Those Who Live by the FLOP May Die by the Flop

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HPC As a Capital Investment

> **To increase productivity, substitute capital for labor**

HPC requires a significant capital investment -- does it increase productivity ?

Productivity presupposes

- **Making efficient use of expensive resources**
- **Corresponding reduction of human costs**

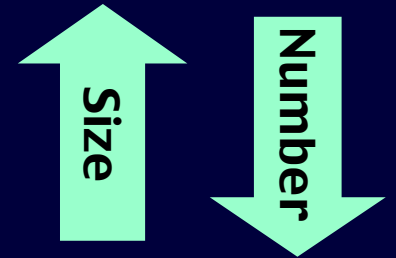## ... How good is HPC's track record?

HPC Productivity Paradoxes

(1) Ubiquity is no measure of success

It's how HPC machines are used that counts...
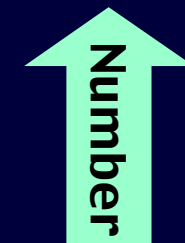
How HPC Machines Are Being Used

Installed base of parallel computers

- government research centers and national labs
- academic institutions and centers
- industry R&D sites
- commercial and financial institutions

Key roles

- (serial) batch server farms
- interactive development / testing
- parallel production runs

Size

Number

Number

Performance Isn't Enough

Machines are more powerful, but we're using them less efficiently

- **5 years ago, 20% sustained efficiency was respectable**
- **On today's SMP clusters, it can take real work to get 5%**

"Effective lifetime" is also a growing concern

- **Today's users don't have the luxury of writing to just one machine**
- **Typical "prime" approximately 2 years**
  - » **planned obsolescence**
  - » **Mean-Time-to-Bankruptcy**

Portability is the obvious way to extend software lifetime

How Portability Affects HPC Costs

Portability isn't just a matter of multiple targets, but multiple <u>moving</u> targets

A ported code only works

       until the new processor boards are installed

       until the shared library changes

       until the next system upgrade

       until the next reboot

       until the load changes
       ... or until the next phase of the moon

HPC Productivity Paradoxes

(2) There's an inherent tension between portability and performance

- "Each new version of each component in the application development environment introduces some new –– though usually justifiable –– quirk" (Mike Frese, Numerex)

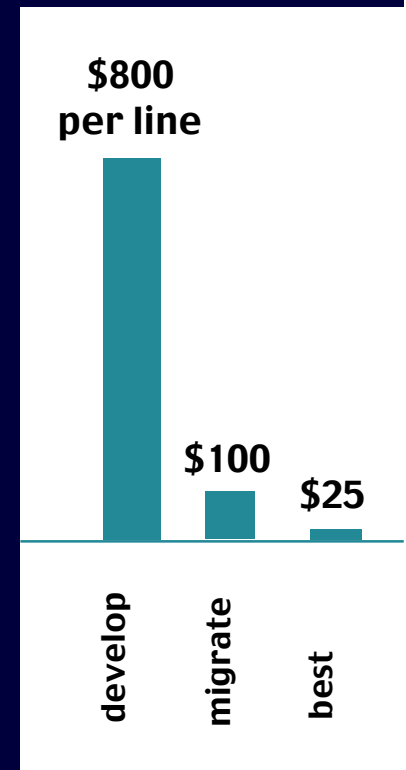- *Experience says:* It's the "portable" code that is most likely to uncover new quirks

The "Hidden" Cost of HPC

Buying the machine *vs.* using it for something

- **Capital costs vastly out-paced by human costs**
- **(Some examples)**

What parallel applications really cost

- **Migrating a parallel application**
- **Developing a key application**
- **Best-in-the-business estimate (Gary Montry)**

"We had this problem with vector computing…"

- **Jack Worlton's estimate of per-line cost**

$800 per line

$100

$25

develop   migrate   best

HPC Productivity Paradoxes

> **(3) The more we spend on a machine,
> the more human effort
> is required to use it efficiently**

When technology is intended to facilitate processes, it's the recurring costs that dominate

- **Cost–of–entry = purchase of HPC system and infrastructure**
- **Recurring costs = human effort expended to apply HPC technology**

Usability Is the Real Measure of Success

TRUE or FALSE?
"HPC technology frees us from work"

Technology has met its promise of reducing our work load.

It does this primarily by preventing us from doing any work at all.

What Usability Is All About

Usability means

- **Ease-of-learning**
- **Ease-of-use**
- **Usefulness**
- **Productivity**

When will HPC get there?

Oops!

We've been emphasizing machines that perform -- instead of machines that help humans perform better

Productivity Paradoxes

(4) HPC computers shift rote tasks to more highly-paid workers

Highly-trained scientists spend ridiculous amounts of time mastering details of technology

Those Who Live by the FLOP ...

The problem: **Too much emphasis on FLOPs undermined the health of HPC !**

The demand for faster, more specialized machines

- **didn't really make users more productive**
- **cost us more than we're willing to admit**

The effect: **We're seeing <u>natural selection</u> at work**

It's Not Your Father's Supercomputer

HPC has been absorbed into the commodity marketplace

- **Today's machines aren't designed for largescale computations**
- **Large systems won't ever be as robust or reliable as users want**

HPC Users Who Whine Are Missing the Point!

Commodity-based HPC was inevitable

- **The window for success is decreasing**
- **Software costs are increasing**
  - » **Initial development costs are only small fraction**
  - » **Support / maintenance soon outpaces all development costs!**

SGI isn't interested in one-off solutions, even if users are willing to pay

HPC is no longer the leading edge ...

Does it have to become the trailing edge?

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Learn to Care ... about Commercial Computing

The core business for SGI is mid-range and high-end servers for commercial applications

- **Dollar value of this market is at least 6 times that of HPC**
- **Traditional HPC viewed as a special market with high risks in both R&D and sales**

Tools designed for commercial applications may be just what you need

- **Compared with large-scale commercial applications, traditional HPC applications are nicely constrained!**
- **It's much easier to make a case for developing a software tool if it supports commercial needs**

SGI Is Missing the Point, Too!

"Your father's business model" won't work any more

Your father's business model

Design & Implementation	→	Pricing	→	Marketing

The "new" business model

Requirements	→	Pricing	→	Design & Implementation

Whose requirements?

- **It's commercial ISVs who will bring the customers you want**
- **HPC users are good <u>predictors</u> of those needs**

SGI *Can't Afford* to Ignore HPC Users

Significant experience working with new architectures and parallel computing

- HPC users have more relevant knowledge than commercial ISVs
- Have already faced the challenges commercial ISVs are just coming to terms with

Familiar with many types of system software

- HPC users are a quick source of useful insight

Have been dealing with portability for a decade

- This *is* the key issue for commercial ISVs

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HPC Productivity Paradoxes

Users think commercial computing is a threat to technical computing

Vendors think HPC users don't really count

(5) "Sleeping with the enemy" is the only way to get usable computing –– technical or commercial

Must Those Who Lived by the FLOP ... ?

- **Emphasizing FLOPS led to HPC that costs more than it yields**

- **Ignoring the lessons of HPC –– and HPC users –– will lead to more flops**

SGI+CUG partnership is essential