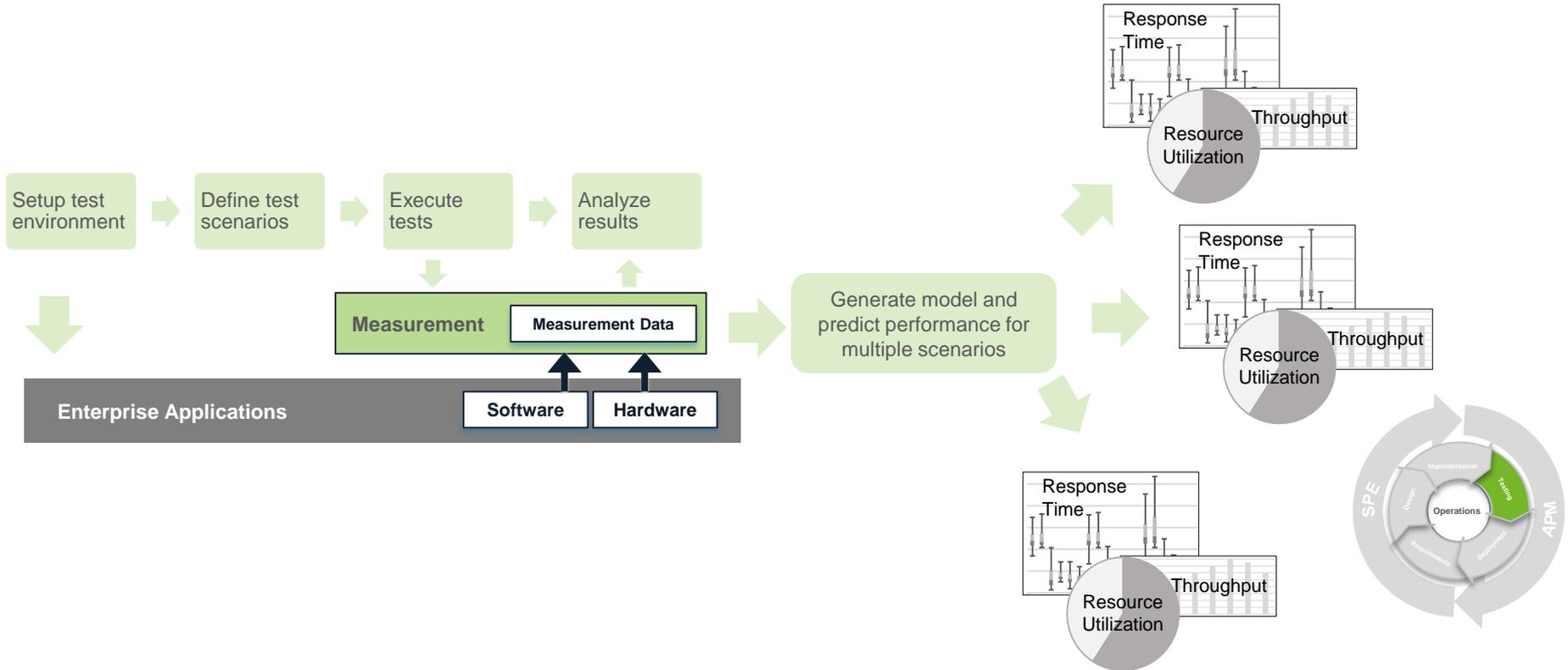


Customer Example – Model-based Perf. Eval. in CD

- A customer (software vendor) has 5 major enterprise applications (EA):
 - 1 CI system per EA (Jenkins)
 - 5 customer scenarios (workload/hardware environment combinations) should be tested for each new build
 - A small performance test environment costs 10 k € / year
 - → 250.000 € / year
- Performance models can evaluate these scenarios without huge investment in multiple test environments



Use Cases – Integrating Load Tests w/ Predictions



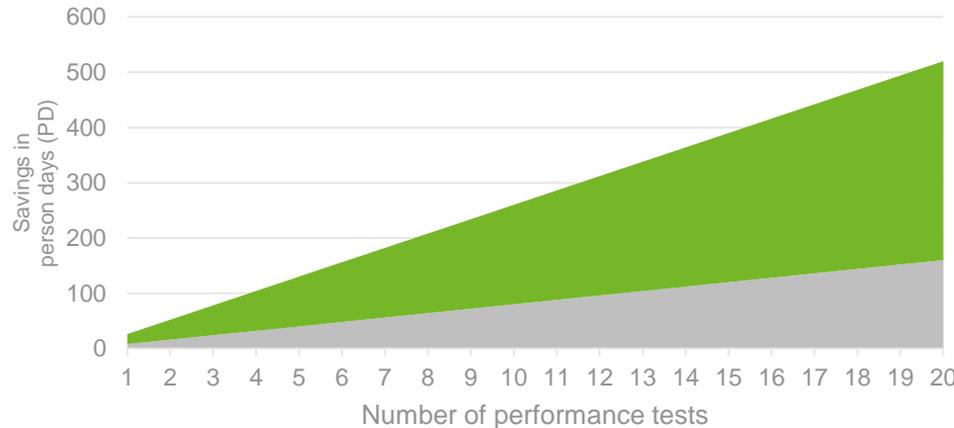
Benefits – Integrating Load Tests w/ Predictions

- ✓ Save costs by reducing the amount of load/performance tests
- ✓ Increase the coverage of your tests
- ✓ Evaluate scenarios without buying the corresponding hardware
- ✓ Easily grow the coverage as the deployment count of your application increases



Customer Example – Integrating LT with Predict.

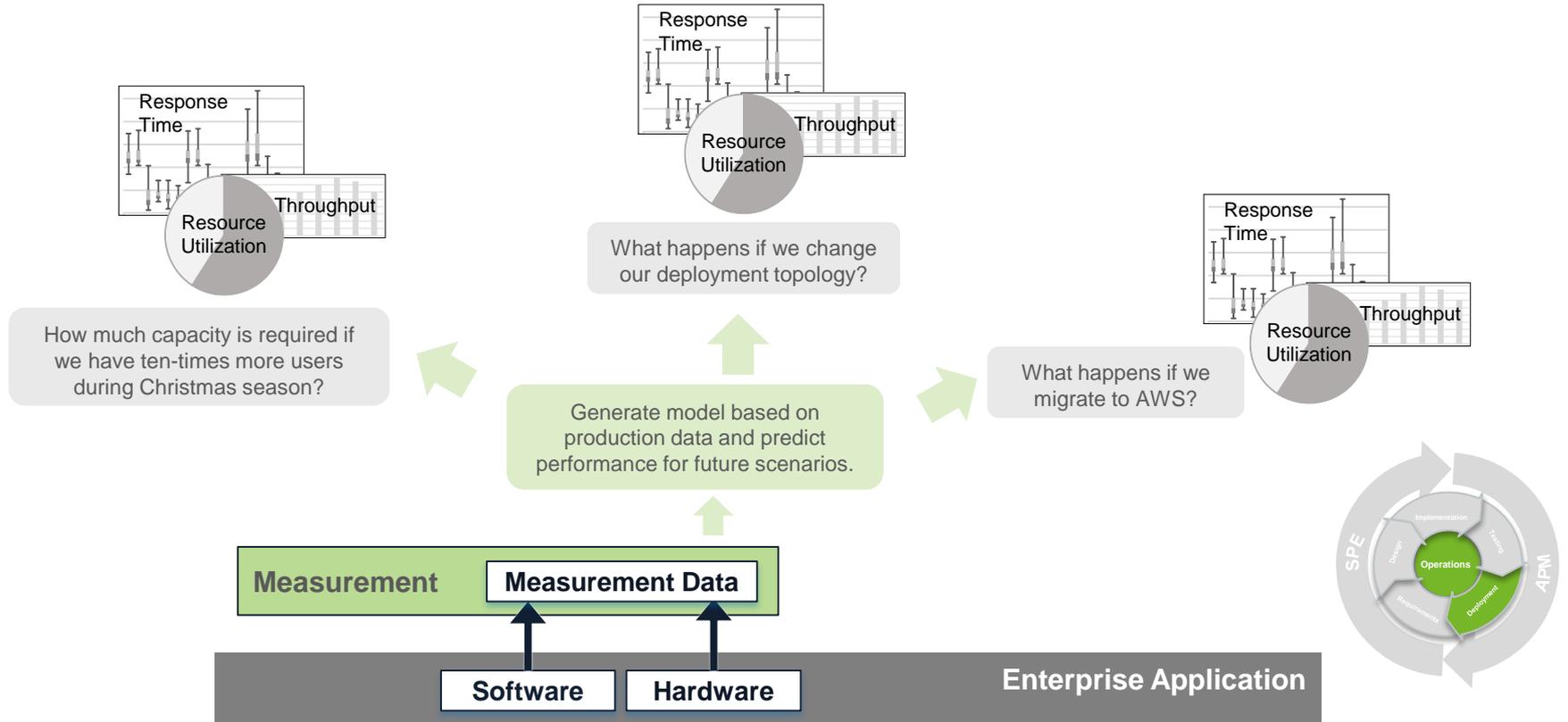
- Save costs by reducing the amount of load/performance tests
 - Effort for load tests (real customer example, incl. script development, test setup, execution and result analysis):
 - Small scale: 13 person days (PD), medium scale 23 PD, large scale: 41 PD
 - Replacing one medium or large scale test by a small scale test with predictions saves between 8 and 26 PD (assuming 2 PD for predictions)



- PD savings when replacing large scale tests with small scale tests and predictions
- PD savings when replacing medium scale tests with small scale tests and predictions



Use Cases – Model-based Capacity Management



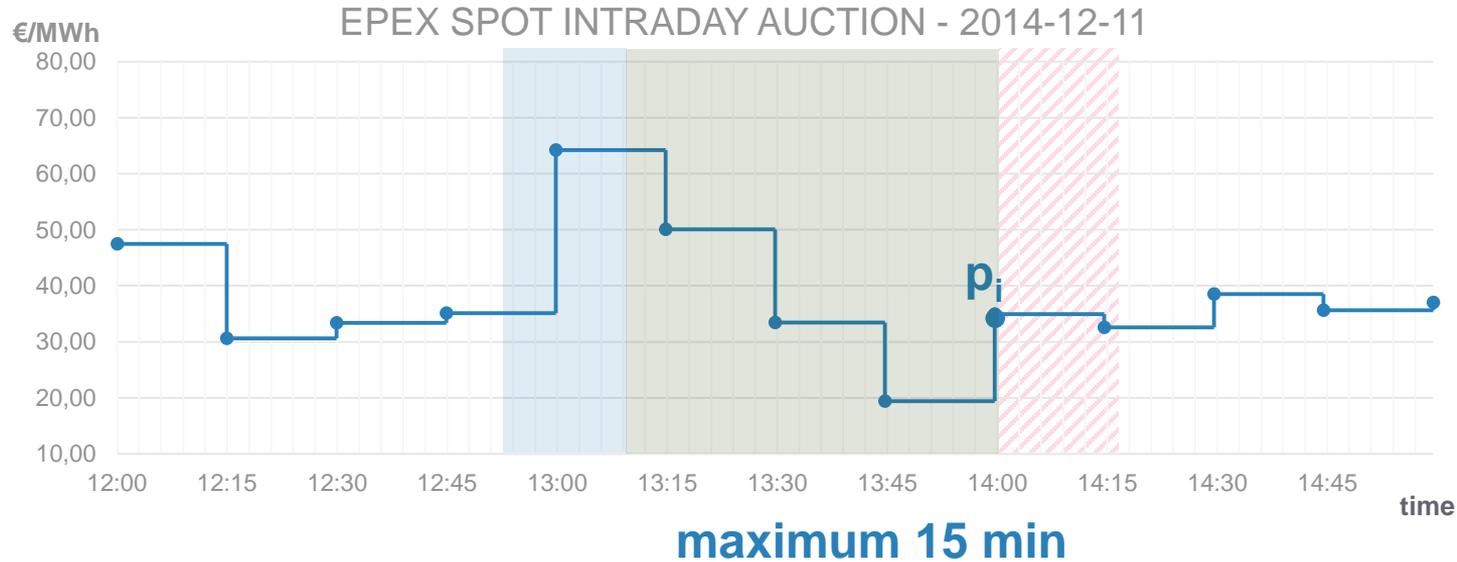
Benefits – Model-based Capacity Management

- ✓ Right-size your environments to pay only for what you really need
- ✓ Avoid the need to setup expensive test environments to evaluate changes
- ✓ Reduce risk for hardware environment (e.g., cloud) migrations
- ✓ Reduce the time for capacity management activities
- ✓ Increased accuracy as the simulations avoid the need for linear assumptions



Customer Example – Model-based CM

- ✓ Smart Grid Capacity Planning for several million households



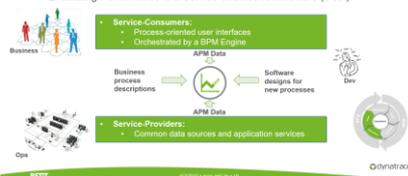
Summary

- What did we learn today?
 - Performance modeling...

✓ Improves cross-team collaboration

Real Example - Design Time Perf. Evaluations

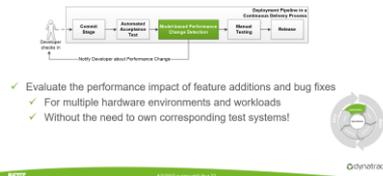
- Evaluating Performance in a Service-oriented Architecture (SOA)



...by integrating multiple data sources

✓ Increases performance awareness

Use Cases – Model-based Evaluations in CD

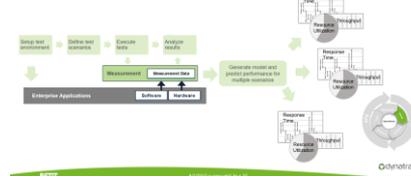


- ✓ Evaluate the performance impact of feature additions and bug fixes
- ✓ For multiple hardware environments and workloads
- ✓ Without the need to own corresponding test systems!

... through immediate feedback during development.

✓ Extends test coverage

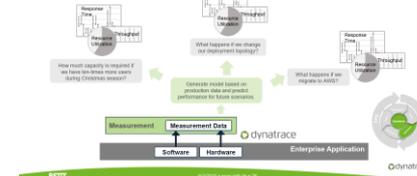
Use Cases – Integrating Load Tests w/ Predictions



... by allowing you to test more workloads and hardware environments.

✓ Saves cost

Use Cases – Model-based Capacity Management



... by taking the guess-work out of capacity planning activities.

Want to learn more?

<http://www.meetup.com/de/Software-Performance-Meetup-Group/>

The screenshot shows the Meetup.com page for the 'Software Performance Meetup' group. The header features the group name, location (Munich), a description of the group's focus on software performance discussions, and a QR code. Below the header is a navigation menu with options like 'Startseite', 'Mitglieder', and 'Gruppenverwaltung'. The main content area includes a 'Herzlich willkommen!' message, a 'PLANE EIN NEUES MEETUP' button, and a featured event titled 'Sixth Software Performance Meetup' by codecentric AG. The event details include the date (October 22nd at 19:00), a 'ICH GEHE HIN' button, and statistics showing 42 people going, 8 spots left, and 0 comments. A sidebar on the left shows the group's location in Munich, Germany, and a member count of 342. A sidebar on the right displays a 'Was gibt es Neues' section with a vertical stack of photos from previous meetups.

Can't get enough performance?

<http://www.performance-symposium.org>

Symposium on Software Performance

Enter search word...

Wednesday, 2015-09-30

Symposium on Software Performance 2015
(Joint Developer and Community Meeting)

November 4-6, 2015
Munich, Germany

2015
Important Dates
Submission
Venue
Registration
Organization

2014
2013
2012
2011
2010

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Julius-Maximilians-UNIVERSITÄT WÜRZBURG
Universität Stuttgart
Technische Universität Chemnitz

Goals

Performance is one of the most relevant quality attributes of any IT system. While good performance leads to high user satisfaction, weak response times lead to loss of users, perceived unavailability of the system, or unnecessarily high costs of network or compute resources. Therefore, various techniques to evaluate, control, and improve the performance of IT systems have been developed, ranging from online monitoring and benchmarking to modeling and prediction. Experience shows, that for system design or later optimization, such techniques need to be applied in smart combination.

Therefore, the "Symposium on Software Performance (SSP)" brings together researchers and practitioners interested in all facets of software performance, ranging from modeling and prediction to monitoring and runtime management. The symposium is organized by four already established research groups, namely *Descartes*, *Kieker*, *Palladio*, and *PMG* who will use this symposium also as a joint developer and community meeting. *Descartes*' focus are techniques and tools for engineering self-aware computing systems designed for maximum dependability and efficiency. *Kieker* is a well-established tool and approach for monitoring software performance of complex, large, and distributed IT systems.

So you really want to get into performance?

<http://research.spec.org/devopswg>



The screenshot shows the website for the SPEC Research Group, specifically the DevOps Performance Working Group page. The page has a dark header with the SPEC Research logo and the text "SPEC Research Group". Below the header is a search bar and the date "Wednesday, 30 September 2015". On the left is a navigation menu with "Publications" highlighted. The main content area is titled "About the DevOps Performance Working Group" and features a circular logo with the text "spec RG DevOps Performance". The text describes the group's focus on research in combining application performance management (APM) and model-based software performance engineering (SPE) activities for business-critical systems. It mentions that the group's goal is to consolidate concepts and tools to better integrate these activities, and lists its membership body including fortiss GmbH, Imperial College London, Kiel University, Karlsruhe Institute of Technology, NovaTec Consulting GmbH, University of Stuttgart, and University of Würzburg. On the right, there are sections for "Important Links" and "Upcoming Events".

Home
News
FAQ
Mission and Charter
Working Groups
Big Data Working Group
DevOps Performance Working Group
Mission and Activities
Meetings and Presentations
Publications
Contact
IDS Benchmarking Working Group
RG Cloud Working Group
ICPE Proceedings
Awards
Tools
Newsletter
Publications
Links
Member Organizations

About the DevOps Performance Working Group



spec RG
DevOps
Performance

The DevOps Performance Working Group fosters and facilitates research in combining application performance management (APM) and model-based software performance engineering (SPE) activities for business-critical application systems. The need for a better SPE/APM integration is driven by an increased interrelation of development and operation teams in corporate environments due to DevOps concepts. SPE proposes to start performance evaluations by transforming software design models into performance models. These performance models need to be parameterized with estimates of resource demands to derive meaningful predictions. APM tools enable the collection of fine-grained monitoring information of a running system. This monitoring information has the potential to significantly increase the accuracy of the performance model predictions during the complete life-cycle of a software system. The goal of the working group is to consolidate concepts and tools to better integrate these activities. Its membership body currently includes representatives of fortiss GmbH, Imperial College London, Kiel University, Karlsruhe Institute of Technology, NovaTec Consulting GmbH, University of Stuttgart, and University of Würzburg.

Important Links

- [Big Data Working Group](#)
- [DevOps Performance Working Group](#)
- [IDS Benchmarking Working Group](#)
- [RG Cloud Working Group](#)
- [Latest Newsletter Issue](#)
- [ICPE International Conference](#)

Upcoming Events

- [QUIDOS 2015, Bergamo, Italy](#)
September 1, 2015
- [ICPE 2016, Delft, the Netherlands](#)
March 12-18, 2016

Join our **LinkedIn** group

How to join the DevOps Performance Working Group

Thank You!

Andreas Brunnert
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RETT

Resource Efficient Technologies & IT Systems