

# Time Stable Workload Characterization Techniques

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# How Are IS Decisions Made?

- Internal political pressures
- Maneuvering for future positions
- Status
- Entertaining boondoggles and other ego strokes
- Economic pressure on managers
  - Pay systems based on span of control and budget size
    - Big complex systems need big staffs
    - Big machines cost a lot to buy, a lot to maintain and even more for software
- Extreme management risk aversion

# Why Do Technical Staff Have So Little Impact?

- Politically naïve
- Incorrect and short term focus
  - Technical staff think that they are answering this question
  - Managers are thinking years ahead, building empires and relationships
- Answer questions with single numbers or “yes/no”, not a framework of information that highlights over-capacity
- Rely on text and huge tables of numbers
  - Management understands charts and graphs

# Why Do Technical Staff Have So Little Impact?

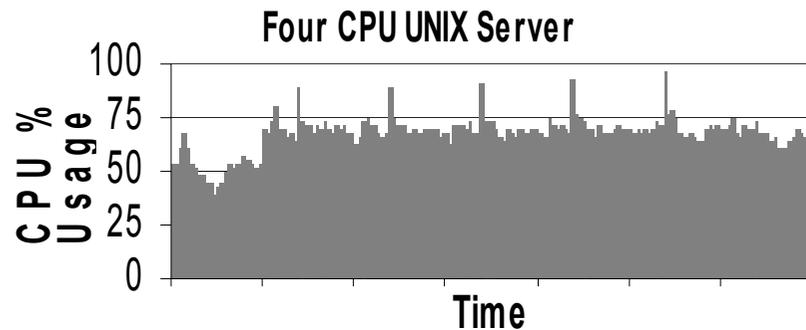
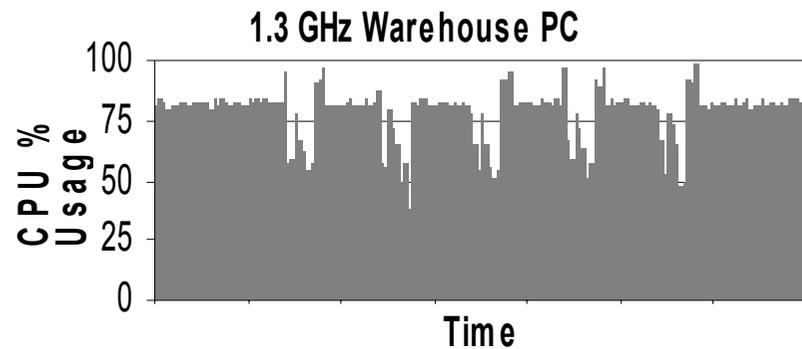
- Failure to collect, maintain and have ways to report long term historical context
- Communication skills issues
  - Hiding instead of sharing background information (The guru complex)
  - “Frustrated novelists” bury the answer near the end
    - Nobody reads past the first page, EVER!
- Need to point out past mistakes
- They think that they make decisions
  - Technical staff informs
  - Management decides

# How Can We Do Better?

- We need to provide better information in more effective ways, and often more information than they ask for
- Good business workload characterization is critical to making the right decisions
- Workload characterized views of consumption are present in almost every well run IS shop
  - Let's look at an example of why

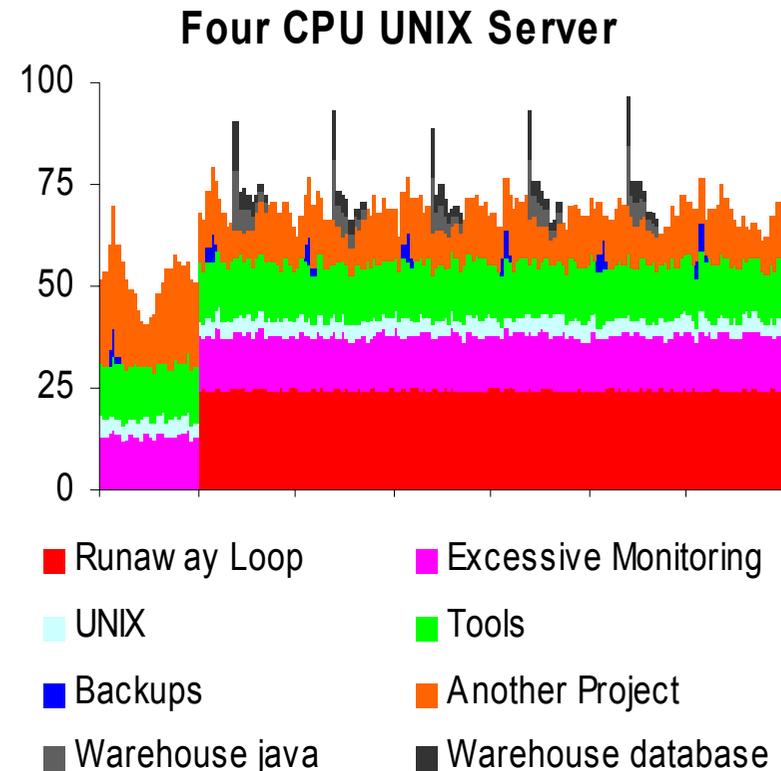
# Compelling Need For Upgrades

- The development group is requesting a huge new UNIX box and hundreds of PC upgrades to support their new warehouse system
- They offer these classic CPU charts of their benchmark week as proof



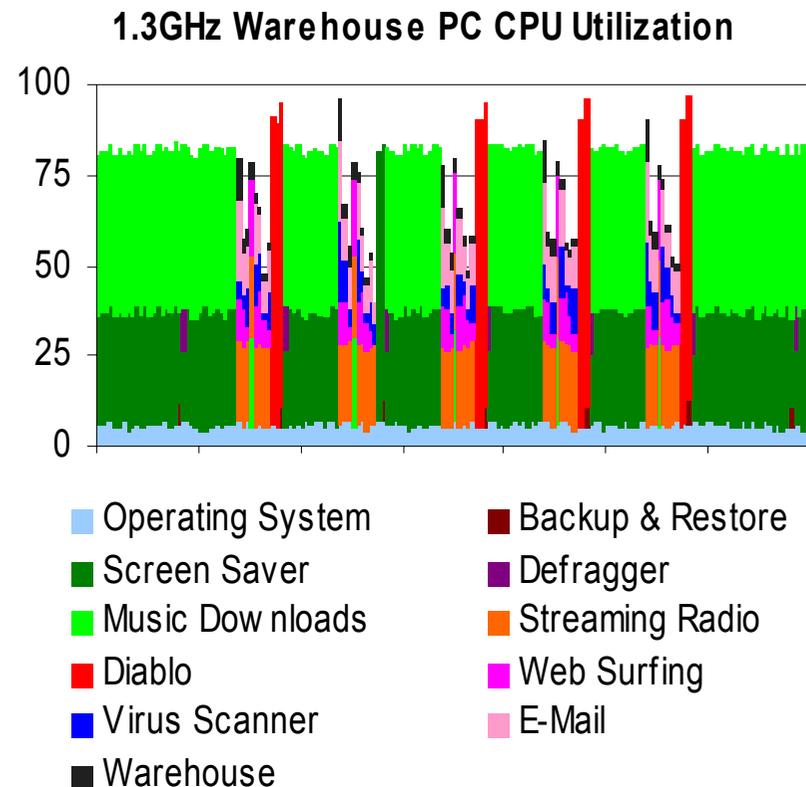
# Maybe Not So Compelling!

- The majority of the utilization on the benchmarked UNIX server has nothing to do with the warehouse project!
- Note:
  - Undetected runaway looping process
  - Excessive Tools processing
  - Another project is on the server!
  - Typically, naïve benchmark monitoring swamps real processing



# Maybe Not So Compelling!

- These developers are having a good time on that “warehouse” PC!
  - Note all the non-warehouse processing
  - Note how the nightly Diablo tournament takes Tuesday off to watch “Buffy”
    - Update, this has recently moved to Wednesday to see “Enterprise”



# Is That Realistic?

- Yes!
  - At least a third or more of my consulting engagements and studies of poor performance have found:
    - Excessive monitoring
    - Process pathologies (loop, ramps, etc.)
    - Presence of previously unknown “other resource consumers”
- All are invisible without workload characterized views of consumption!

# What Is Workload Characterization?

- A workload is just a grouping of resource consumers
- A workload can have zero, one or many processes and these processes are selected by criteria such as
  - process name
  - directory location
  - owner username
  - any other differentiator that you can reasonably imagine
- Workloads are constructed for a variety of reasons
  - Reporting
  - “What-if...?” modeling growth or hardware choices

# Workloads That Don't Work

- There is considerable “art” in workload characterization
  - Experience
  - Situational awareness
  - In-depth technical understanding of the specific operating system, database, infrastructure components and application design
- When people first discover workload characterization, they generally split into two camps:
  - Zealots
  - Minimalists

# Too Many Workloads

- Zealots
  - make too many workloads
    - Dozens
    - *Hundreds!*
  - Each node is judged “unique”
    - Many complex workloads with intricate criteria
      - Intricate workloads are brittle
    - “Special case mania”
      - The *same process* can end up *in different workloads* on different machines
    - These inconsistencies lead to:
      - Increased burdens on the audience
      - Confusion
      - Overburdened tools and capacity planning machines

# Too Few Workloads

- Minimalists
  - Are often in a hurry to “get graphs out as soon as possible”
  - Are typically under-trained or unaware of the power that historical views of workload characterized consumption data can provide
    - Wonder why we can’t just use “top” like we used to
  - Tend towards extremely broad workloads
    - Often based on usernames
    - At some point broad workloads aren’t much better than total CPU
  - Get little value for their efforts, and tend to stop

# Workloads That Do Work

- The advanced workload characterizer
  - uses consistent criteria to strike a balance between the two camps
  - Intricacy is used only when needed
  - broad, “sweeper workloads” are defined to minimize the clutter
- They also have a stronger weapon - consistency - that makes it easier on them and on the decision makers using their output
- Let’s explore some of their methods

# Beginning Hints

We will describe many good reasons to create specific workloads, but keep these general ideas in mind:

- Use “business based” workload names
  - If the database is used for warehouse functions, call the workload warehouse, not database
- Use normal business language and short names
  - Intricate technical names just confuse management
  - Speak business, not “computerese”
  - If you have to explain what the name means, pick another name!

# Beginning Hints

- Avoid defining “nit” workloads
  - Set a threshold (we use 2.0% - 0.5%), and determine that anything smaller is a nit that doesn’t deserve a unique workload
- Consider your audience and vary your workload characterizations accordingly
  - Basic workloads for daily reporting
  - More intricate workloads for accurate modeling and problem resolution

# Beginning Hints

- Anticipate the “next questions” and always answer them before being asked
  - The unanswered “next question” can be a huge time waster
    - Often a stall technique used by the politically astute
      - It raises temporary doubt in your findings, and builds their case for swift purchase, before you answer their question
      - Often a way for the old guard to show that they still are the “top dogs” to management
    - Impatient or frightened management might run off and buy something!

# Beginning Hints

- If you are going to shoot down someone’s hypothesis that lack of CPU was the cause of a problem, you’d better find out what really caused the problem before the meeting
- Your goal:
  - One meeting or phone call per issue!
- They may say “We just want a quick and dirty answer” but they never really do! Always cover:
  - CPU
  - Memory
  - Disk IO
  - Workload response time changes

# Beginning Hints

- Cultural differences are real and might affect your workload choices
  - Some cultures avoid direct blame or information that would cause someone to “lose face”
  - Any workloads are better than none
- Be consistent!
  - Always use the same groupings on all similar nodes
    - Use the same colors if you can!
  - Reduce the burden on your audience
  - Multiply the value of your workload creation efforts
  - Use consistent precedence order to decide where to put a process that meets the criteria to be in several different workloads

# Workload Types

- The Heavy Hitters
- The Usual Suspects
  - The “Must Have” workloads
- Sweepers
  - No Nits Allowed!

# The Heavy Hitters

- In every firm, there are usually a few well-known monster applications that receive the lion's share of the attention
- As a new capacity planner, you will often see these on the top of your "to-do" list
  - Major databases
  - Payroll applications
  - Integrated accounting automation
  - Customer analysis packages
- If the vice president's phone rings when there is a problem, it probably belongs on this list

# The Heavy Hitters

- Investigate...
  - Does consumption match up well with work done?
  - Are backups running at inopportune times?
  - Are there any “well intentioned” but now bloated “home-grown” monitors present
    - Is their output worth the cost?
- Lean towards zealotry with these
  - Often the effort to subdivide huge workloads into smaller parts will yield the answers to long-standing questions
  - There are often millions in savings available

# The Heavy Hitters

- Often have large “black box” components
  - Look for vendor supplied information to further subdivide consumption
  - Function counts
    - Find or create periods where only a single function is running, then divide to get function impact
    - Factor analysis
      - Keep a change history
      - Watch for noise!

# The Heavy Hitters

- Use recent data!
  - Small coding, database or file layout changes can have huge impacts
  - Solving the previous problem is no fun!
- Reinvestigate after all changes
- Question any processing that does not consume resources like the underlying business
  - Ramping consumption monitors

# The Usual Suspects

- Most firms deploy similar tools across all nodes of a given operating system
  - Monitoring tools
  - Consumption collectors
  - Disk Defragmenters
  - Security sweepers
  - Anti-virus products
  - Remote administration/access
  - Backup and Restore
- Most firms have well known rogues
  - Music downloads and streaming audio
  - Excessive web surfing on that speedy company LAN

# The Usual Suspects

- Some of them can bloat-up in resource intense ways
  - A memory leak or CPU intense bug in a common tool can ruin your whole summer
  - Get to know their peccadilloes
    - Automate detection and notification of their common issues
- Set a maximum budget for non-application code and manage to it
- Bonus answers:
  - Are you really backing up all the machines?
  - Are administrators still using insecure or banned applications?

# The “Must Have” Workloads

- Backup/Restore
- Tools
- Administration accounts
- Political workloads
  - Is the \_\_\_\_\_ department hogging the machine again?
- Heavy Hitters

# The Joys and Perils of Sweeper Workloads

- After you've characterized your major applications, usual suspects and infrastructure, what do you do about that pile of "nits"?
  - You make sweeper workloads!
- Take advantage of
  - user groups
  - naming conventions
  - regular expressions
    - Country-specific language patterns
    - `.*[Aa]dmin.*` works great in the USA
  - operating system specific common names

# The Joys and Perils of Sweeper Workloads

- Perils
  - Creeping innovation bloats your little sweeper
  - The blame game
    - “What did it” is usually more useful than “who did it”
    - Focus on the technical problem that you can solve
- Solutions
  - Keep sweepers small
    - Set a threshold, we use 5%
  - Use workload naming conventions to help you find your sweepers
    - `.*_logins`

# Time Stability

- Time Stability is a measure of the resilience of your workloads in the face of changes and entropy
- Workloads that remain consistent over long periods reduce the burden on your audience
  - They like it when “Tools” always means the same thing
  - Inconsistency limits your effectiveness
- Your time is a scarce resource
  - Lots of fiddling with workloads means less nodes serviced
  - Consistency eases automation efforts
  - Consistency helps you reduce the cycle time between “question asked” and “answer delivered”

# Time Stability

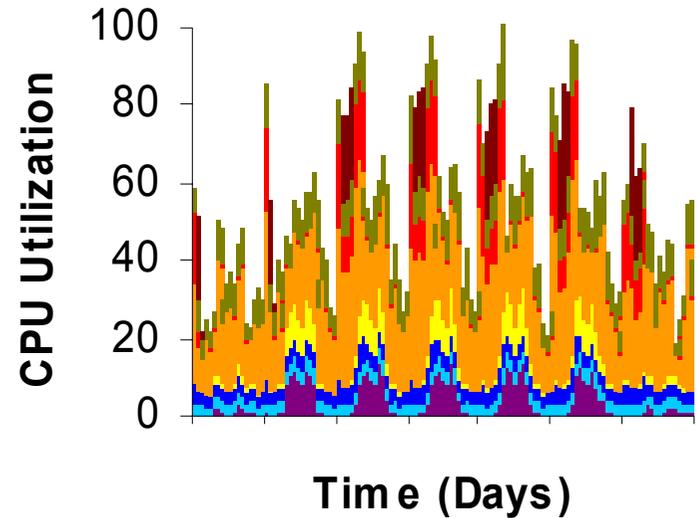
- Time stability will become even more important
  - Machine proliferation
  - Operating system proliferation
  - Increased overseas outsourcing
  - Increased use of purchased packages
    - No “in-house” developer expertise
  - Shrinking IS staff spread over more machines
  - You will be responsible for thousands of nodes someday very soon, if not already
    - There is simply no time to fiddle with twitchy workloads

# Using Workloads for Analysis

- Graphical methods
  - Workload consumption over time
    - Weeks or months, not just a day
  - Workload consumption versus Business Metric of Interest (BMI)
    - Vital to forecast an modeling accuracy
    - Need to validate consumption versus your Candidate BMIs (CBMIs)
- Automated methods
  - Pathology signatures
    - Friday morning, 8:00 AM “*Automating Process and Workload Pathology Detection*”

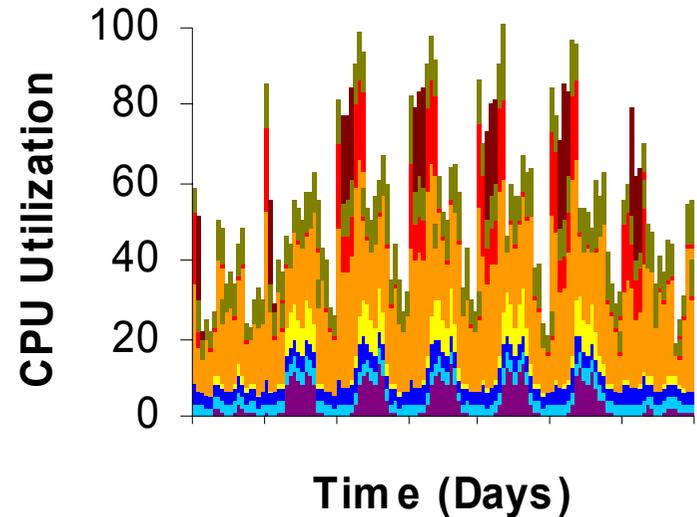
# Workload Consumption Over Time

- Great for seeing consumption patterns
  - Look for:
    - When are employees using the system?
    - When do Backups run?
    - Are there any troughs?
    - Are we monitoring ourselves to death?



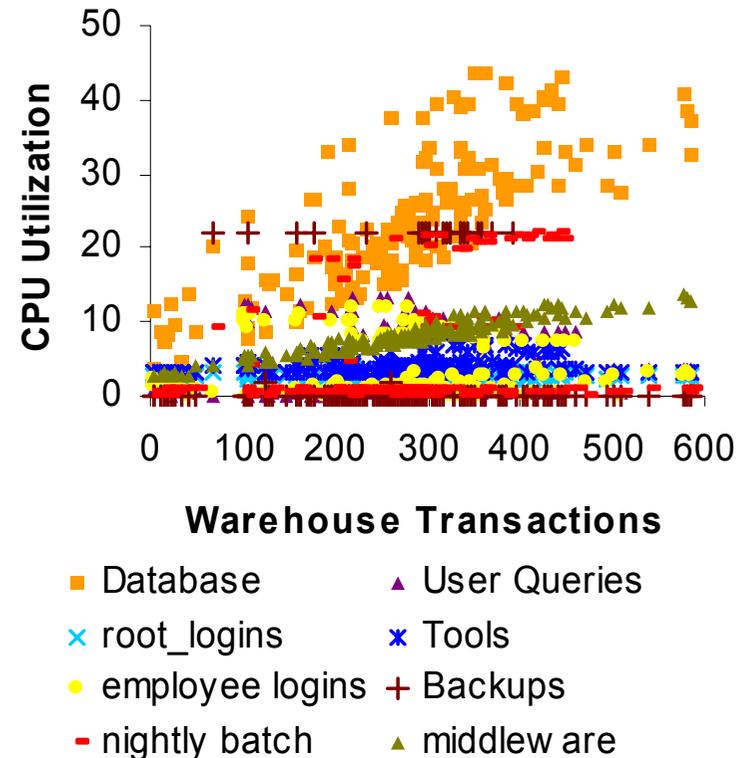
# Workload Consumption Over Time

- Look for:
  - Are there weekday versus weekend differences?
  - Are there “batch-like” functions present?
  - Do some workloads rise when others appear?
    - Database
    - Nightly batch
    - Backups
    - Users



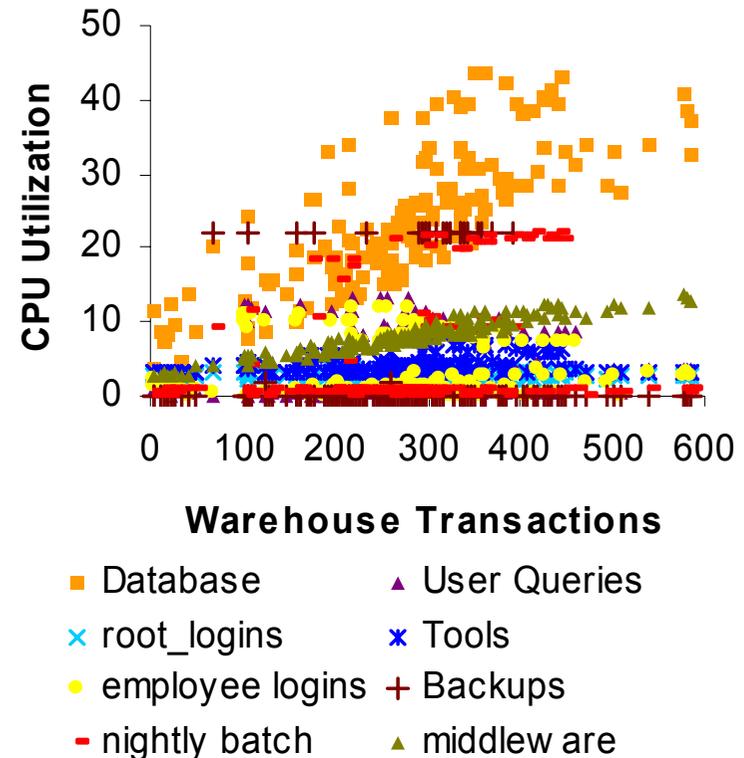
# Workload Consumption Over Business Metric

- Great for seeing what consumption follows your CBMI
  - And what doesn't!
- Look for:
  - Static workloads whose consumption appears as a horizontal line
    - Backups
    - Tools
    - Parts of nightly batch?



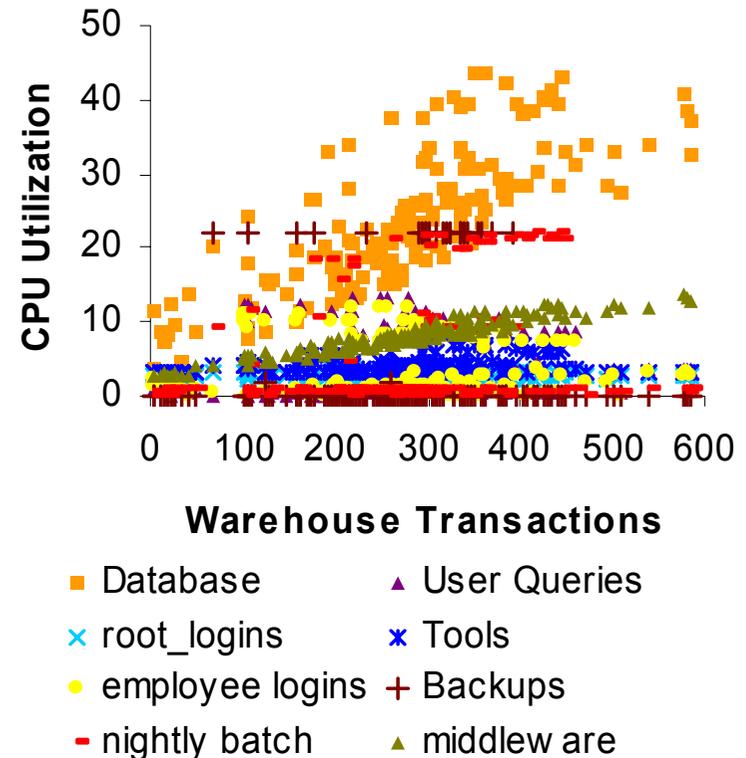
# Workload Consumption Over Business Metric

- Look for:
  - CBMI related workloads whose consumption appears as a rising line
    - Database
    - Middleware
    - Interesting if you are planning to grow this system, aren't they?



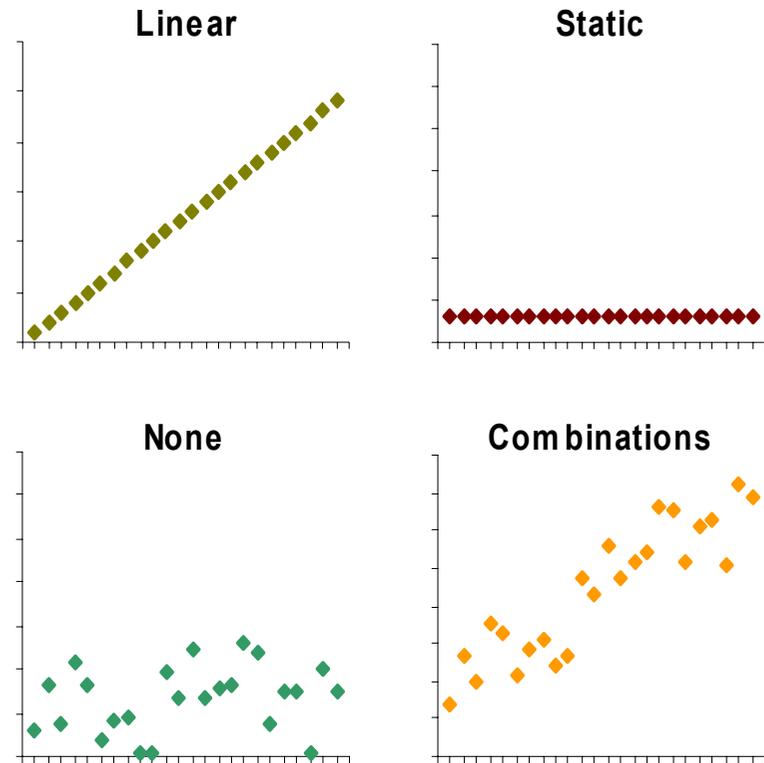
# Workload Consumption Over Business Metric

- Look for:
  - Workloads that aren't either static or CBMI
    - Undiscovered CBMIs?
      - Workloads involving human activity
        - » Employee logins
  - Are you adding people?



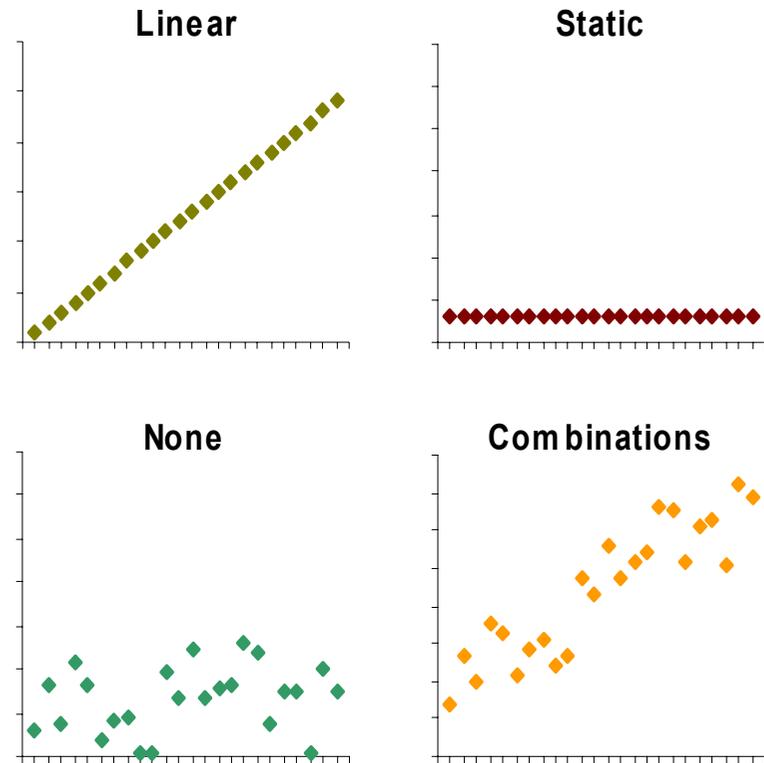
# Workload Consumption Over Business Metric

- The three basic patterns:
  - Linear
  - Static
  - None
  - Combinations
    - Most workloads are combinations



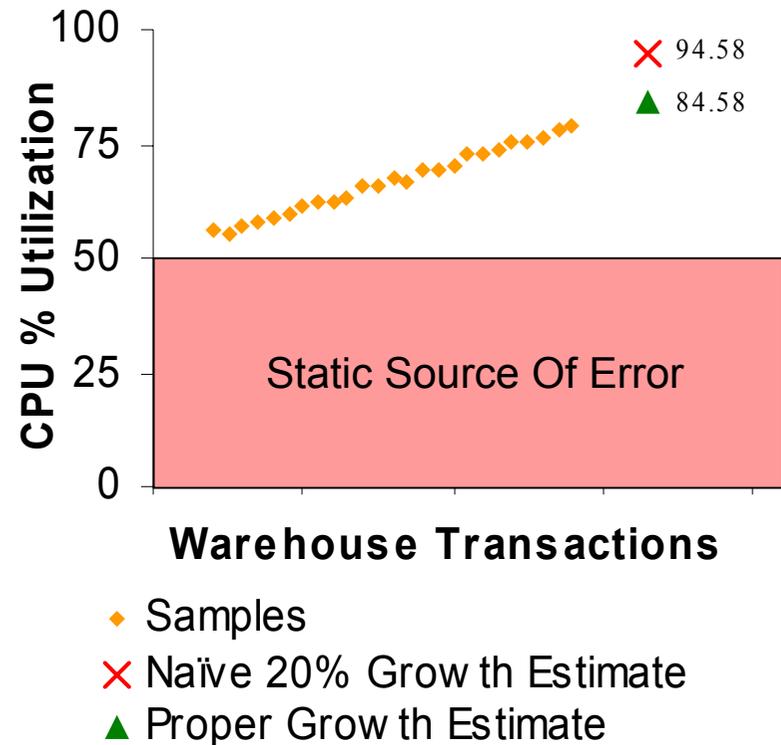
# Workload Consumption Over Business Metric

- Why care about the three patterns?
  - Validate your CBMIs
  - Improve your workloads
    - Watch out for that y-intercept!
    - The zero CBMI test
    - Increase accuracy, split workloads into:
      - Static
      - Linear



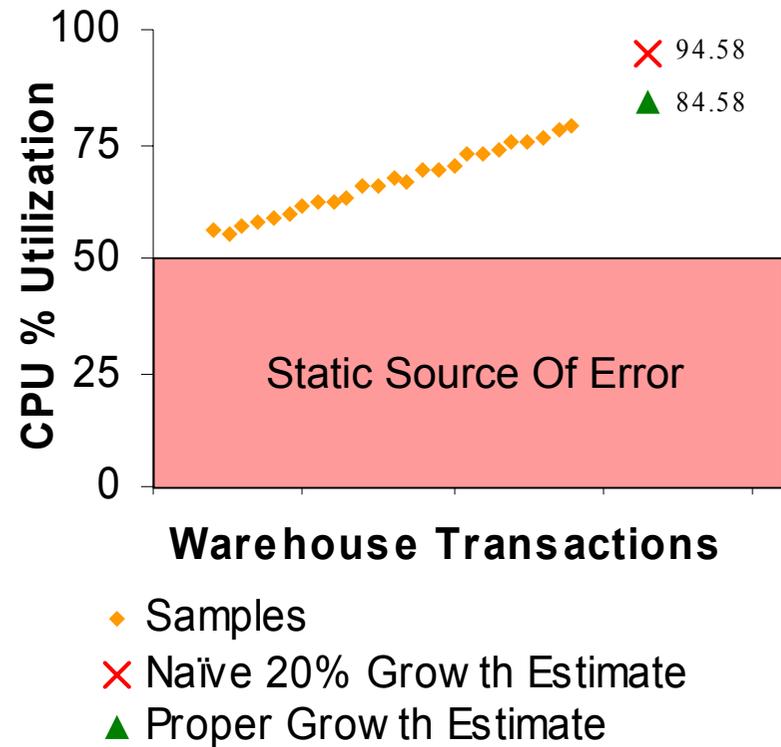
# Extra For Accurate Modelers

- The Naïve Growth Trap
  - Lets add 20% more accountants and warehouse transactions
- Naïve growth:
  - Highest point times 120%
  - $79.79\% \times 1.2 = 95.78\%$
- Workload growth %
  - $(95.78\% / 79.79\%) = 20\%$
- *Wrong!*



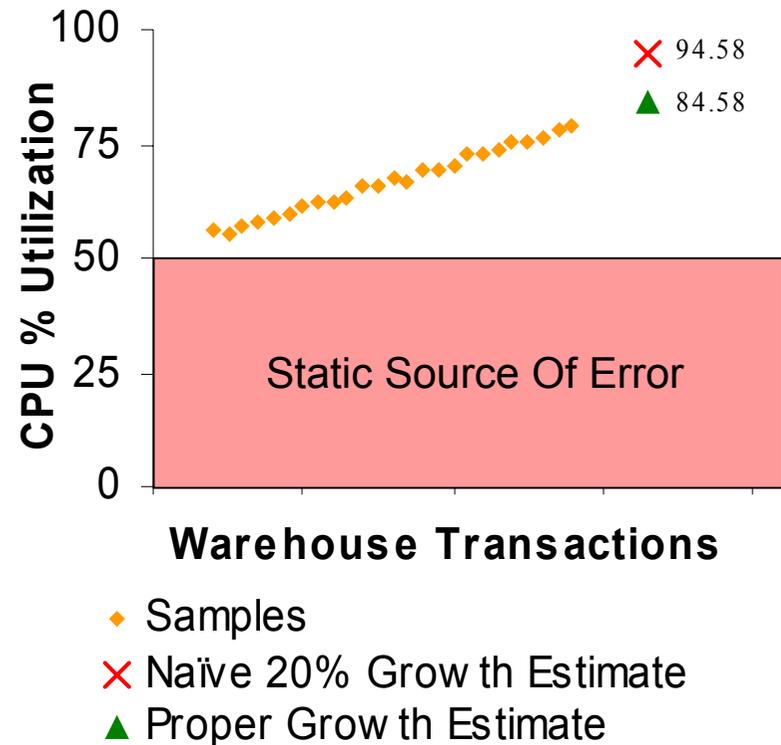
# Extra For Accurate Modelers

- Accurate modelers remember that all workloads can have:
  - Linear components
  - Static components
- Accurate growth:
  - Linear component times 120% plus unaltered static component
  - $29.79 \times 1.2 + 50 = 84.58\%$
- Workload growth %
  - $(84.58\% / 79.79\%) = 6\%$
- Correct!



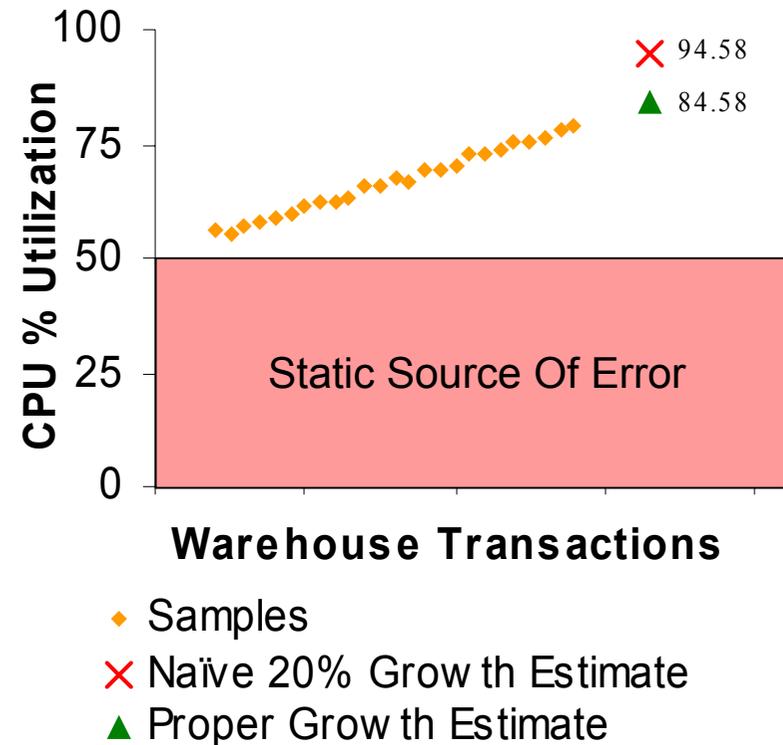
# Extra For Accurate Modelers

- The Naïve Growth Trap is very common
  - When you don't graph versus BMIs
  - When your workloads contain static components
- Precise modeling tools will give the wrong answers if you use incorrect growth estimates



# Extra For Accurate Modelers

- Other issues
  - Dealing with inevitable fuzziness
  - Deciding between CBMIs
- Want more detail?
  - Friday morning, 10:30 AM  
“*Business Metrics and Capacity Planning*”  
coauthored with Yiping Ding

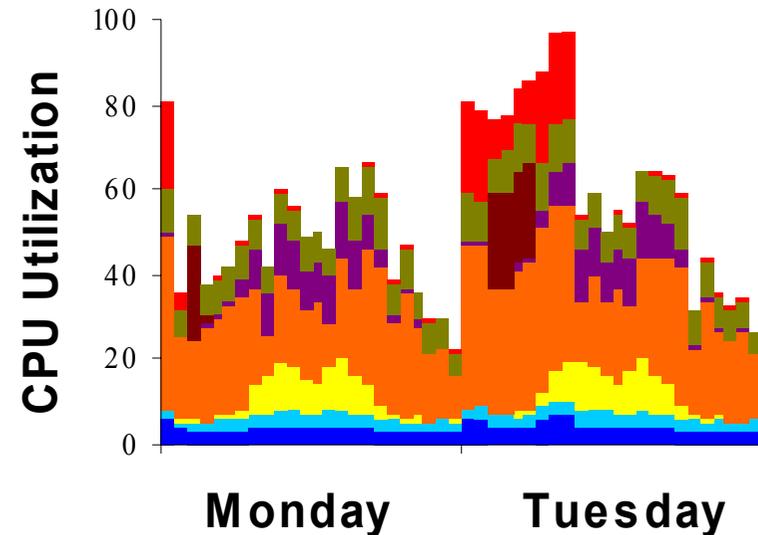


# Using Workloads to Solve Problems

- Accountants are unhappy with performance on the warehouse system Tuesday through Friday mornings
  - Management reports late
  - Response times double
- Monday mornings are fine
  - Maybe because of lower weekend warehouse volume?
- Hardware vendor is proposing a \$350,000 server as the solution

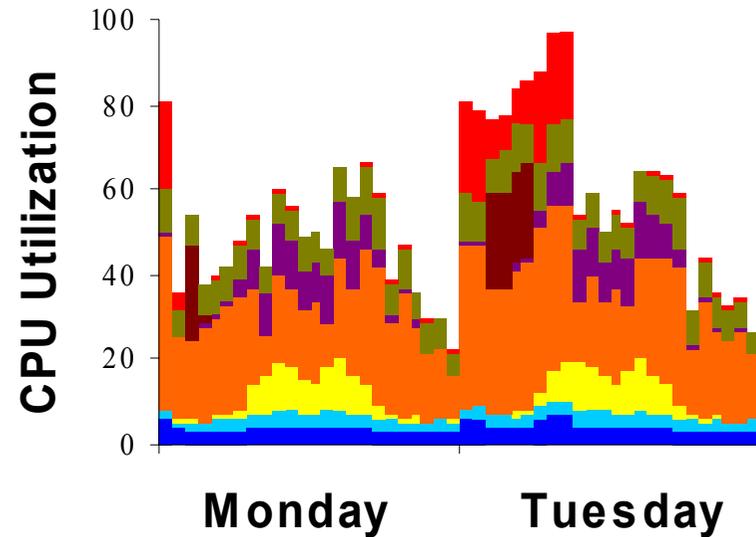
# Using Workloads to Solve Problems

- Examine a day when they are happy (Monday) and a day when they are not (Tuesday)
  - What is different?
- Monday:
  - Nightly batch finishes in an hour
  - Backups run at 3 AM
  - No Batch and Backup contention



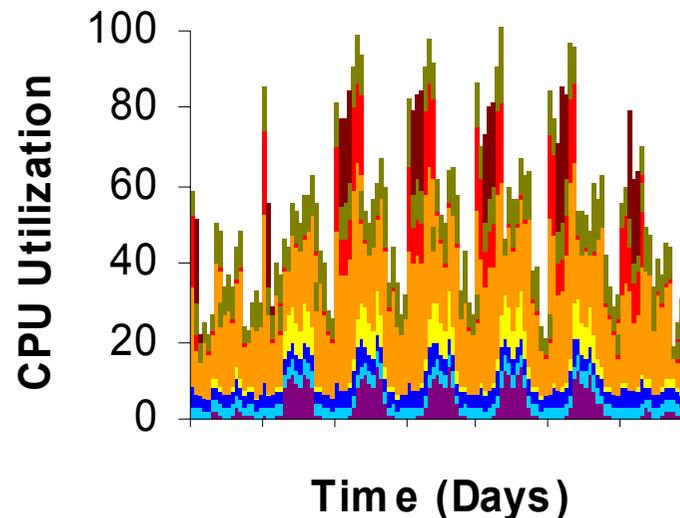
# Using Workloads to Solve Problems

- Tuesday:
  - Nightly batch runs much longer
  - Backups run much longer
  - Batch and Backups are fighting for the same IO bandwidth
  - The accountants poor morning response is due to contention with nightly batch running late
- There is a big empty trough just before the busy period...



# Using Workloads to Solve Problems

- The Tuesday pattern repeats over the next three problem days!
- Why can't we move the backups to the trough?
  - No more IO contention
  - Key backup data (day's warehouse transactions) are present after 7 PM
  - Nightly batch will end before the accountants arrive!
- *We don't need a \$350,000 upgrade! We need to move the backup start time!*



# What to Look for in Vendor Products

- Ask your vendor how you can subdivide consumption. Favor vendors that can characterized consumption:
  - by username
  - by process name
  - by command line parameters
  - by directory
  - Using regular expressions
  - in AND combinations of the above
  - in OR combinations of the above

# What to Look for in Vendor Products

- Ask to see examples of workload characterized CPU consumption over large spans of time
  - Days
  - Weeks
  - Months
- Make sure that workload characterization can be done after the data is collected
  - Otherwise, you are stuck with your first guess

# What to Look for in Vendor Products

- Ask to see examples of workload characterized CPU consumption
  - Don't settle for total CPU
  - On \*NIX, don't settle for "sar" CPU components
    - We want to make business workloads, %SYS and %USR hardly ever helps solve a business issue
- Ask to meet their other customers
  - They are probably sitting next to you!
  - CMG is a great place to do it!
  - Have dinner with someone here that you don't know...

# What to Look for in Vendor Products

- No vendor is perfect, but there are some great ones out there!
  - Compare talent, commitment and technical excellence
  - Great support and continuing technical improvements are expensive
    - Be willing to help pay for it!

# What We Wish Vendors Would Provide

- The Über Workload
  - Multi-level groupings of workloads
  - Less detail for general reporting
  - More detail underneath when you drill in
  - Great for post-consolidation nodes
- This OR That
  - Boolean OR relationships could reduce the number of workloads needed to describe certain business functions

# What We Wish Vendors Would Provide

- “Generate On Demand” Web Graphics
  - Traditionally we’ve had “do all ahead” graphics
    - Nightly race to make morning reporting
    - Few nodes actually ever examined
    - Huge graph files, large consumption to produce them
  - Modern web technologies like CSS and XHTML make this much more practical
  - Multiple output formats supported
    - Screen
    - Print
    - Handheld

# What We Wish Vendors Would Provide

- Workloads That Apply To All Nodes
  - Most products create/apply/store workload information in the context of a single machine or small set of machines
  - Maintaining consistency as workloads evolve is hard for humans
  - Consider workloads that apply to all nodes of a given operating system
    - We use operating system based default workloads on new machines until we get a chance to look at them

# What We Wish Vendors Would Provide

- Workload Color Consistency
  - All the graphs in this presentation have consistent colors
  - All the workloads your viewers see should too
    - Once they know that brown means backups, the next time they see brown, they already know what it is
  - Colors should be assigned at workload creation
  - If an application spans many nodes
    - If the same workload on each node is the same color, meetings go well
    - If not, try to explain why the pink workload here is the green workload there and the puce workload there...

# What We Wish Vendors Would Provide

- Use more colors!
  - The “web safe” pallet of 256 colors does not allow uniqueness in environments of thousands of nodes
  - Modern browsers and machines support millions of distinct colors, use them!
  - Calculate color pallets to account for common forms of color blindness
    - Many men are at least partially color blind
  - The limitations of the 1990s should no longer restrict us today

# What We Wish Vendors Would Provide

- Make it easier!
  - Automate
  - Make libraries of common application workloads (and hopefully BMIs)
    - 85% of WINDOWS machine workloads are always the same
  - If BMIs are available, how about pre-calculating accurate growth percentages for us?
  - Add more graphics to the modeling tools
  - Automate precedence order choices via rule sets

# Summary

Workload characterizations are incredibly powerful ways to increase the information quality available to decision makers. Whether you use a commercial product, or you program a solution yourself, you owe it to your audience to provide the power of significant, consistent, and business relevant characterized consumption views.

We look forward to large-scale innovation and improvements in workload characterization and reporting technologies in this decade.

# Questions?

Have a Great CMG!