The most trusted source of analysis, advice, and engineering for embedded processing technology and applications

Creating Meaningful Benchmarks: Lessons Learned

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About BDTI

BDTI provides:

- Best-in-class product development engineering services
  - Emphasis on optimization for performance, cost and power
- Expert, objective benchmarking and evaluation
  - For technology selection, feasibility studies, competitive analysis and proof points
- Licensable benchmark suites and certification services

Focused on:

- Algorithm-intensive applications: vision, video, audio, wireless
- Embedded processors, tools and techniques:
  - CPU, GPU, DSP, FPGA, many-core, etc.

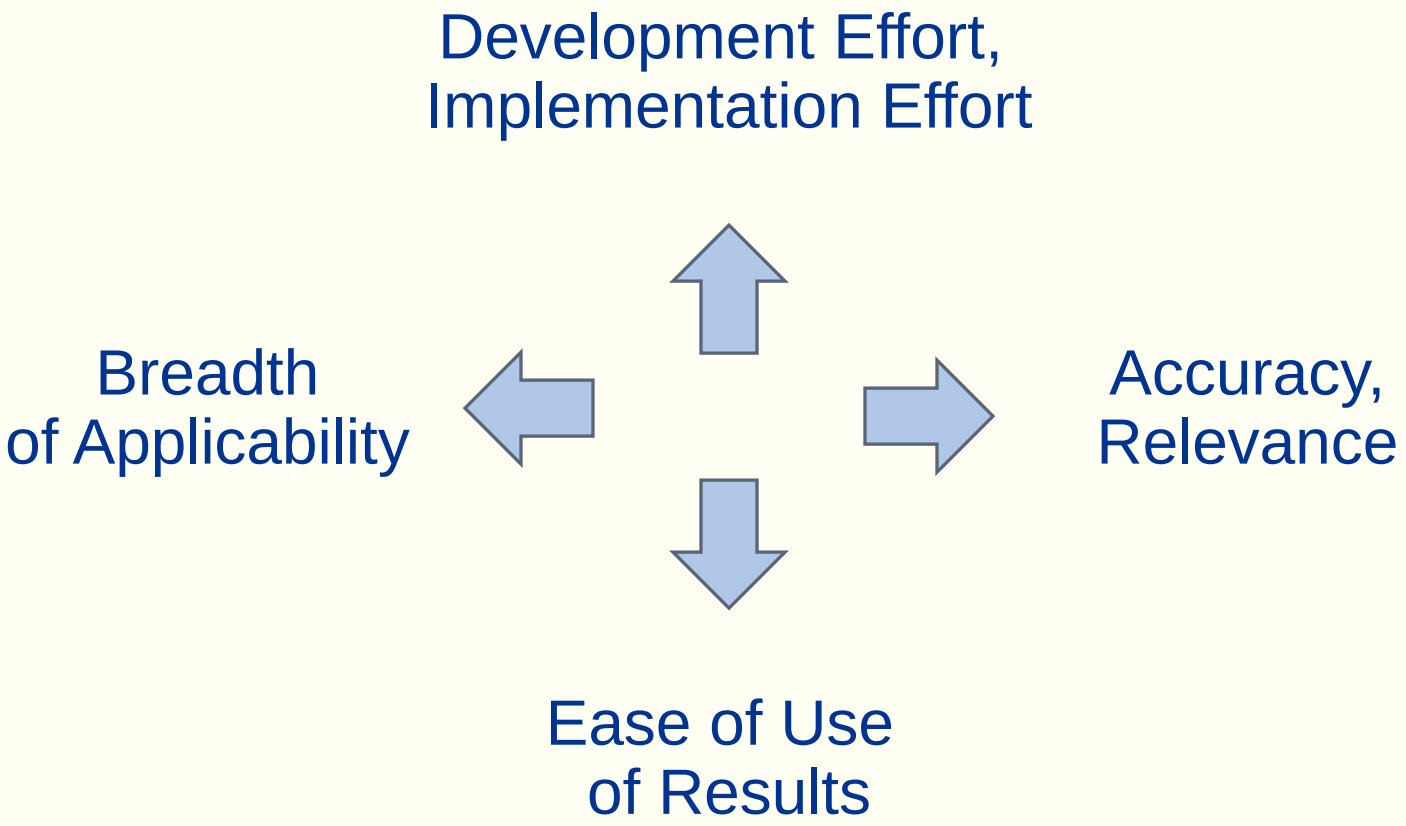
"These guys make a living telling the truth."

– Kevin Morris, Editor in Chief, FPGA Journal

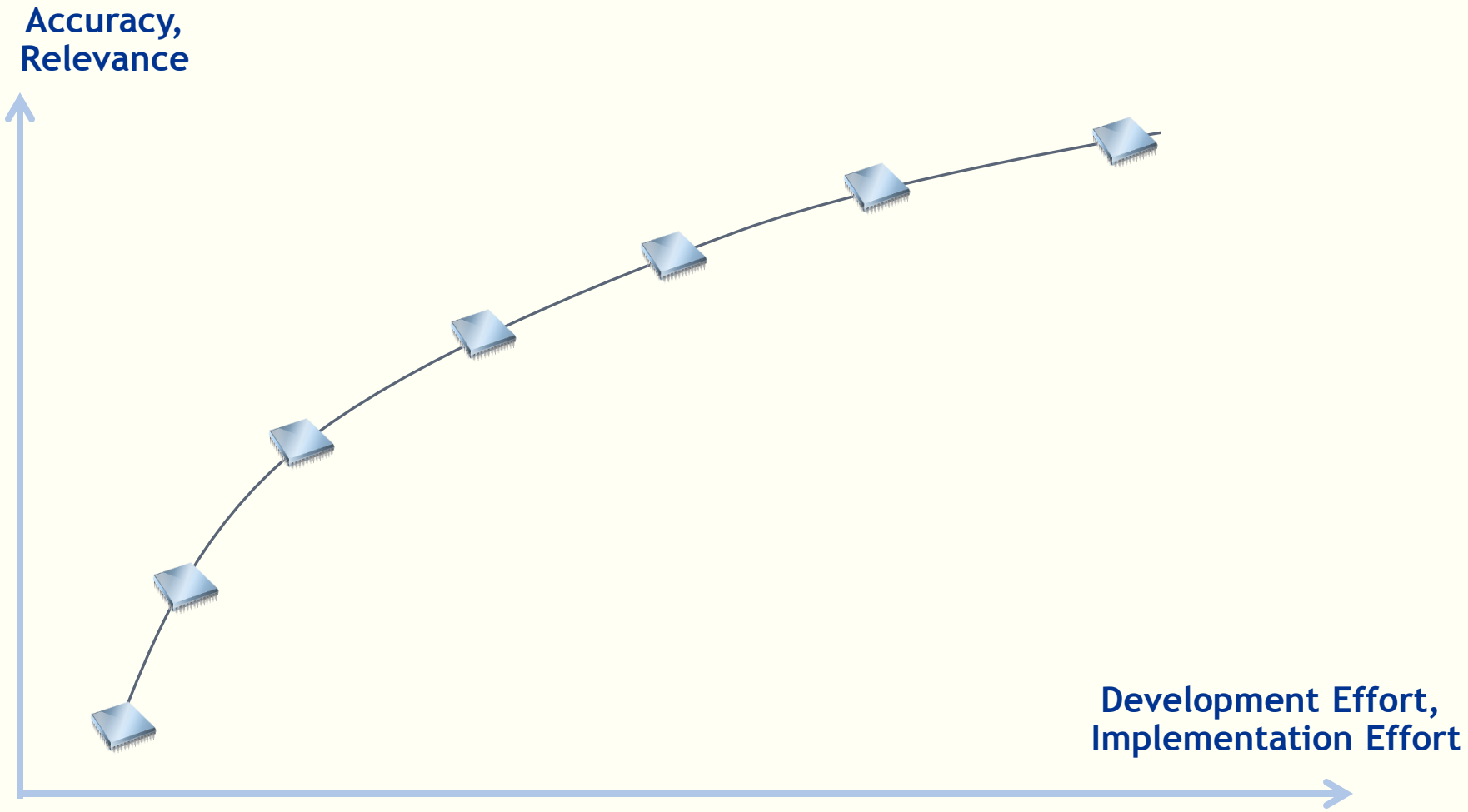
Objectives for a New Benchmark

- Results must exist—soon
- Results must be relevant
- Results must be accurate
- Results must be credible
- Results must reach the target audience(s)…
- …in a readily understandable and actionable form

Benchmark Design Trade-offs



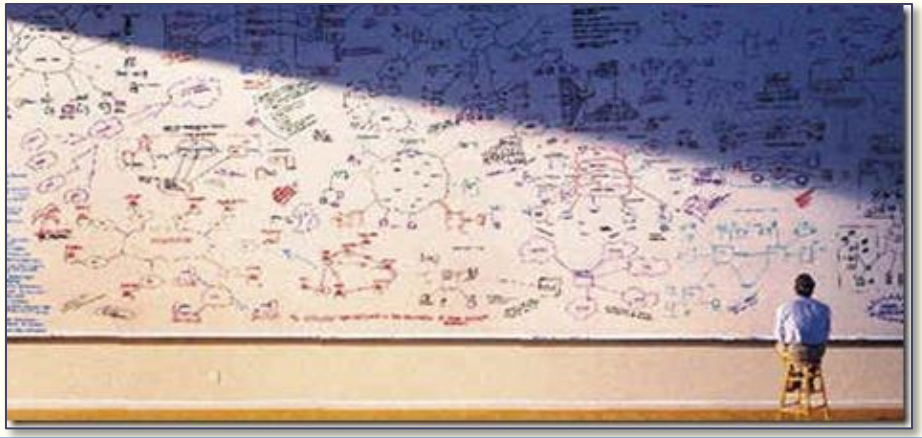
Diminishing Returns



Long-term Embedded/Mobile Trends

- Application, system, software capability and complexity increase
- System functionality becomes more heterogeneous
- Processors become more complex and heterogeneous
- Proprietary algorithms are key differentiators
- Programming approaches, languages, tools are changing more rapidly

➔ **Collectively, these trends create enormous challenges for benchmarking**



Addressing Complexity and Heterogeneity

As systems, applications and processors become more complex, it becomes difficult to approximate the performance of the whole from that of the parts

Kernel benchmarks are of diminishing value for evaluating systems

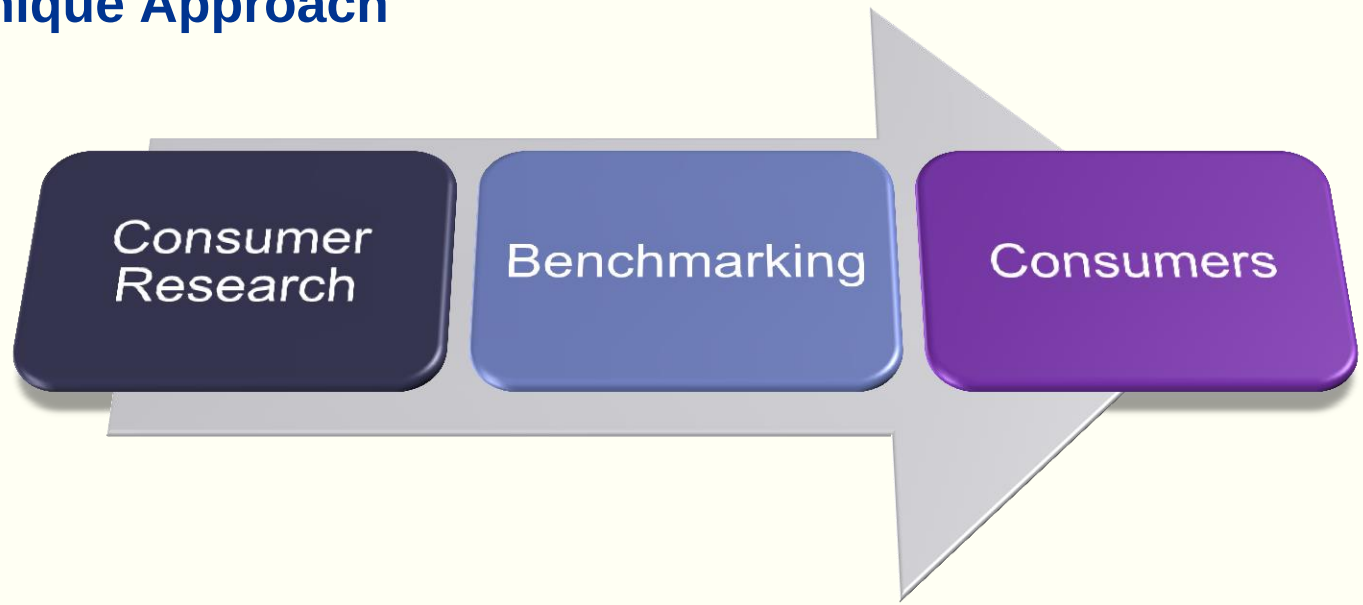
The natural solution is to benchmark at the system level, using full applications

www.treehugger.com

This approach has its own challenges:

- Creating realistic synthetic full-application benchmarks is very costly
- Access to the real application code is often impossible
- Porting and optimizing the real application code to multiple system architectures is very costly

Certimo: User Experience Ratings For Smart Devices
A Unique Approach



Consumer Research

- User research data
- Consumer usage patterns
- By device type
- By region

Benchmarking

- Performance, battery and display
- Lab-run tests ~3 days
- Ratings weighted by UX data
- All ratings certified by BDTI

Consumers

- Educate consumers on UX
- Deliver UX ratings at scale
- Analytics via mobile app

Certimo™

A Word of Caution Regarding Open Source Benchmarks

The benefits of creating open-source benchmarks are obvious

The drawbacks are sometimes less obvious:

- Fragmentation can encourage bogus comparisons
- Proliferation of unverified erroneous results means that errors and cheating are much more likely to go undetected
- ➔ Utility and credibility suffers

Metric Neglect

Great care goes into the choice of benchmark functionality

Often, insufficient thought goes into the choice of metrics

Even seemingly simple metrics can be complex

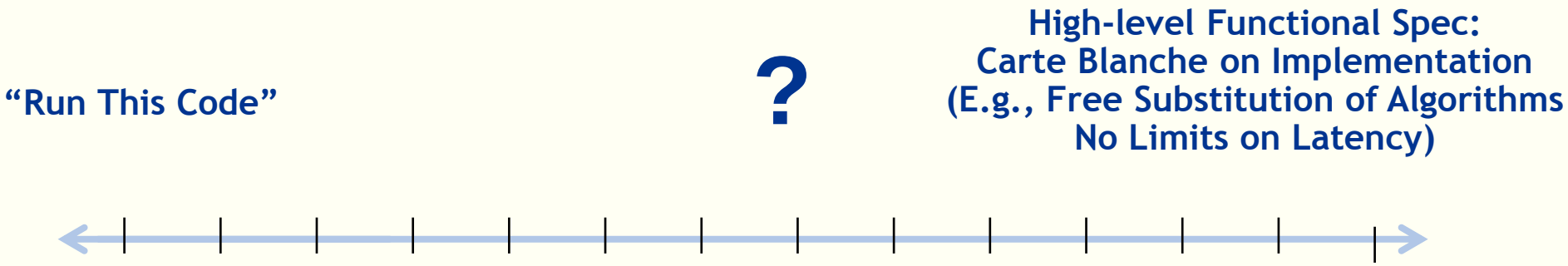
- E.g., what is “time”? Throughput? Latency? Average? Peak?

Increasingly, the metrics that matter are complicated. E.g.,

- An application requires a certain level of performance; more performance is not better – and may actually be worse
- Output quality is often a complex concept
  - E.g., smoothness of user interface response
  - E.g., perceived quality of audio and video

Implementation and Optimization Methodology

Specifying the allowable implementation and optimization paths for a benchmark is as important as specifying the functionality



Key Application Domain: Computer Vision ➔ Embedded Vision

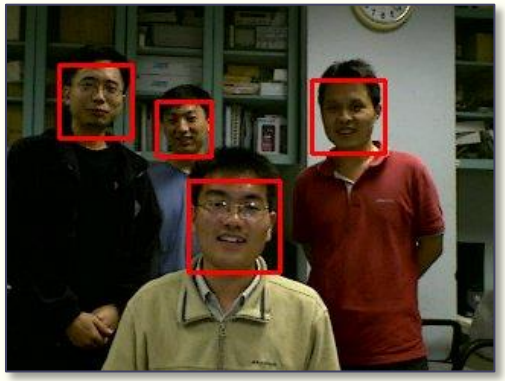
***Computer vision*: systems that **extract meaning** from visual inputs.**

Computer vision has been an active research field for decades, with limited commercial applications.

***Embedded vision*: the **practical, widely deployable** evolution of computer vision**

- Applications: industrial, automotive, medical, defense, retail, gaming, consumer electronics, security, education, …
- Embedded systems, mobile devices, PCs and the cloud

What Does Embedded Vision Enable?



Empowering Product Creators to Harness Embedded Vision

The Embedded Vision Alliance (www.Embedded-Vision.com) is a partnership of leading embedded vision technology and services suppliers

Mission: Inspire and empower product creators to incorporate visual intelligence into their products

The Alliance provides low-cost, high-quality technical educational resources for engineers

- The Alliance website offers in-depth tutorial articles, video "chalk talks," code examples, tools and discussion forums
- The *Embedded Vision Insights* newsletter delivers news, Alliance updates and new resources
- Embedded Vision Summit conferences provide classroom and hands-on learning, exciting demos and keynotes, and unique networking opportunities

Embedded Vision Alliance Member Companies

Thank You!

For More Information:

- BDTI development, benchmarking and analysis services, and licensable benchmark suites: www.BDTI.com
- Certimo mobile device rating system: www.Certimo.org
- Embedded Vision Alliance: www.embedded-vision.com
- Or email us at info@BDTI.com