Application Performance Tuning Activities in LANL's X Division
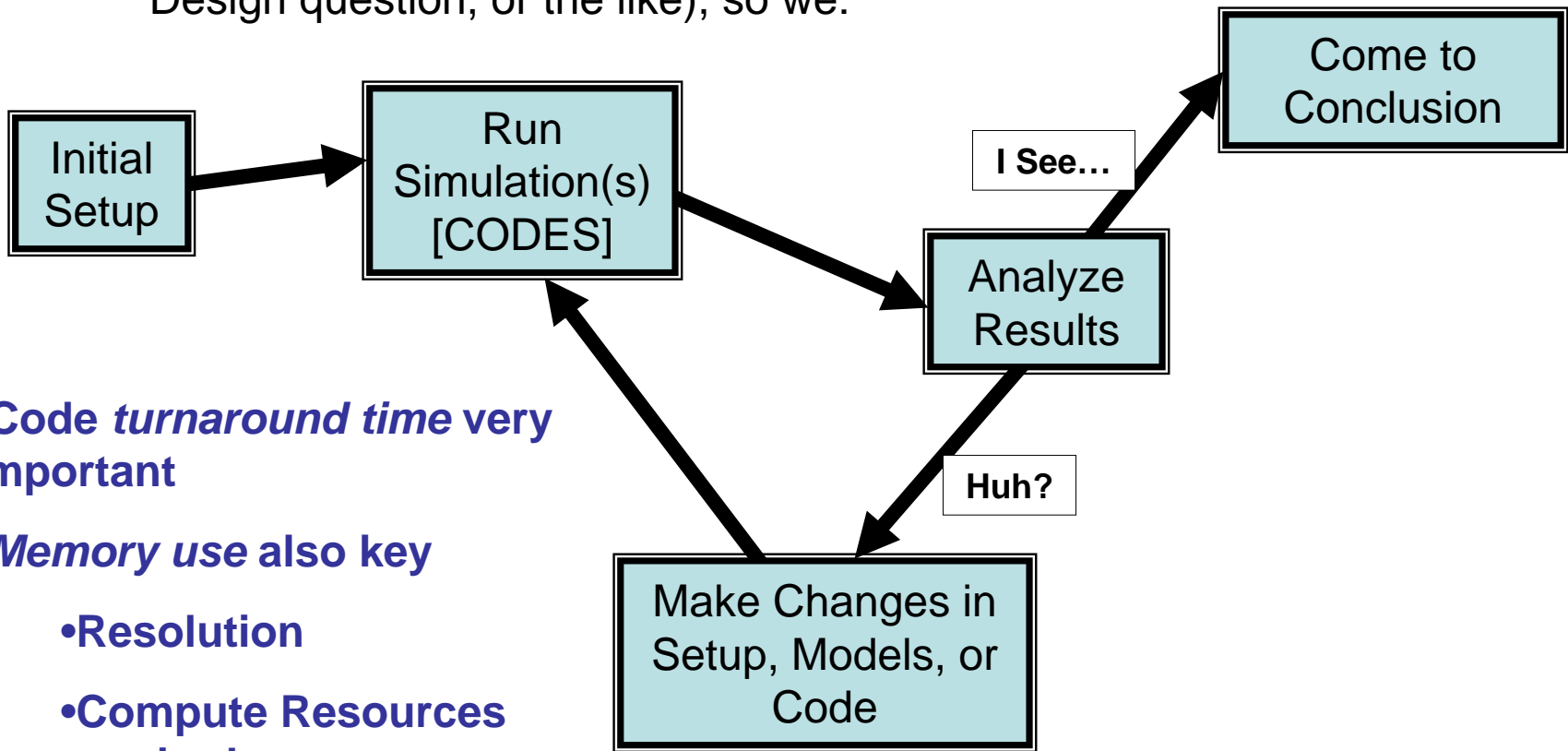
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What a LANL User Does

We want to look at something (V&V, Model parameter study, Design question, or the like), so we:

- **Code *turnaround time* very important**
- ***Memory use* also key**
  - **Resolution**
  - **Compute Resources required**

The Code Environment

- LANL Designers use a small number of codes in their work
  - F90, F77 (C/C++ used mostly as glue)
  - Tens to hundreds of PEs
  - Depending on study, a few to a few hundred separate calculations
- Codes contain a variety of algorithms and run on several platforms.
  - LANL work is mainly on ASC Q (Digital-Compaq-HP) and on Lightning (Linux cluster)…
  - …but other platforms are becoming interesting (Red Storm at SNL, Purple at LLNL)

"Problems" We Want to Help With

- Code Team work load
  - Can preclude performance work
  - Certainly precludes *systematic* performance work
- Communication
  - …**or lack thereof**, with outsiders
  - Latest tools may not filter in
    - Unaware of them
    - Learning curve
    - Filtering useful from not

The Current Team

- Core: 3 Staff members in Computational Methods group (X-8)

- I/O:1 Staff member in HPC Systems Integration group (CCN-9)

- I/O & Tools: 2 Staff members in HPC Environments group (CCN-8)

FY 2006: Optimization "L2"

- "L2" milestone (6 FTE effort) on Weapons Code optimization

- Evaluate current performance

- Develop infrastructure to maintain performance data

- Design suggestions/implementations for better performance/efficiency

- Most important product: ***the team***

Stakeholders

- ASC Program CS element funds 6 people: the "customer"

- ASC codes element – the code teams at LANL – provide some level of help and will benefit: the "clients"

- The Designers – users of the codes: the ultimate "clients"; they need to run more problems, and run them faster

We want to…

- Put the latest tools to work helping LANL codes
- Provide a base of expertise in efficient use of compute resources
- Serve the users of the codes by providing faster, more memory efficient codes
- Be a center of LANL code performance data
- Bridge the gap between CCS, CCN and X division efforts

Fast

- Performance characterization
  - Share data with relevant teams outside X-Div
    - CCS-3 PAL Team
    - CCN-8 Tools
    - CCN-9 File systems (partnership here for I/O optimization)
  - Interact with groups outside LANL
  - Close the loop – make recommendations
- Take Action
  - Plan and execute optimizations in the codes
  - Subject to teams' testing and acceptance standards and SQA processes

Daily Life in the Code Optimization Team

- Cycle
  - Characterize/study
  - Plan modifications
  - Implement and test
  - Collect data on each step
    - Estimate vs. Actual {Time|Speedup|Similar}
- Work on the rhythm of the code teams
  - Follow their testing & acceptance processes
  - Tie work to release schedules

Some Current Activities

- Developed an instrumentation library in use in the main ASC codes at LANL

- Collected "typical" calculation setups for use in characterizations

- Extensive work examining I/O issues in the codes

- Initial characterizations

Transparency is Key

- Data on performance should be available
  - To the code team
  - To other LANL researchers
- Hiding it is no way to improve
  - Experts from outside team may be able to contribute
  - Performance problems - if they exist - don't magically go away
  - The lab must fight against a culture where it would be used to punish teams or people

What We Can Do Together

- Tools in our team's hands, and put at the disposal of the developers

- Process for using extra-LANL people and ideas

- Bring the latest computer science research to bear on the codes

- Increase outside interactions

Conclusions

- *Systematic* optimization
- An "engineering" orientation
- The important product: the team
- Building a center of expertise
  - In tool use
  - In characterization
  - In interactions within and without LANL

Thanks!

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