EXASCALE ECO-SYSTEM PRODUCTIVITY AND PERFORMANCE WORKSHOP

HILTON WASHINGTON DC NORTH, GAITHERSBURG, MD
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How We Got Here!

Computational science software crisis – convergence of two trends

- **High-fidelity multiscale and multi-physics grand challenge problems**
- **Moore's Law and the emergence of heterogeneous multicore hardware**

Extreme-Scale productivity Summit, DOE/HQ, September 23, 2013

- ✓ **50 attendees from labs, Office of Science, & several federal agencies**
- ✓ **Goal: Productivity gap in computational science (whitepaper)**

Extreme-Scale Productivity Workshop I, MD., January 2014 - 80 attendees

- ✓ **Application Software Productivity for Extreme-Scale Science**

Extreme-Scale Productivity Workshop II, MD., June 3-4, 2014

- ***Execution-time productivity and performance***

Exascale Project Planning and Design Document

- ***Productivity R&D as a funded exascale activity***
- ***Justification and supporting document***

Implementation of extreme-scale recommendations

- ✓ **Joint ASCR/BER FOA on extreme-scale application software development issued**
- ***Exploring the role of productivity in Exascale***

Exascale Computing System Productivity

Exascale computing Productivity

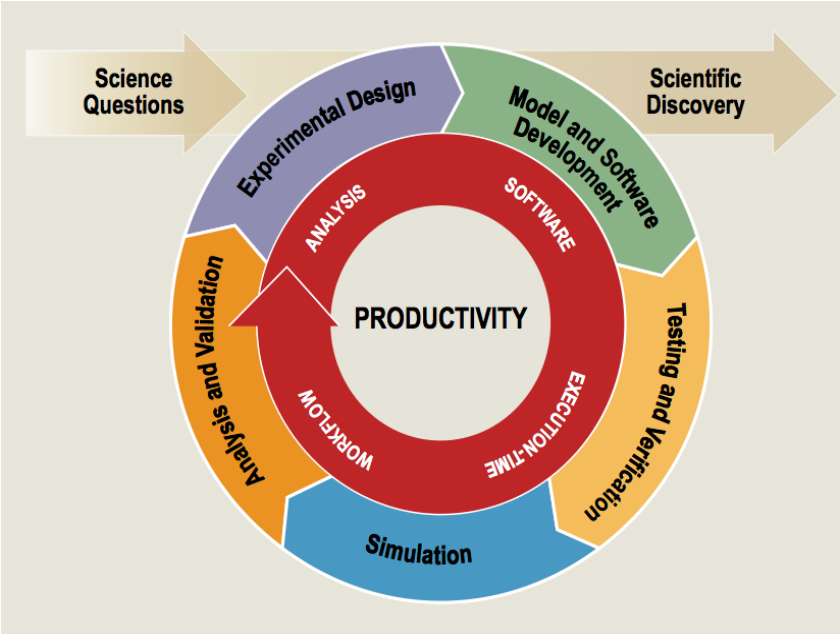
- *The effective and efficient use of all exascale resources (hardware, application software, runtime software, people, processes, energy, etc.) in the of production of new scientific insights.*

Goal

- *Identify, remove, or ameliorate productivity and performance bottlenecks in the overall exascale ecosystem during research and development*

Productive Exascale

- *Productivity awareness embedded in all exascale lifecycle activities from R&D through deployment to operation and production of scientific insights*



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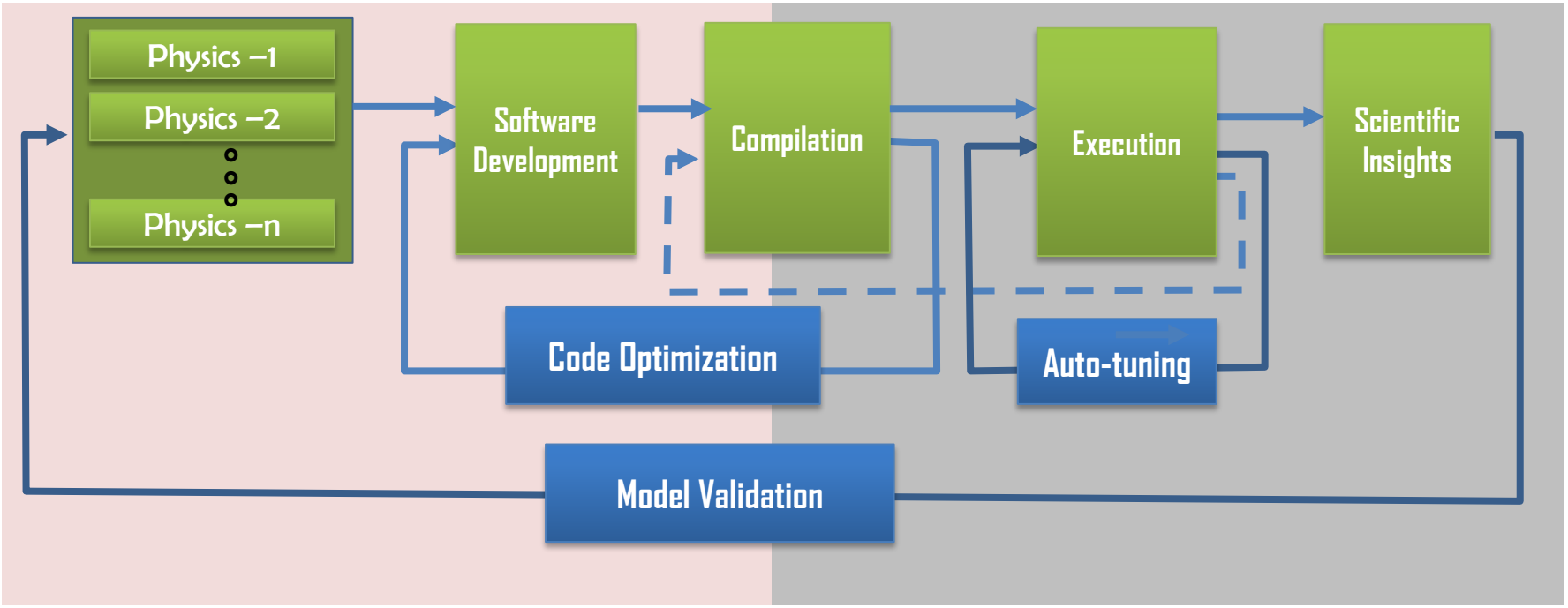
Productivity Improvement Process-- an End-to-End View



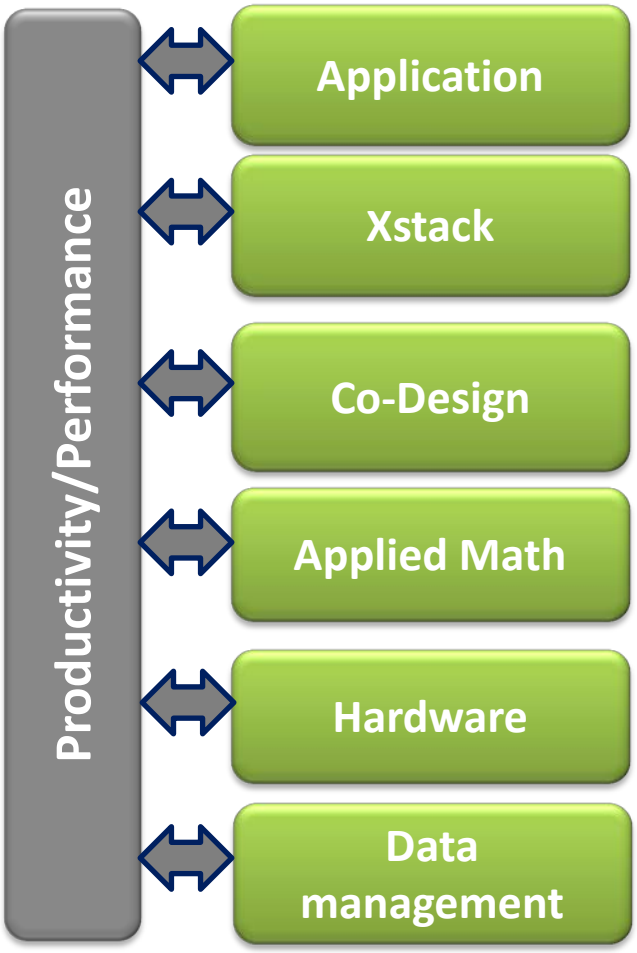
Application Software Productivity

- Metrics/attributes
- Ease of use
- Heterogeneous portability
- Reusability
- Interoperability/maintainability
- Hardware capabilities discovery
- Software performance engineering

Execution-time productivity

- Metrics/attributes/execution models
- Observability /controllability/monitoring
- Instrumentation/measurement/ traceability
- Productivity modeling/simulation: prediction, diagnosis
- Performance engineering

Exascale Systems Productivity
(An Exascale Cross-cut Effort)



Exascale R&D Context

- *Cross-cutting activities across all nexus and plexus to enable the development of a high-productivity exascale system,*

Post-deployment Context

- *Cross-cutting activities to enable the operation and the production of science at exascale,*

Pre-exascale Context

- *Petascale productivity/performance as a launching pad for exascale productivity.*

Workshop of Current Expectations

- A sound workshop report with compelling recommendations to justify investment in productivity R&D in the following areas:
  - Petascale/pre-exascale systems
  - Exascale design, development, deployment, and production system

Fin

Q&A