IBM Systems and Technology Group

TCO: Comparing System z and Distributed Environments

Building the Business Case

Session 9265

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Objective - Level the playing field

- Datacenter Reality

- Defining the RULES for the TCO Business Case
  - select the application
  - determine the configuration
  - size the workload
  - size the support organization
  - quantify the QoS requirements
  - determine the incremental TCO

- Customer Studies
  - Cross Platform - i, p, x, z
  - Very Large Unix versus zSeries

Reality: Common customer profile

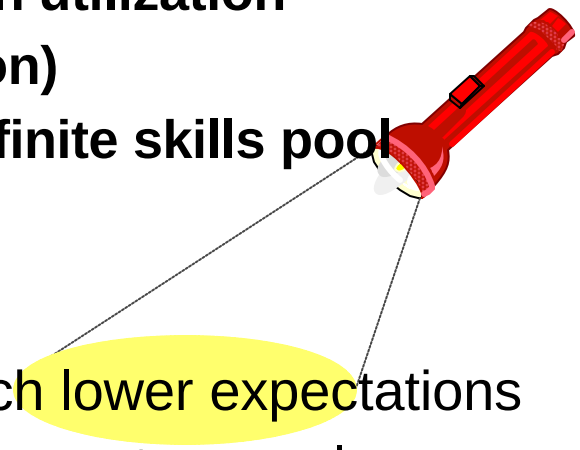
Mainframe

Well managed - SLAs, metrics & controls

Rock solid QoS - high utilization

Expensive (perception)

Limited or No R&D - finite skills pool



Unix & Intel

Well managed? - much lower expectations

Good QoS - showcase systems only

QoS unknown - most systems

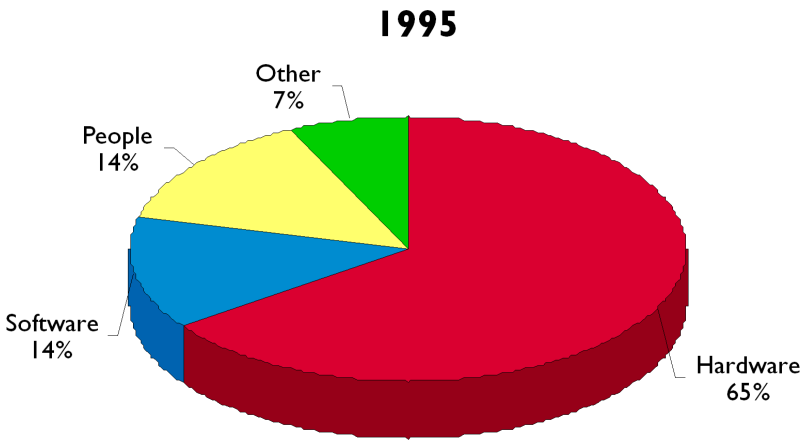
Heavy R & D - decentralized

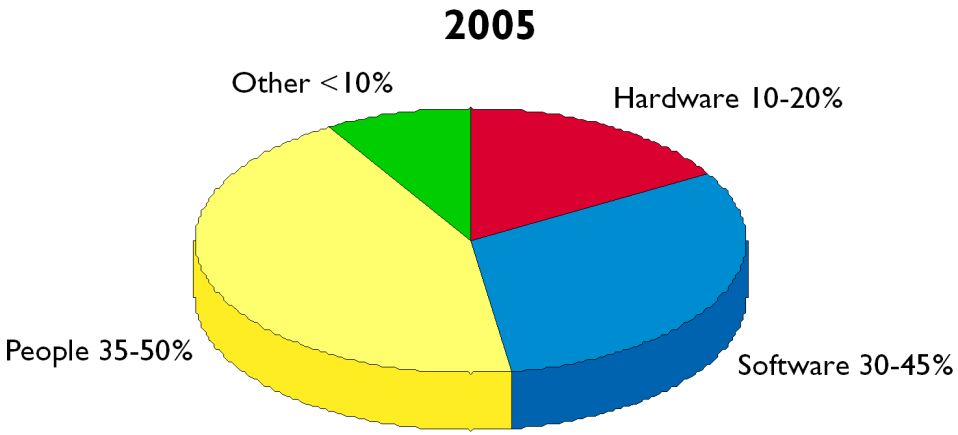
Inexpensive (hardware)

Proliferation of servers & non-infrastructure staff

High TCO (reality)

Reality: The changing IT expense profile





People expense has tripled as a %

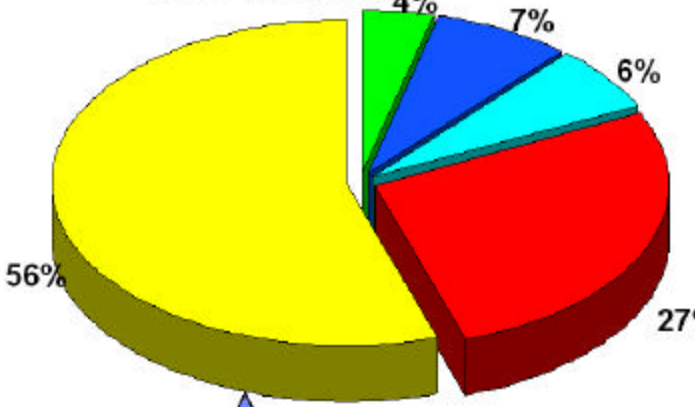
Software expense has doubled as a %

Hardware is less than 1/3 of its original %

Reality: The costs differ by architecture

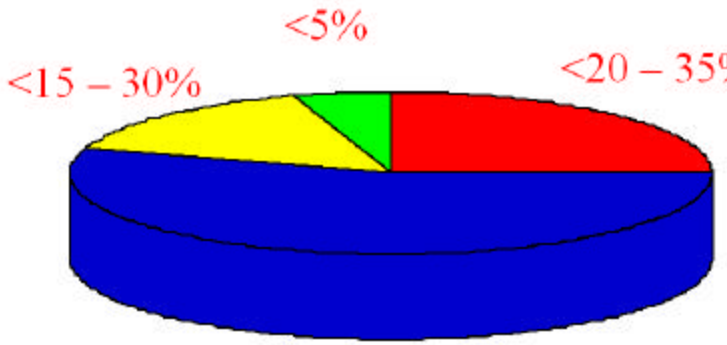
These are typical customer examples

Windows



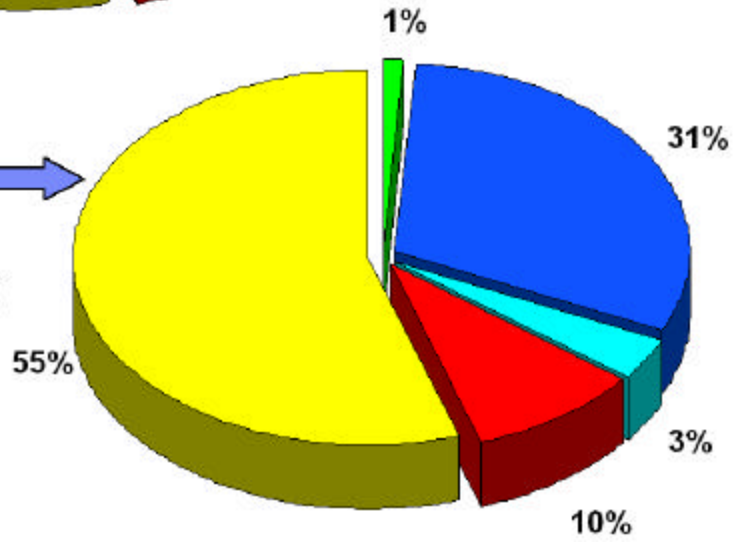
Sum of power pa
Sum of SW pa
Sum of SW pCPU pa
Sum of HW Mnt pa
Sum of Mgmt pa

Mainframe



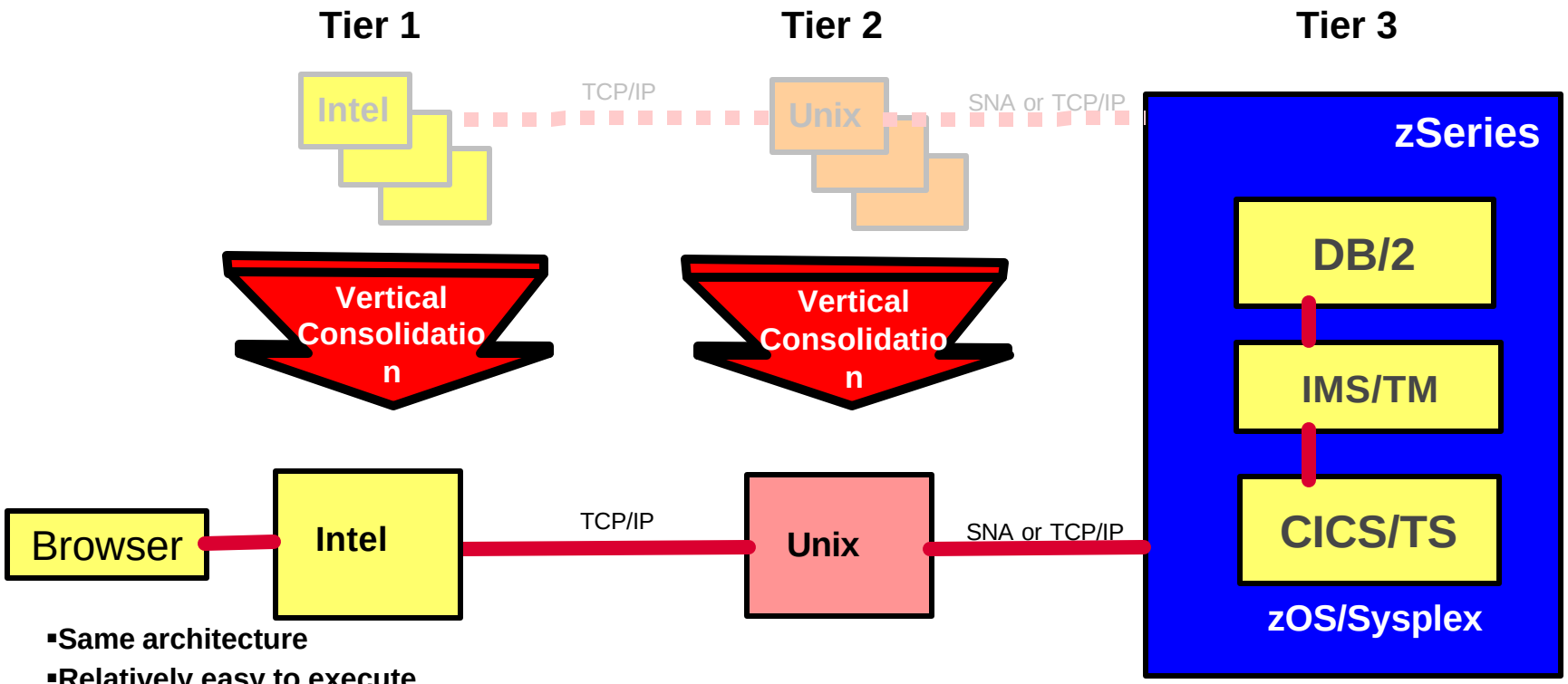
The key is people

Unix



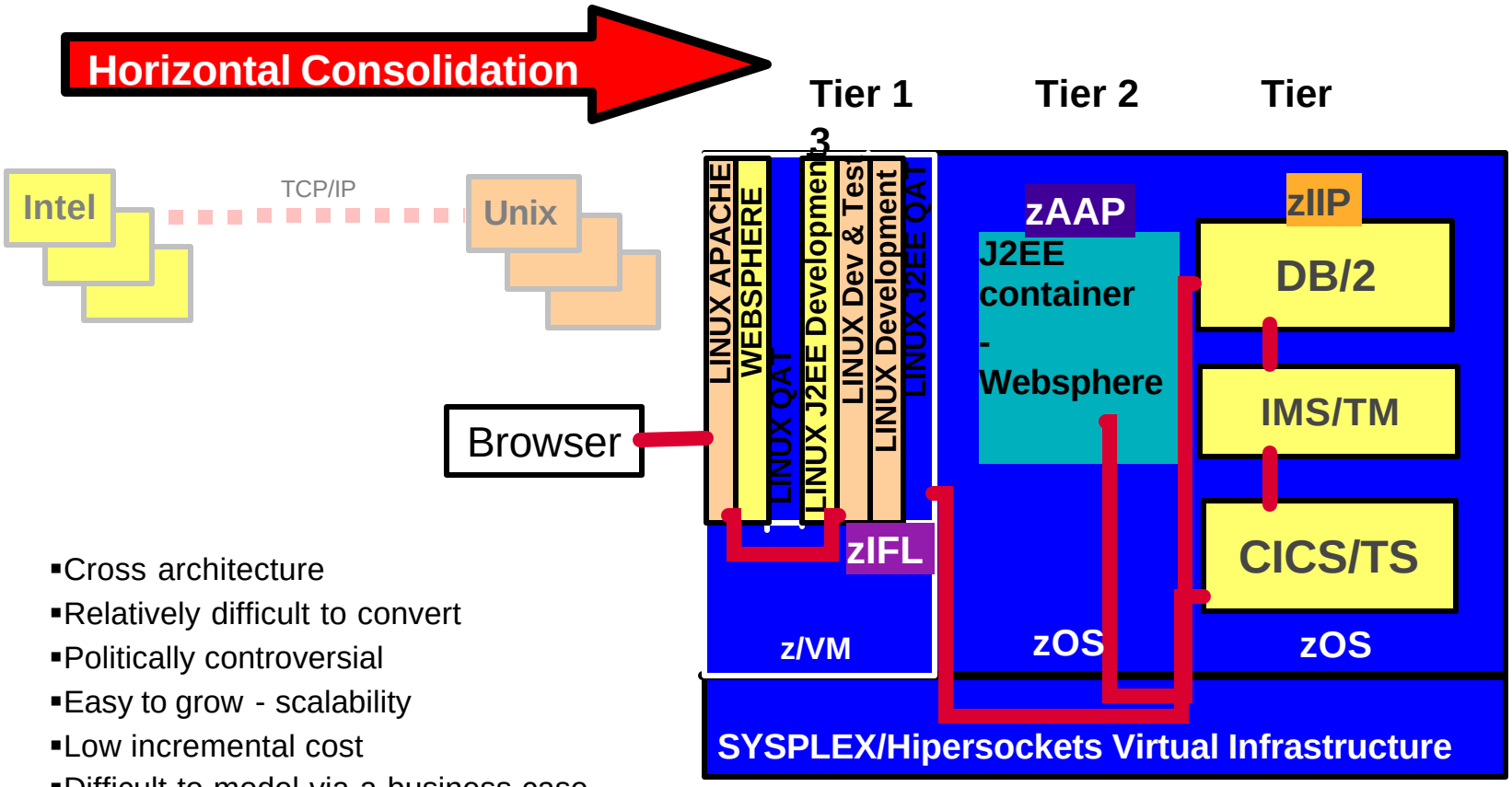
Sum of power pa
Sum of SW pa
Sum of SW pCPU pa
Sum of HW Mnt pa
Sum of Mgmt pa

"Vertical" server consolidation - the c/s model



- Same architecture
- Relatively easy to execute
- Politically acceptable
- High incremental costs
- Very easy to model in a business case
- May perpetuate existing issues - does not necessarily reduce complexity, only numbers
- Implements newest technology - improved price/performance, and better environmentals
- Rolls the inventory - vendors like it, users like it, technical staff likes it
- Often becomes a "process" - will have to be done again in months to years, especially in high growth areas
- Relatively small savings
- Does not require much assessment or incremental analysis

"Horizontal" server consolidation - the System z model



- Cross architecture
- Relatively difficult to convert
- Politically controversial
- Easy to grow - scalability
- Low incremental cost
- Difficult to model via a business case
- Implements newest technology - improved price/performance, and better environmentals
- May or may not roll the inventory, but vendors like it since it represents a long term committment
- Users may not like it since it represents a shared environment which may be “different”
- Often done as a decision "event" - the strategy is set and need not be considered again
- Can eliminate whole layers of infrastructure, potentially large savings - especially if executed on the lowest cost architecture

Building the TCO Business Case

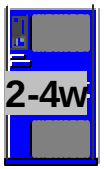
- Defining The Rules for Comparing Different Solutions

1. **Selecting an application(s)**
   - Is this a study or a targeted effort?
   - Existing infrastructure is a major consideration/opportunity
2. **Like-for-like configs**
   - Application, database, middleware
   - QA, failover, DR, development, test, and infrastructure servers
3. **Useable capacity/utilization * Important z characteristic**
   - Significantly different by platform and application (zAAP)
   - Accommodate peaks with WLM, IRD, and oD/VE features
4. **Cost of support staff * Important z characteristic**
   - Doubling Unix and NT servers usually means "almost doubling" staff
   - Add System z extra capacity with minimal incremental people
5. **Cost of outage (QoS) * Important z characteristic**
   - Unscheduled, scheduled, catastrophic
6. **Incremental cost analysis**
   - Incremental costs are usually much lower than full costs
   - **System z ~20%-25%, Unix & Wintel ~ 60%**

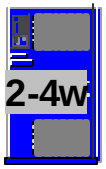
Application Selection

- **What is "the" critical application environment?** (a targeted effort)
  - Production
    - Database server? How many?
    - Application server? How many?
    - Messaging server? How many?
    - Failover servers? For each?
    - Dedicated infrastructure servers? What and how many?
  - Additional Servers
    - Development servers? Multiple levels?
    - Test servers? Multiple levels?
    - Systems test? Multiple levels?
    - Quality Assurance servers?
    - Training servers?
  - Disaster Recovery
    - Do you have a DR site?
    - Do you have a DR contract? $$?
- **What applications/types of workload do you have?** (a study)

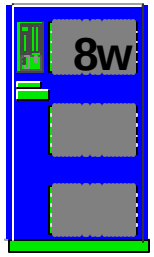
Application selection: e-business App



Web/App



Messaging



Database

Hardware

- 3 primary production servers
- purchase, 4 year life, plus maintenance

Software

- 8+ processors for database SW
  - ~ $450k for 3yrs

Management

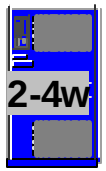
- FTEs per Server on Average
  - ~ better than Gartner @ 25/FTE

QoS

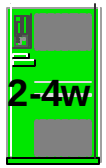
- Response, Reliability, Recoverability all "good"
- Utilization over 50% on average

System z will not win in a situation that down-plays it's operational strengths.

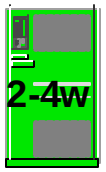
Like-for-like Configs: e-business App



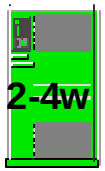
Web/App



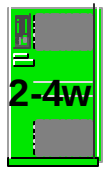
App F/O



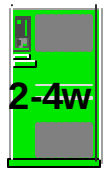
Development



Test

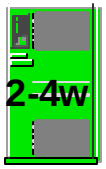


Web/AppD/R & QA

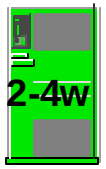


D/R F/O

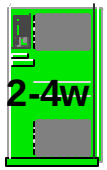
Messaging



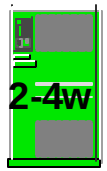
Messaging F/O



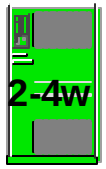
Test/Education



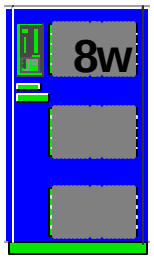
Integration



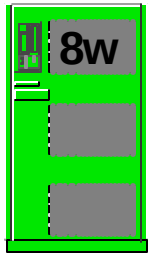
Messaging D/R & QA



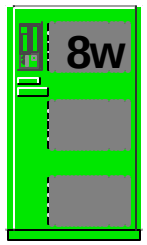
D/R F/O



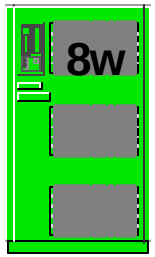
Database



Database F/O



Database D/R & QA



D/R F/O

Hardware

- 3 primary production servers
- 16 total servers **5:1 ratio**

Software

- 32+ processors for database SW
  - ~ **$1.8M for 3yrs**
- 15+ processors for application SW

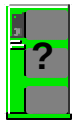
Management

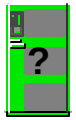
- FTEs per **Application Environment**

QoS

- Response, Reliability, Recoverability
- **Low utilization, untested DR**

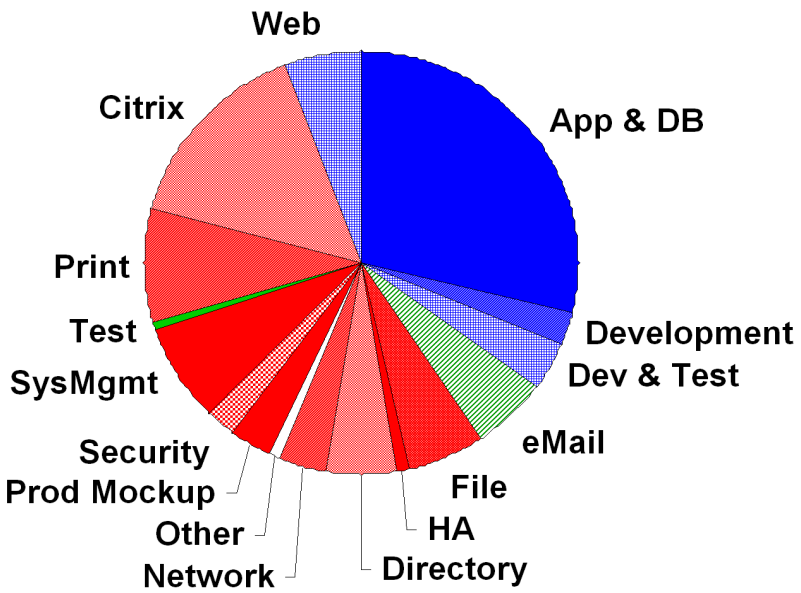
but if we look at the whole picture...



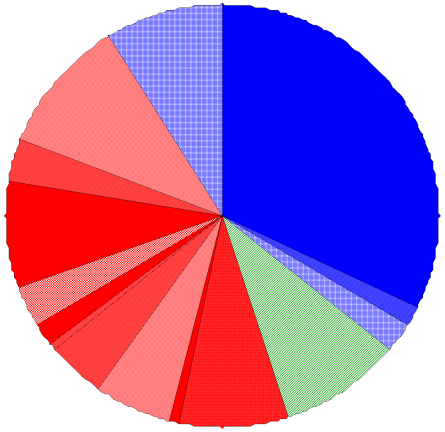


All servers - Include all the piece parts!

Count



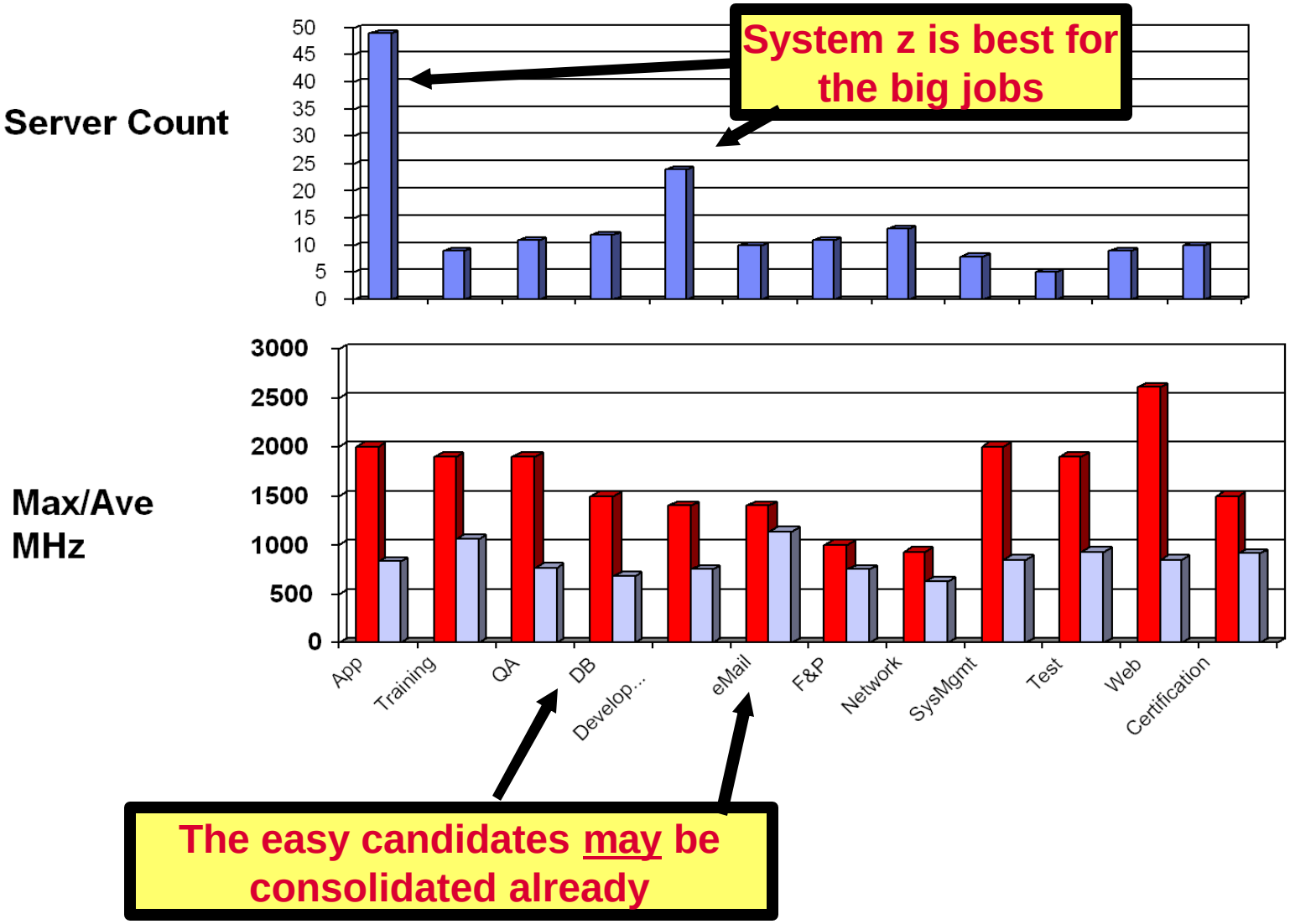
RIPs



On average, only 1/3 of RIPs are dedicated to Application/Database serving role.

* RIP is a relative unit of transaction processing workload that is valid within the scope of this study only. It cannot be directly equated to commercial benchmarking workloads or ratings.

All Servers - or pick the low hanging fruit

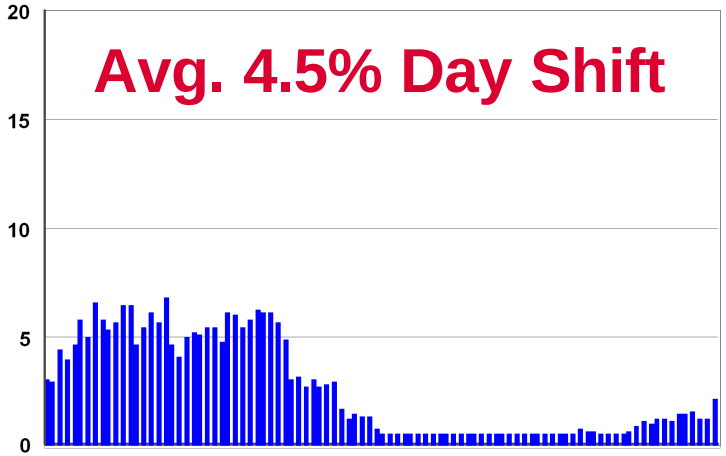


Workload sizing: Why is utilization low?

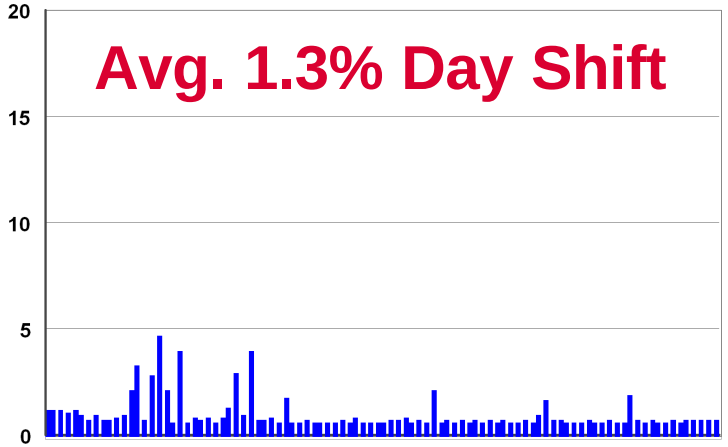
- One APP/One BOX mentality
  - 2.67 GHz is the slowest you can get
  - Supersize it and forget it - hardware is cheap
- Inadequate tooling and/or understanding
- Backup, development, test, training and integration servers
- Peaked, spiky workloads on dedicated hardware
- I/O Bound workloads, contention
- Vendor ROTs are low to avoid system stress and outages
  - This is changing
- Backlevel systems
- Incompatible release levels
- Incompatible maintenance windows

Workload sizing: Windows Customer Example

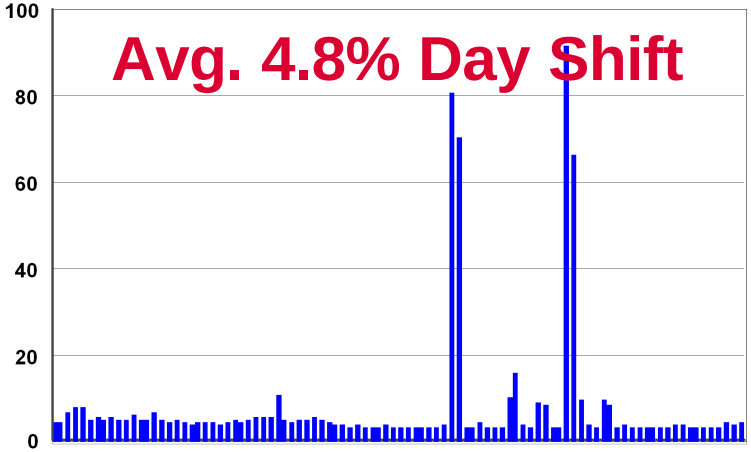
Prod App Server 4-way



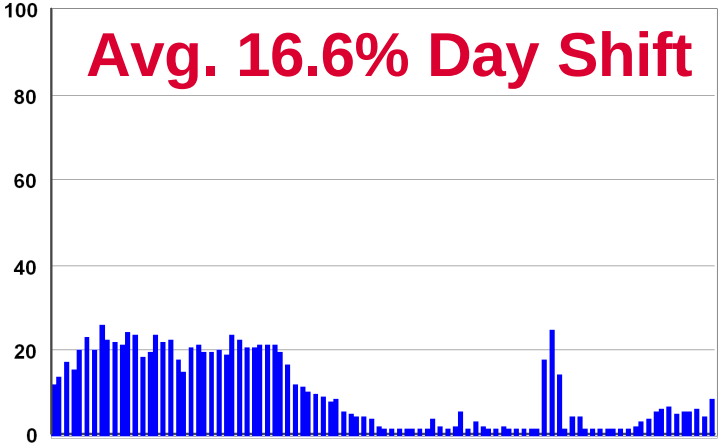
Prod Infrastructure Build Server 1-way



Prod Exchange Server

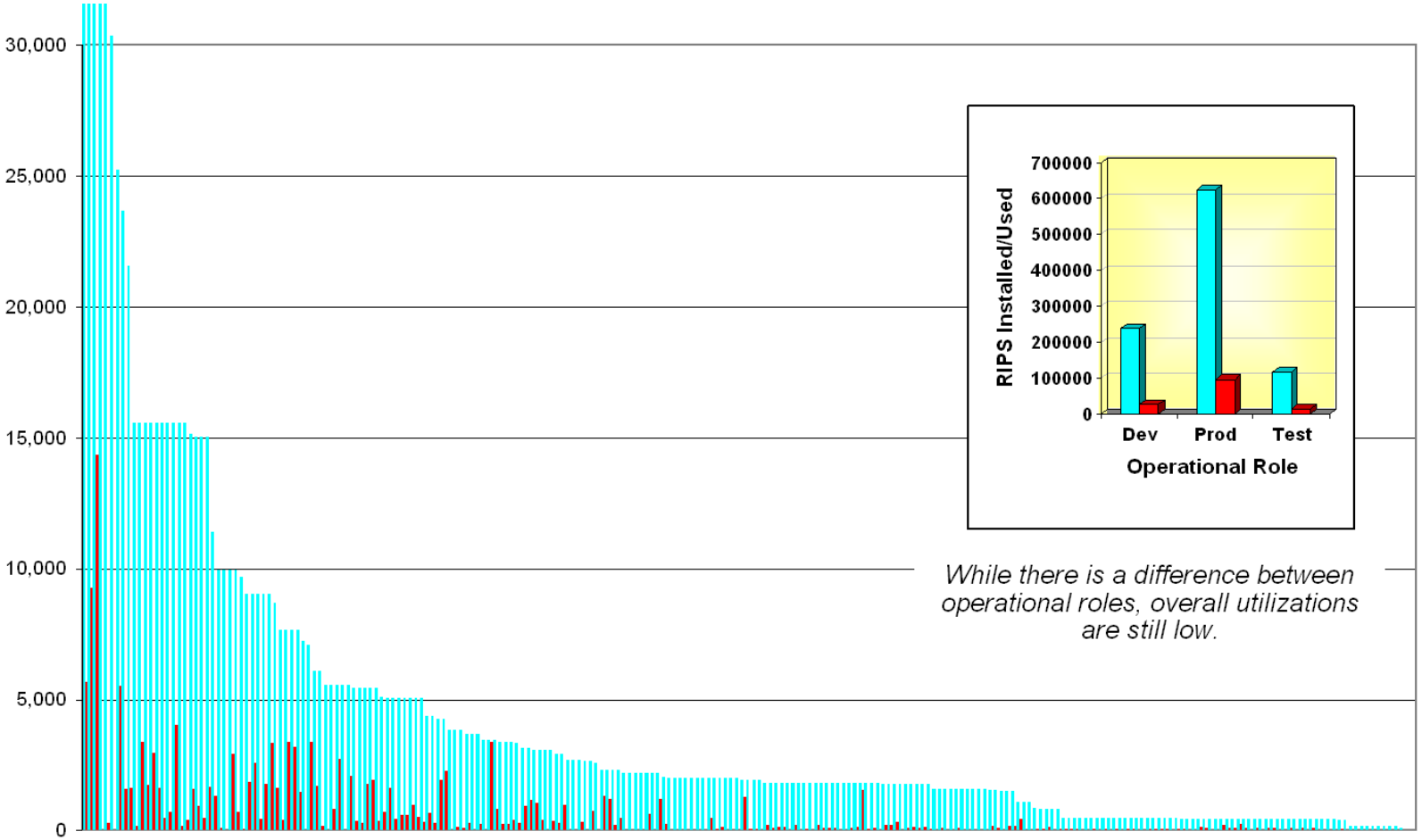


Prod SQL Server - 4-way



*these measurements are from 08:30am 24th to 08:15am 25th

Workload sizing: Management does not know how bad it is



While there is a difference between operational roles, overall utilizations are still low.

Relative Internal Performance is a cross-architecture capacity estimate. It is intended to be used only within the context of this study and cannot be compared to external benchmarks or other IBM performance ratings. Load or Used RIPS is the product of estimated utilization and RIP per instance for all 250+ server instances. Mainframe CPs are not included.

Gather data needed for the GOTO environment.

- System z assumption: z/OS is a robust operating system managing a shared pool of resources with some lower priority workload that can be pre-empted for short bursts of activity so...
- Gather prime shift, simultaneous one hour peak utilization across ALL machines in the configuration or environment
- OR...
- Select workload types that are appropriate for System z (zAAP/zIIP,IFL)
- Have clear expectations: (prime shift average utilization)
  - Intel = 7% (higher for SQL, Exchange, Citrix, and VMware)
  - Unix = 20% (higher for Oracle, Web, and pLPAR)
  - System i = 50%
  - System z = 85%
- Take the data assume 4:1 peak-to-average ratios and 2:1 peak overlap ratios
- Choose an appropriate workload translation factor (zAAP will change)
- Convert to MIPS and configure

Cost of Support Staff:
The support roles differ between platforms.

IT Infrastructure Support Roles: Development vs. IT Staff

Development / Support TASK	Distributed Wintel	Centralized Wintel	Unix	Linux	AS400	MF
User needs analysis	D	D	D	D	D	D
Application design & Analysis	D	D	D	D	D	D/S
Middleware needs analysis	D	D	D	S	D/S	S
Software selection and analysis	D	D	D	S	D/S	S
Hardware selection and analysis	D	D	D/S	S	S	S
Hardware sizing and configuration	D/S	D/S	D/S	S	S	S
Hardware installation	D/S	S	S	S	S	S
OS implementation & maintenance	D/S	S	S	S	S	S
Ongoing software maintenance	D/S	D/S	D/S	D/S	S	S

"The xClient IT cost model does not include some tasks that are performed by Development staff. "

The IT Budget is $142 million with a staff of 597 employees (including contract workers).

($ Millions)

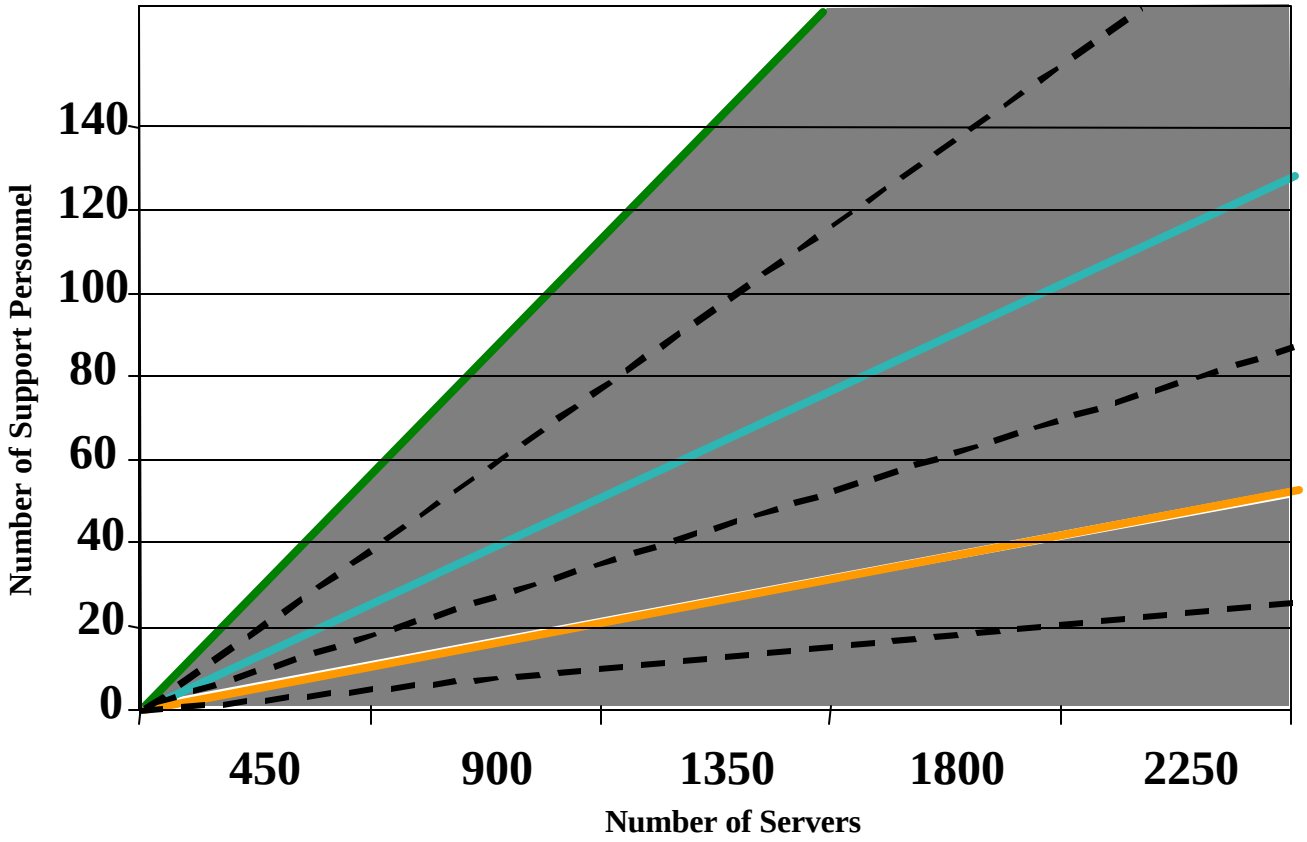
Operating Expenses

Full Time Equivalents (FTEs)

Service Category	Initial Allocation	Revised Allocation	Initial Staff Allocation	Revised Staff Allocation	SCORPION Averages
Mainframe	**39.4**	**39.4**	**83.3**	**72.9**	**60-100**
Unix	**0.9**	**1.2**	**6.0**	**7.1**	**14-23**
Intel	**11.1**	**14.7**	**47.9**	**79.2**	**115-231**
AS/400	**1.6**	**1.1**	**3.4**	**2.9**	**2-4**
Storage Management	12.1	13.2	20.3	24.1	
High Volume Print	4.4	6.6	24.3	42.4	
Desktop Support	11.2	15.4	106.6	131.7	
Help Desk	2.2	2.8	32.0		
Data Network	15.5	17.6	38.6		
Voice Network	7.0	8.0	20.1		
eMail	1.6	2.1	10.7	12.4	
Internet	2.5	3.1	13.9	16.5	
Other – IMT	1.1	1.4	5.0	6.0	
Out of Scope	12.4	15.5	90.5	99.4	
Overhead	19.1	0	75.4	0	
TOTAL	**142.1**	**142.1**	**578.0**	**597.0**	

This delta will make or break a TCO. Get it right!

Wintel Server Management: Staff Efficiency



Un-Cloned

Great diversity in number of operating system versions, applications and usage. Limited or no automation in server replication.

Cloned/Virtualized

Limited diversity in number of operating system versions, applications and usage. Some automation in server replication.

Super-Cloned

No diversity in number of operating system versions, applications. Limited diversity in system usage. Server replication is automated.

Cost of Support staff:
Use the right "Servers per Person" for TCO

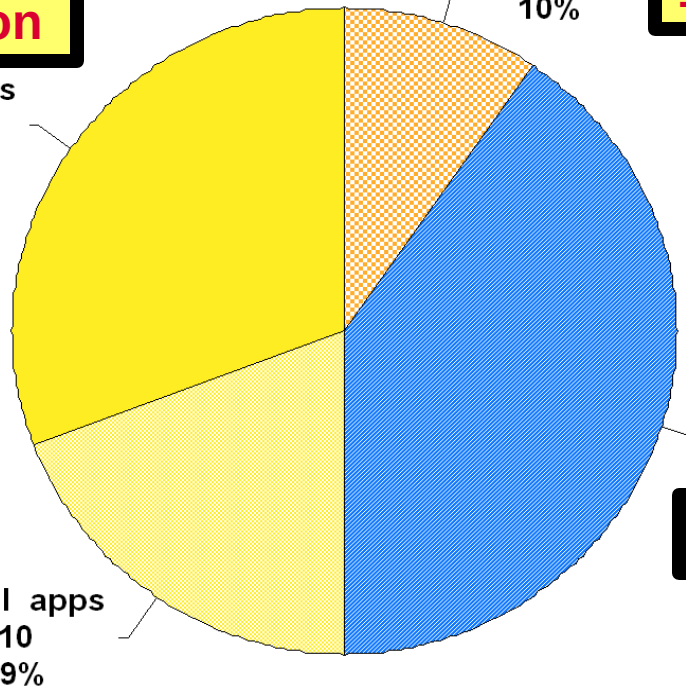
52 people (int + ext)

2.1 servers/person

6 large applications; 34 servers
22 large, 12 small.med servers
3.6 (large) servers per application

3.2 servers/person

10 small applications; 32 servers
26 small, 6 med servers
3.2 (small) servers per application



16.4 firewalls/person

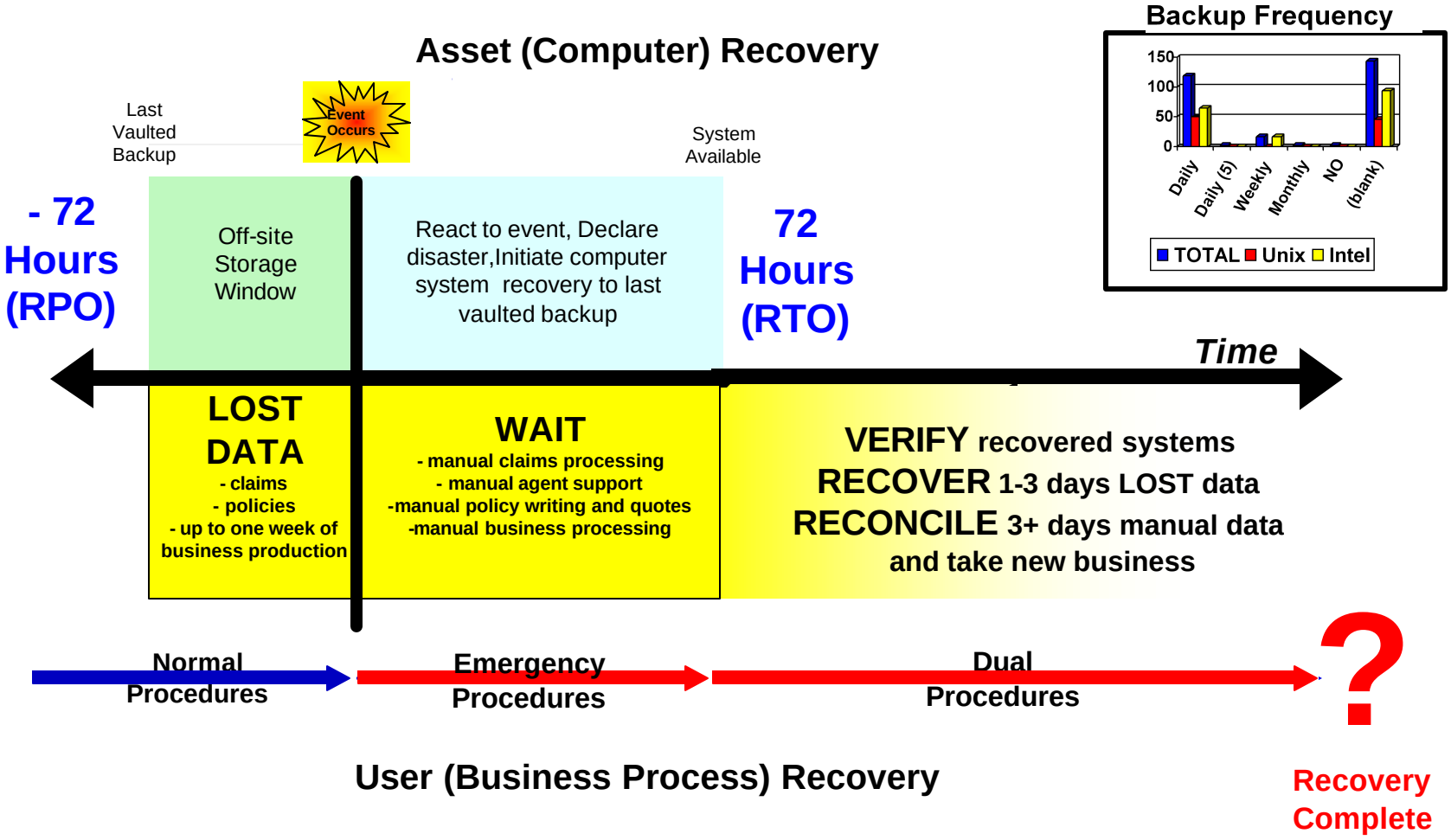
6.0 SysMgt/person

Big productivity differences between cloned infrastructure and application/database servers

QoS - Cost of Outage:
Scheduled and Unscheduled Downtime

- Know what the answers should be before you ask
  - Is it a sysplex? Unix cluster?
  - Have there been recent availability issues?
  - 24 x 7 Web presence?
- Conservative = **Operational loss** = # users x $50/hour salary expense per user x 25% after n hours
- Aggressive = **Revenue loss** = annual revenue divided by 1960 hours adjusted as above, plus time to recover
- Ask the right person - operations, CFO, security or DR
- Define "outage" - ensure consistency
- Talk in hours, not percentages
- Ask in the right order - scheduled, longest single, average
- Gartner, Forrester, and others = Useful for "bargaining"
  - Intel = 26 hrs./svr/yr (99.7%), Unix = 12 (99.85%), MF = 4 (99.95%)

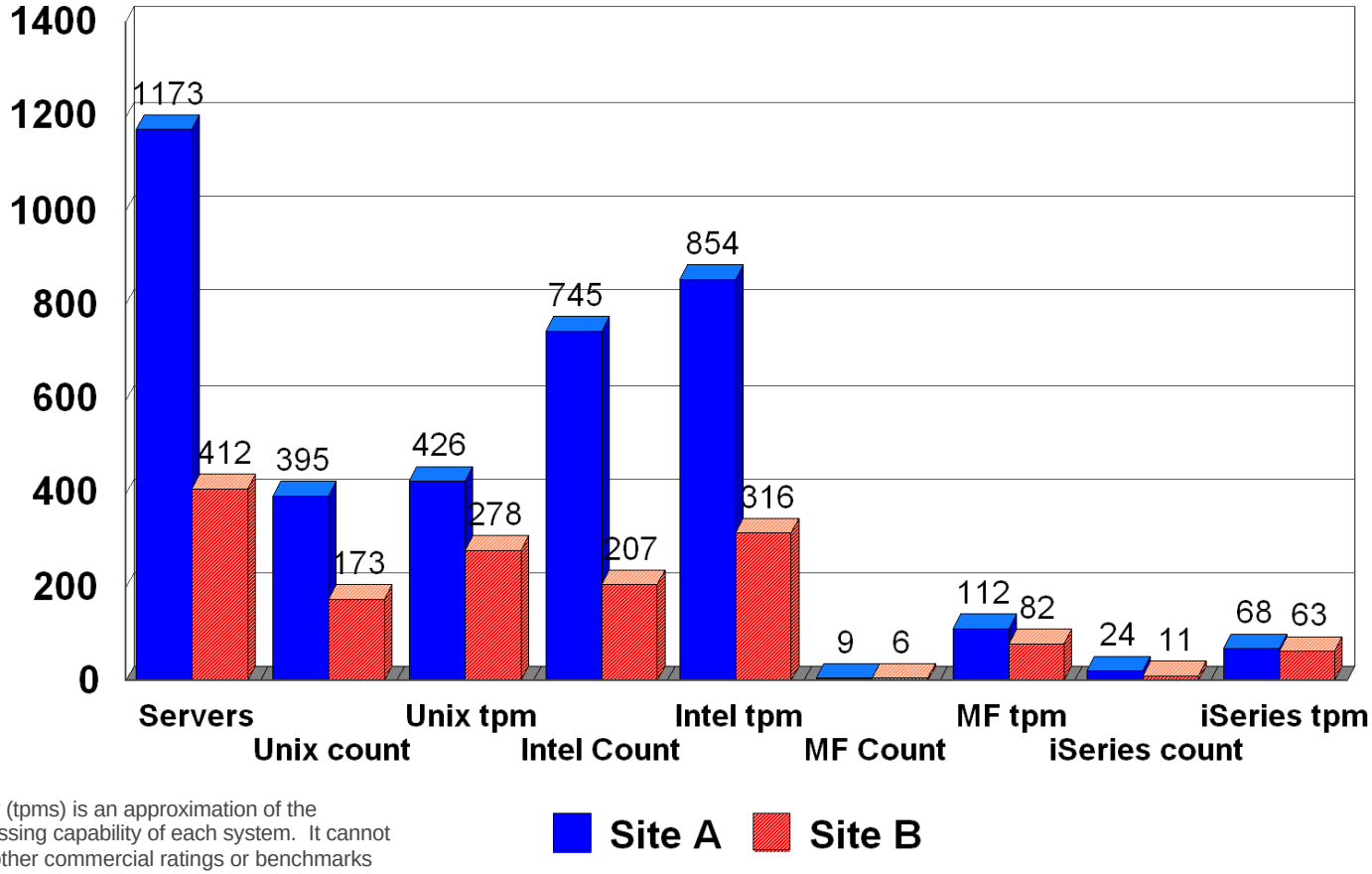
Cost of Outage:
DR is poorly understood, but a significant MF advantage.



Significant differences exist between client/server and mainframe disaster recovery.

Cost of Outage:

Internal Dual-site Disaster Recovery



* system capacity (tpms) is an approximation of the transaction processing capability of each system. It cannot be compared to other commercial ratings or benchmarks and is invalid outside of the context of this IBM study.

Intel and Unix are poorly positioned for dual-site internal disaster recovery. Balancing the two centers will require significant investment.

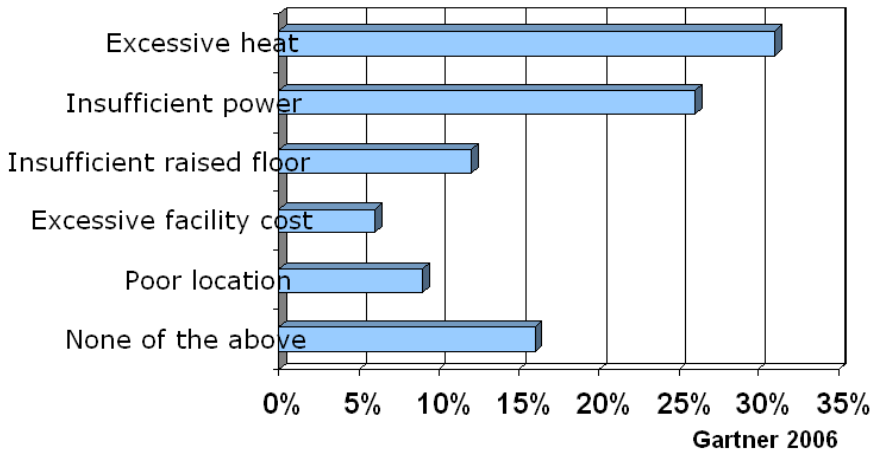
Are there other issues?

"Power and cooling will be a top 3 issue with all CIO's in the next 6-12 months"
Michael Bell– Gartner Group

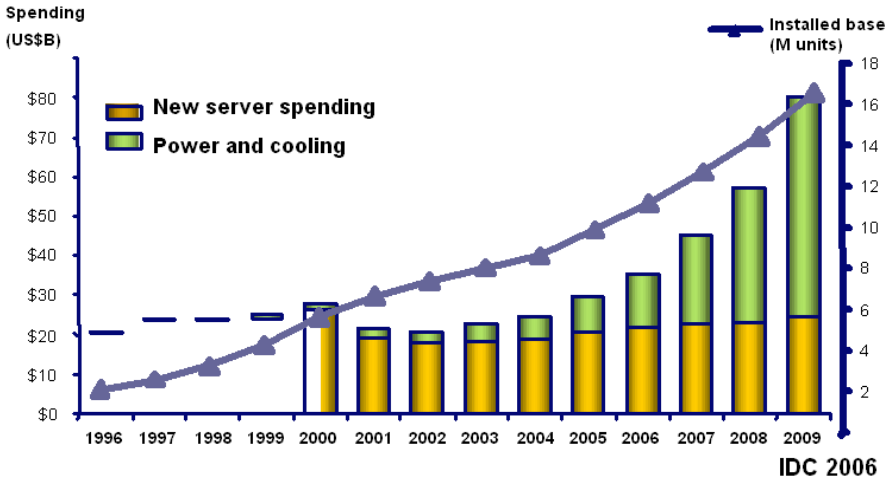
"Power and cooling costs will increase to more than one-third of the total IT budget"
Robert Frances Group, January 2006

"The cost of datacenter floor space is inconsequential compared with the cost of operating and cooling a datacenter"
"You pay once to power the systems and again to cool them"
Information Week, February 2006

"And again and again for" redundancy
Marlin Maddy, February 2006



Power and cooling exceeds server spending



Building the TCO Business Case

- Defining the Rules for comparing platforms

1. **Select the right application(s)**
   Is this a full study? Do you need an assessment?
   Who is your sponsor? Is this line-of-business, infrastructure, or IT?
2. **Ensure like-for-like configs**
   Application, database, middleware
   QA, failover, DR, development, test, and infrastructure servers
3. **Determine useable capacity/utilization * Important z advantage**
   Ask for peak AND average - discuss overlap and ratios
   Accommodate peaks with WLM, IRD, and oD features
4. **Quantify cost of support staff * Important z advantage**
   Determine how "reasonable" this is to your customer
   Expand the effort to look for complexity issues that require staff
   Look for areas of rapid growth
5. **Determine cost of outage (QoS) * Important z advantage**
   Simple operational or aggressive revenue based
   Disaster recovery RTO/RPO
   Get the numbers or get "it is not important" in writing
6. **Perform "incremental" cost analysis**
   Incremental costs are usually much lower than full costs
   - **System z ~20%-25%, Unix & Wintel ~ 60%**
7. **"What-if" analysis - "Do nothing" analysis**

IBM Systems and Technology Group

Customer Studies

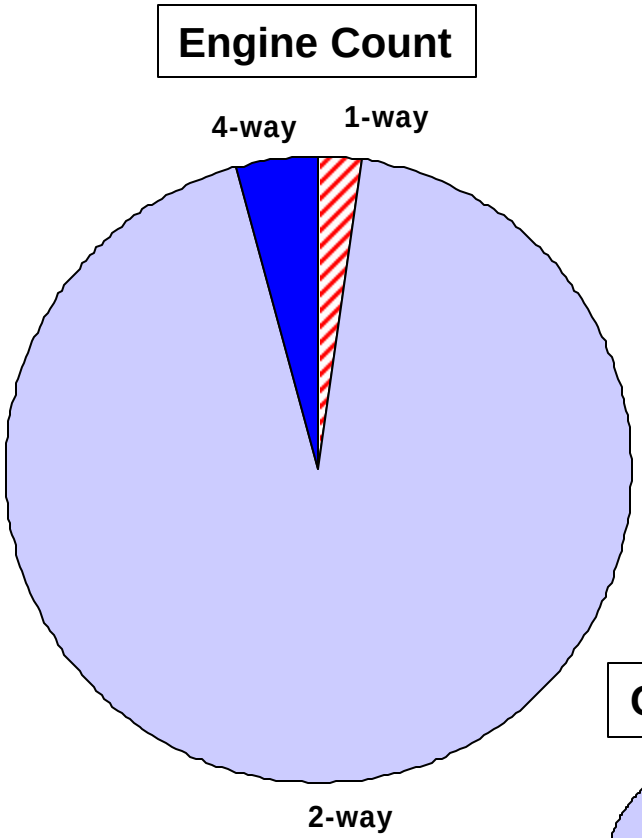
Representative customers
- Real Studies

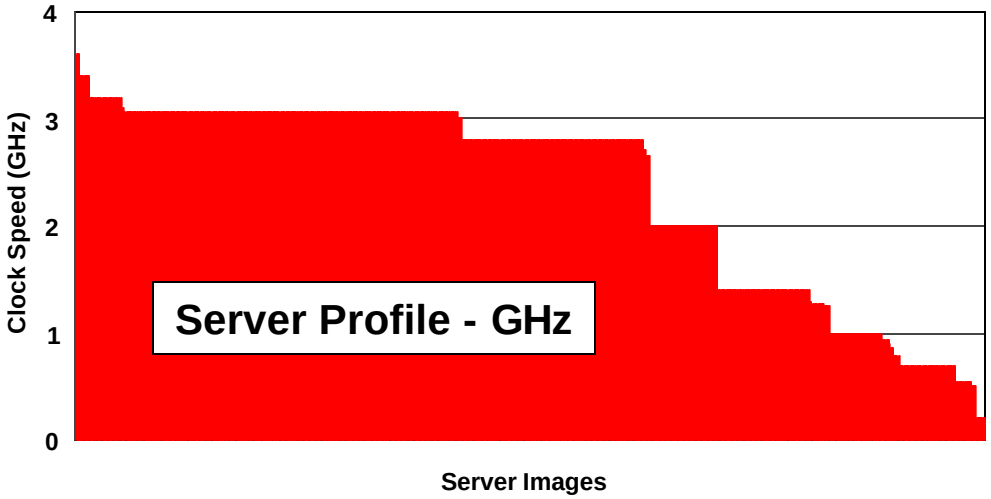
Sample Customer A

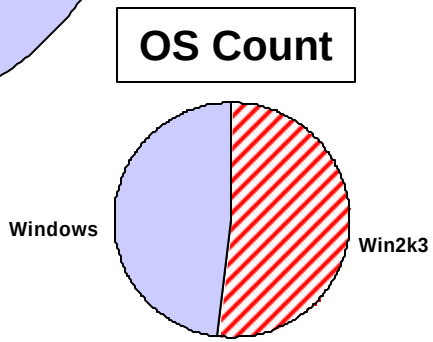
- Medium shop - 500 servers - 4 architectures
- Strategy to simplify with Windows based blades
- Rapid growth
- Multiple locations including international
- Disaster recovery improvement focus
- Cost reduction through modernization
- Excellent quality data provided to IBM

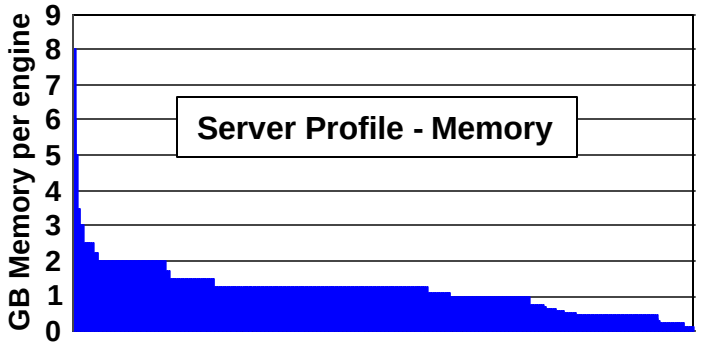
Current State - Intel Complexity is AVERAGE.

The level of effort required to maintain a large inventory of servers is proportional to the number of unique hardware combinations. The ABC environment is dominated by 2-way machines of many speeds.



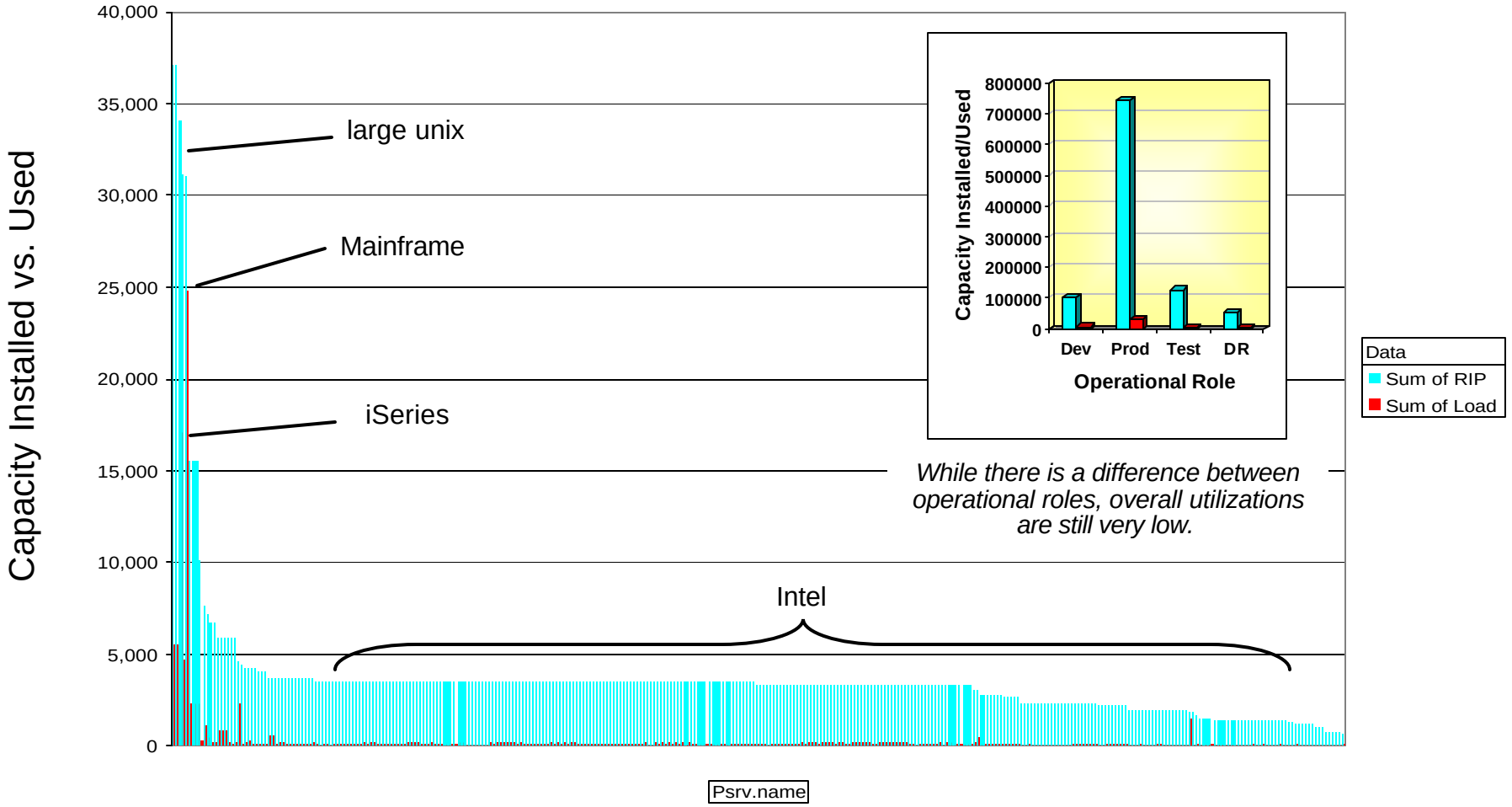






Current State - Unused Intel capacity is HIGH.

Observing the relative performance of 350+ physical machines for which data was analyzed, both installed and used at ABC, we see a considerable amount of unused capacity, particularly for Intel. Utilizations are very low on Intel. VIRTUALIZATION will help improve this situation.

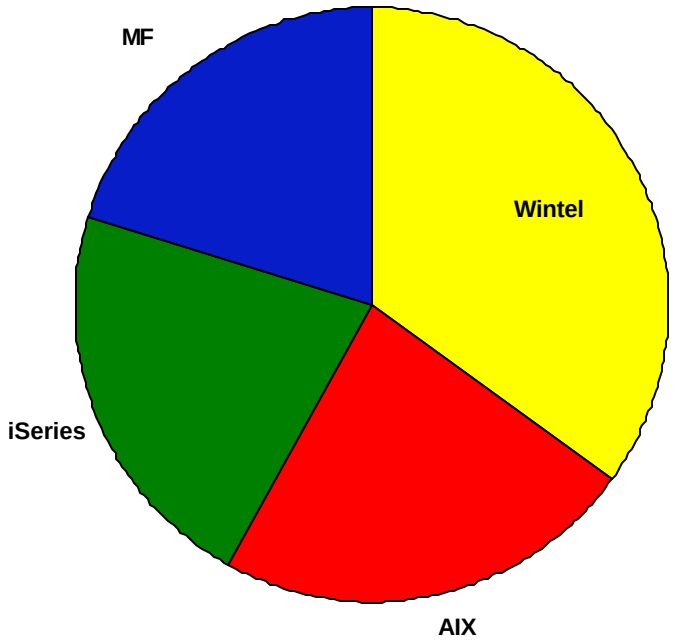


Relative Internal Performance(Capacity (RIP) is a cross-architecture capacity estimate. It is intended to be used only within the context of this study and cannot be compared to external benchmarks or other IBM performance ratings. Used RIPS (load) is the product of utilization and RIP per instance for all 450+ server instances. Teradata CPs are not included.

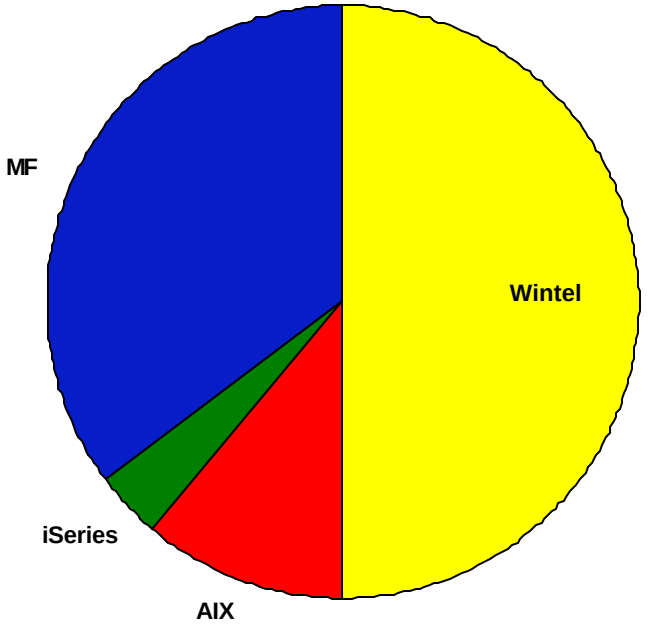
Current State - Capacity / Spend.

The estimated IT budget is, as expected, also dominated by Wintel machines. Most environments at ABC are heavily optimized, so these ratios would no longer apply if workloads were moved between environments. We will project workload movement with this knowledge.

Used Capacity



Estimated Budget / Spend



Relative Internal Performance is a cross-architecture capacity metric used here. It is to be used only within the context of this study and cannot be compared to external benchmarks or other IBM performance ratings. Load or Used RIPS is the product of estimated utilization and RIP per instance for all 3000+ server instances. Mainframe CFs are not included.

Current Systems: DR is GOOD, but only for Critical systems.

Asset (Computer) Recovery

Last Vaulted Backup

Event Occurs

System Available

RPO 24 Hours

RECOVERY POINT
Off-site Data Storage

RECOVERY TIME
React to event, Declare disaster,Initiate recovery from last backup

RTO 24 Hours

Time

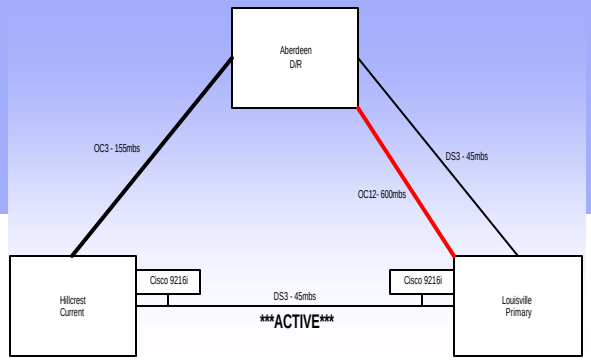
LOST DATA
- payroll records
- sales/financials
-- up to 4 hours critical production

WAIT
- stand-alone store systems
-- manual replenishment
-manual polling and collections
- up to 24 hours critical production

VERIFY recovered systems
RECOVER 1-7 days LOST data
RECONCILE manual data

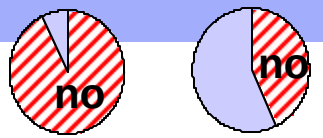
Normal Procedures → **Emergency Procedures** → **Dual Procedures** → **Return to Normal**

Key observations:
Critical Apps are recoverable
- Peoplesoft (Payroll, A/P, A/R, Cash)
- Polling, EAI, JDE
- eMail
Recovery Time Objective = 24 Hours
Recovery Point Objective = 24 Hours
Non-Critical Apps are unknown!



SAN environment:
- Non-shared
  - Tru-copy for MF
  - MIMIX for iSeries
  - 15TB for Wintel/Unix
  - Win=60%, U=20%
- DS3 site links
- OC12 available
- Datacenter move

SAN Connected Apps



Intel Unix

Current State - Summary Observations

Our assessment indicates some marked differences between architectures in support efficiency, utilization, and Quality of Service. Overall efficiency looks Good.

Architecture Summary	**Wintel**	**Unix**	**iSeries**	**MF**
Support Staff *(est. FTE ratio)*	GOOD (17+)	AVERAGE (5+)	EXCELLENT (1+)	GOOD
Servers *(virtual / real)* *	466 / 451 LOW	60 / 26 V. GOOD	10 / 4 V. GOOD	4 / 2 EXCELLENT
Growth *(estimated)*	20-25%	20-25%	10-25%	0-10%
Utilization *CPU / Storage*	4.1% LOW	15% (estimate)	50+% GOOD	70-80% GOOD
	20% (estimate)	35% (estimate)	70+% V. GOOD	80% Excellent
Complexity	AVERAGE	AVERAGE	LOW	LOW
Application Criticality	LOW	HIGH	HIGH	HIGH
QoS Delivery *(RTO, RPO, Response, Availability)*	FAIR	AVERAGE	EXCELLENT	EXCELLENT
Currency *(Hardware and Software)*	GOOD	AVERAGE	FAIR	FAIR

* Server counts are based on a point-in-time server inventory and may differ from data from other sources, and sections of this presentation.

Staffing, Storage & Incremental Cost Analysis

Headcount includes all reported staff known to support the server infrastructure. Storage, unless internally, was used to allocate the SAN costs. The Incremental Cost Analysis ("ICA") represents the full burdened marginal cost of computing.

	Intel Xeon & AMD	Unix *3 &4 pSeries	MidRange iSeries	MF *2 zSeries	DSS Teradata	In-Scope Totals
Total Images:	**466**	**50**	**9**	**4**	**1**	**530**
Total Headcount:	19.4	9.0	0.8	9.6	1.0	39.8
Images / Person:	24.1	5.5	10.8	0.4	1.0	41.8
Total TB Storage:	14.2	7.5	2.0	19.2	20.0	62.9
Replicated Data:	?	?	1.0	4.0	-	5.0
Total Spend:	**$ 12,505,403**	**$ 2,771,756**	**$ 914,162**	**$ 8,859,268**	**$ 2,146,195**	**$ 27,196,784**
RIPS:	1,004,694	187,978	39,423	47,300	27,596	1,306,991
Utilization:	4.3%	15.0%	66.1%	80.0%	30.0%	11.0%
Utilized RIPS:	43,080	28,197	26,282	37,840	8,279	143,678
Cost / Util. RIPS:	**$ 290**	**$ 98**	**$ 35**	**$ 234**	**$ 259**	**$ 189**

Notes: *1:	Mirrored storage 20 TB, Useable 10 TB. Qtrly review of SLAs. Managed remotely by NCR.
*2:	Existing plans to reduce Mainframe ISV cost has been discussed. Claims of up to $1 Mil in savings
*3:	Of the 50 LPARs reported, 25 AIX 5.3 boot from SAN & 47 use SAN storage (Except Using VIO)
*4:	Those not booting from SAN use local mirrored 72 GB Disks for boot and tools.
*5:	2 Hr scheduled downtime for iSeries maint window is difficult to schedule given country demands
*6:	8 Hr.scheduled downtime for Intel maint window is accepted. SLA = 99,8% One mission critical appl

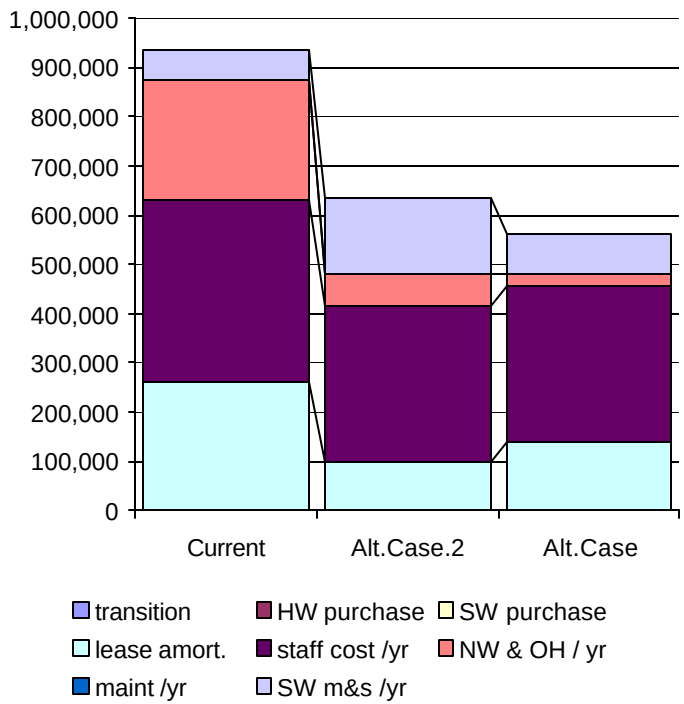
#101 - Windows Application Servers to VMware or Blades

101: win-app Windows App' Servers Actual

Sizing	Current	Alt.Case.2	Alt.Case
server type		HS20/express	x366/4DC3
total #CPU	169.54	44	24
used #CPU		44	24
#Log.Servers	88.00	88	88
#Phys.Servers	80.04	22	6
avg.Log.srv RIP	2,877.1	1,263.5	1,332.8
total capacity RIP	230,285.8	111,188.0	117,288.0
total workload RIP	7,969.5	7,969.5	7,969.5
average utilization	3.46%	7.17%	6.79%

AOC: Annual Operating Costs			
Staff cost code	0		
SW cost code	0	win.VMw	win.VMw
SW cost /CPU /yr	0.00	3,168.04	3,168.04
SW cost /Lsrv /yr	0.00	0.00	0.00
SW cost /Psrv /yr	786.00	786.00	786.00
SW m&s /yr	62,912.75	156,685.83	80,749.00
maint /yr	0.00	0.00	0.00
NW & OH / yr	241,204.78	61,326.55	24,566.70
staff cost /yr	371,833.71	316,058.65	316,058.65
lease amort.	259,856.52	100,952.77	140,850.00
total AOC	**935,807.76**	**635,023.80**	**562,224.36**

1 Year Projection



373,583 est.potential saving /yr

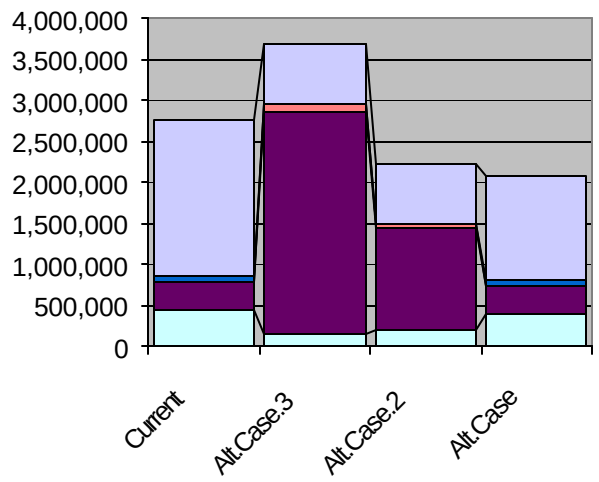
#113 - Peoplesoft Database Tier

113: mf-ps MF Peoplesoft DB Server Actual

Sizing	Current	Alt.Case.3	Alt.Case.2	Alt.Case
server type		HS20/express	x460/8	z9-zIIP
total #CPU	3.70	68	56	2
used #CPU		68	56	2
#Log.Servers	2.00	34	14	2
#Phys.Servers	1.30	34	7	2
avg.Log.srv RIP	12,382.7	5,054.0	12,548.5	8,646.6
total capacity RIP	16,097.5	171,836.0	175,679.0	17,293.2
total workload RIP	12,878.0	12,878.0	12,878.0	12,878.0
average utilization	80.00%	7.49%	7.33%	74.47%

AOC: Annual Operating Costs				
Staff cost code	0			
SW cost code	0	WinEE.sqlEE ıEE.VMw.SQLEE		none
SW cost /CPU /yr	0.00	9,566.67	12,734.71	0.00
SW cost /Lsrv /yr	0.00	1,933.33	1,933.33	0.00
SW cost /Psrv /yr	1,469,134.21	0.00	0.00	0.00
SW m&s /yr	1,909,874.47	716,266.67	740,210.33	1,273,249.65
maint /yr	64,926.00	0.00	0.00	61,950.67
NW & OH / yr	11,309.87	94,777.39	37,327.10	11,793.43
staff cost /yr	335,402.43	2,713,444.16	1,241,445.04	335,402.43
lease amort.	448,316.40	156,017.91	204,224.67	392,877.60
total AOC	**2,769,829.18**	**3,680,506.12**	**2,223,207.13**	**2,075,273.77**

1 Year Projection



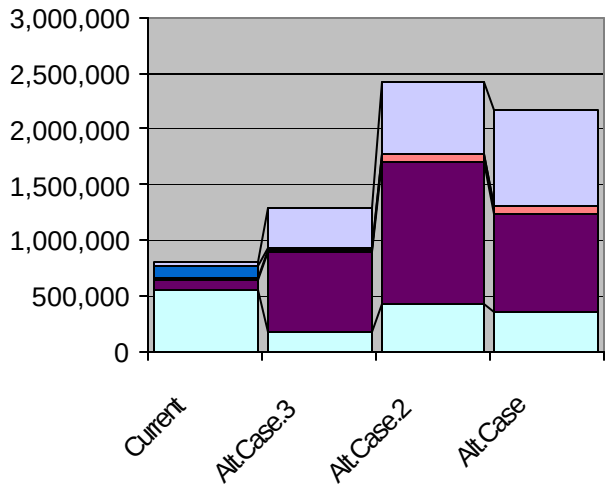
694,555 est.potential saving /yr

#115 - JDEdwards database backend

Sizing	Current	Alt.Case.3	Alt.Case.2	Alt.Case
server type		p5-570/8 3TB	x366/4DC3 3TB	x460/8 3TB
total #CPU	20.00	16	64	88
used #CPU		16	64	88
#Log.Servers	9.00	9	16	11
#Phys.Servers	3.00	2	16	11
avg.Log.srv RIP	13,141.1	6,742.7	19,548.0	25,097.0
total capacity RIP	39,423.3	60,684.0	312,768.0	276,067.0
total workload RIP	19,548.1	19,548.1	19,548.1	19,548.1
average utilization	49.59%	32.21%	6.25%	7.08%

AOC: Annual Operating Costs				
Staff cost code	0			
SW cost code	0	aix5.F5/8.oraEE	win23ee.sqlEE	win23ee.sqlEE
SW cost /CPU /yr	0.00	22,687.75	9,566.67	9,566.67
SW cost /Lsrv /yr	0.00	0.00	1,933.33	1,933.33
SW cost /Psrv /yr	7,324.00	0.00	0.00	0.00
SW m&s /yr	21,972.00	363,004.00	643,200.00	863,133.33
maint /yr	116,265.80	18,187.60	0.00	0.00
NW & OH / yr	22,893.27	12,257.86	65,511.20	58,656.86
staff cost /yr	84,761.80	718,264.63	1,276,914.90	877,878.99
lease amort.	556,283.88	182,357.90	425,807.24	367,274.81
total AOC	**802,176.75**	**1,294,071.99**	**2,411,433.34**	**2,166,944.00**

1 Year Projection



-1,364,767 est.potential saving /yr

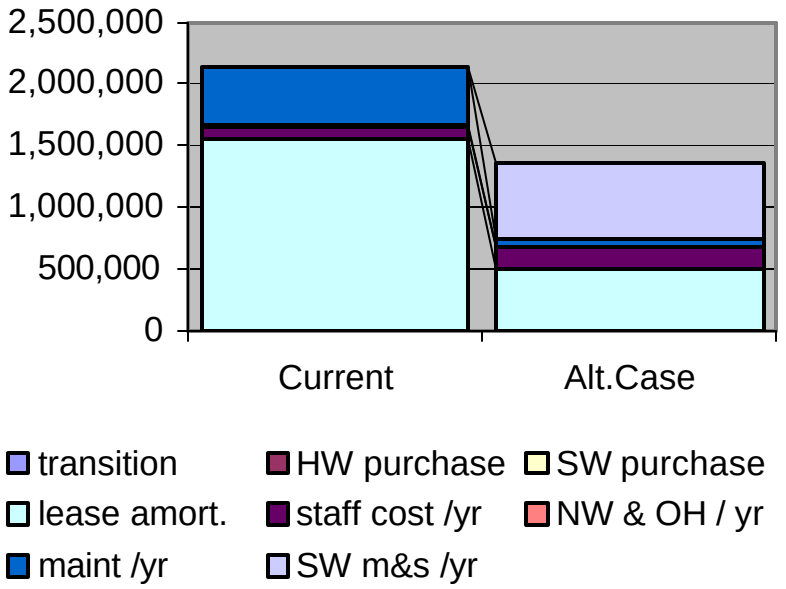
#116 - Teradata system

116: tera — Teradata DB Servers — Actual

Sizing	Current	Alt.Case
server type		p5-570/16 20TB
total #CPU	16.00	16
used #CPU	16.00	16
#Log.Servers	8.00	2
#Phys.Servers	8.00	1

AOC: Annual Operating Costs		
SW cost code	0	IM.db2EE
SW cost /CPU /yr	0.00	38,971.33
SW cost /Lsrv /yr	0.00	0.00
SW cost /Psrv /yr	0.00	0.00
SW m&s /yr	0.00	623,541.33
maint /yr	479,804.00	49,443.33
NW & OH / yr	4,830.29	12,229.97
staff cost /yr	101,706.02	177,349.29
lease amort.	1,557,401.00	494,433.33
total AOC	**2,143,741.31**	**1,356,997.26**

1 Year Projection



786,744 est.potential saving /yr

Environmental Summary

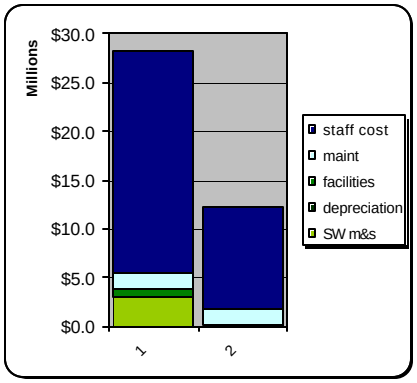
Total: Business Case

Sizing	Current	Alt.Case
server type		
total #CPU	4,204	242.5
used #CPU		
#Log.Servers	1966	1124
#Phys.Servers	1843.928571	45.13
avg.Log.srv RIP	538.0	249.2
total capacity RIP	1,057,679.5	280,132.3
total workload RIP	115,615.5	115,615.5
average utilization	11%	41%

AOC: Annual Operating Costs		
Staff cost code		
SW cost code		
SW cost /CPU /yr		
SW cost /Lsrv /yr		
SW cost /Psrv /yr		
SW m&s	2,952,598	#N/A
maint	1,706,897	1,730,057
facilities	771,327	132,422
staff cost	22,820,226	10,425,530
depreciation	0	0
total AOC	**28,251,048.38**	**#N/A**

OTC: One Time Costs		
SW purchase	0	#N/A
HW purchase	28,627,500	20,547,567
transition	0	5,449,643
total OTC	**28,627,500.00**	**#N/A**
write off	0	0

5 Year Projection		
OTC + 5x AOC	**169,882,742**	**#N/A**



1.7 :1 Log.SCON ratio
40.9 :1 Phy.SCON ratio

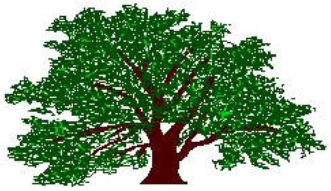
#N/A est.potential saving /yr

#N/A Net Cash Investment

#N/A %age AOC Reduction

#N/A 5yr saving

Environmentals	Current	Alt.Case
avg RackU / Server	4.2	15.8
Total RackU	7,744	715
30U Racks	258.1	23.8
Total kW	1,277	156
Adjusted kWh/yr	11,240,154	1,374,372
Heat BTU/hr	2,919,446	356,971
CO2 tonnes /yr	4,833	591
Carbon tonnes /yr	1,319	161
RIPs /kW	828	1,794
RIPS / tonne CO2	219	474
W /m2	9,892	13,109



CO2 Reduction = 14,031 Trees

System z: The TCO conclusion

System z with z/OS

- Much better utilization of resources (up to 10x)
- Requires **less support staff** (20% - 100% less)
- Has **higher availability** (therefore less downtime costs)
- Has better DR - typically **faster RTO and smaller RPO**
- Power consumption and floor space are minimized (which saves $$$)

System z with z/VM and Linux for System z

- Much better utilization of resources
- Failover is provided by virtual server (therefore less hardware is required)
- Requires **less support staff** (20% - 50% less)
- Has **lower software costs** (savings are significant for application software)
- Has better DR - typically **faster RTO** and an RPO in synch with legacy
- Power consumption and floor space are minimized (which saves $$$)