David Ash – Chip Schutte – Michael Hobert - Sharon Keeler – Dr. Michael Murphy

AGENDA
Joint Administrative Services Board
April 22, 2013 1:00 p.m.
Joint Government Center

1.   **Call to Order.**

2.   **Approval of Minutes. (February 25 Minutes Attached pg. 2).**

3.   **Update from Director.** Four *credit cards* have been cancelled and reissued due to fraudulent activity from culprits outside Clarke County. *Travel Policy* issues: per diem payments for meals with no receipts vs. daily limits with receipts; restrictions on mileage reimbursements; valet parking; missing detailed receipts; variable reporting of mileage.

4.   **ERP Implementation Guideline.** Please find attached a generalized outline of actions needed to implement the ERP system. *(p. /0)*

5.   **ERP Research Documents:**

   a. GFOA/Microsoft Study on ERP in the Public Sector.
   b. GFOA Consulting Proposal.
   c. Economics of the Cloud for the Public Sector.
   d. Gartner on Cloud Security. *(p. //)*

Joint Administrative Services Board

February 25, 2013   Regular Meeting   1:00 pm

At a regular meeting of the Joint Administrative Services Board held on Monday, February 25, 2013 at 1:00 pm in Meeting Room AB, Berryville Clarke County Joint Government Center, 101 Chalmers Court, 2nd Floor; Berryville, Virginia.

Members Present

     David Ash; Chip Schutte; Michael Murphy; J. Michael Hobert

Members Absent

     Sharon Keeler

Staff Present

     Tom Judge

Others Present

     Archana McLoughlin

1. Call to Order - Determination of Quorum

     At 1:01 pm, Chairman Schutte called the meeting to order.

2. Approval of Minutes

David Ash, seconded by Mike Murphy, moved to approve the January 28, 2013 meeting minutes as presented. The motion carried as follows:

David Ash	-	Aye
J. Michael Hobert	-	Aye
Sharon Keeler	-	Absent
Michael Murphy	-	Aye
Charles "Chip" Schutte	-	Aye

3. Update from Director

Joint Technology Plan adopted by Supervisors and School Board. Funding for training and study of Fiber Backbone included in budget requests. Health Insurance deductible creep.

Tom Judge advised that the Joint Technology Plan had been approved without change by the Supervisors and the School Board. The Plan includes ERP and the fiber backbone study.

Mr. Judge provided an historical overview of increases in health insurance premiums, as well as changes in offered plans.

4. Fraud Tip Line Update

Archana McLaughlin, County Attorney, will discuss her findings into the confidentiality of information provided through a fraud tip line.

Archana McLoughlin, County Attorney, joined the Board to provide legal guidance in the consideration of the establishment of a fraud and abuse hotline. She summarized her memorandum titled _Fraud and Abuse Hotline,_ which she distributed with examples of fraud programs from Prince George and Hanover Counties.

Fraud and Abuse Hotline

Confidentiality and Freedom of Information Act (FOIA)

- Any reports made to the hotline would be public records because the JAS is a public body under FOIA. Pursuant to FOIA public records are generally made available to the public when requested.
- There are, however, exceptions for certain investigative records. The exemptions are qualified and apply only while the investigation is active.

See below the relevant excerpt from Virginia Code § 2.2-3705.3(7) that lists exclusions from FOIA disclosure requirements:

"Investigative notes, correspondence and information furnished in confidence, and records otherwise exempted by this chapter or any Virginia statute, provided to or produced by or for (i) the Auditor of Public Accounts; (ii) the Joint Legislative Audit and Review Commission; (iii) an appropriate [federal or state] authority as defined in § 2.2-3010 with respect to an allegation of wrongdoing or abuse under the Fraud and Abuse Whistle-Blower Protection Act (§ 2.2-3009 et seq.); (iv) the Office of the State Inspector General with respect to an investigation initiated through the State Employee Fraud, Waste and Abuse Hotline or an investigation initiated pursuant to Chapter 3.2 (§ 2.2-307 et seq.); (v) the committee or the auditor with respect to an investigation or audit conducted pursuant to § 15.2-825 [urban county executive form of government]; or (vi) the auditors, appointed by the local governing body of any county, city or town or a school board, who by charter, ordinance, or statute

have responsibility for conducting an investigation of any officer, department or program of such body."

- The records created under these circumstances would be confidential while being investigated. Once the investigation is closed FOIA does require disclosure as described in the statute.

See below excerpt from Virginia Code § 2.2-3705.3(7)

"Records of completed investigations shall be disclosed in a form that does not reveal the identity of the complainants or persons supplying information to investigators. Unless disclosure is prohibited by this section, the records disclosed shall include, but not be limited to, the agency involved, the identity of the person who is the subject of the complaint, the nature of the complaint, and the actions taken to resolve the complaint. If an investigation does not lead to corrective action, the identity of the person who is the subject of the complaint may be released only with the consent of the subject person. Local governing bodies shall adopt guidelines to govern the disclosure required by this subdivision."

Implementation

- Do JAS records qualify for the exemption under the statute?
  - o Is there any evidence that the JAS "by charter, ordinance, or statute have responsibility for conducting an investigation of any officer, department or program of [the County Board of Supervisors]?"
  - o If a record of an active investigation is the subject of a FOIA request, and we would likely want to rely on this section, so we must determine whether this body fits, and if not, what we can do to make it fit.
  - o Also exceptions for criminal investigation files. Va. Code §2.2-3706

- See below excerpt from Virginia Code § 15.2-2511.2(B). Duties of local government auditors.

Any fraud, waste, and abuse auditor appointed by the local governing body of any county, city, or town having a population of at least 10,000, or any town constituting a separate school division regardless of its population, who by charter, ordinance, or statute has responsibility for conducting an investigation of any officer, department or program of such body, shall be responsible for administering a telephone hotline, and a website, if cost-effective, through which employees and residents of the locality may report anonymously any incidence of fraud, waste, or abuse committed by any such officer, or within any such department or program, of that body. Such auditor may inform employees of the locality of the hotline and website, if any, and the conditions of anonymity, through the conspicuous posting of announcements in the locality's personnel newsletters, articles in local newspapers issued daily or regularly at average intervals, hotline posters on local employee bulletin boards, periodic messages on local employee payroll check stubs, or other reasonable efforts.

- • Board must develop and adopt guidelines that "govern the disclosure required by th[e] subdivision."

- • As a practical matter, you can not disclose information that you never had
  - ○ One way to keep it anonymous is to establish a telephone hotline with caller ID and call back features disabled.
  - ○ Open up line to public, not just employees.

Discussion followed after the summary; the Board concurred on the following:

- — A hotline may not be the best course of action but does warrant further consideration.

- — Review current complaint investigation process to determine if there is more that can be done. *It was noted that many complaints are about situations over which the County has no control and/or jurisdiction.*

- — Further discussion is needed to determine the value.
  - ○ Reporting quality could present issues and limit the ability to conduct a proper investigation.
  - ○ Resources are limited and subsequent investigations could be time consuming.

- — Establish definitions, such as Hanover County's, and train employees on fraud, waste and abuse.

- — Considerations if implemented:
  - ○ Create a form for staff use that specifically asks the question as to whether the caller wishes to remain confidential.
  - ○ Set up the reporting system to protect anonymity.
  - ○ Forward complaints to the appropriate agency for investigation.
  - ○ Identify resources to pursue investigations.
  - ○ Establish a timeframe for reporting and start of investigation.
  - ○ Establish thresholds.

- — Tom Judge, with Archana McLoughlin, will further research the matter including follow up with County IT to determine if a section could be added to the County's website that would include definitions for fraud, waste and abuse and where to report.

5. Health Insurance Renewal

Please find the health insurance renewal information attached. This requires the consideration and approval of the Board. The rate increases 7%, but there are no changes to the terms of the agreement. However, Anthem has substituted some underlying vendors for others (mental health, pharmacy, dental, and vision).

Tom Judge advised that there were no changes in plan terms however there were changes in underlying vendors: Anthem will move in house mental health, pharmacy, dental and vision coverage; Delta will be the dental vendor for the high-deductible plan.

Following brief discussion, **Mike Hobert, seconded by David Ash, moved to recommend adoption of the Anthem renewal as proposed to the respective bodies. The motion carried as follows:**

David Ash	-	Aye
J. Michael Hobert	-	Aye
Sharon Keeler	-	Absent
Michael Murphy	-	Aye
Charles "Chip" Schutte	-	Aye

FY 14 Monthly Health Benefit Rates
Source: Joint Administrative Services   Effective 7/1/2013

A. Plan Rates	Cost	Employer	Employee	Employer FY 14 Share	Employer FY 13 Share
KA 250 Plan Option					
Regular Full Time					
Single	536.00	456.65	79.35	85%	85%
Dual	992.00	498.02	493.98	50%	50%
Family	1,447.00	727.34	719.66	50%	50%
Transportation, Food Service & Other					
Single	536.00	385.31	150.69	72%	72%
Dual	992.00	420.22	571.78	42%	42%
Family	1,447.00	613.72	833.28	42%	42%
KA 500 Plan Option					
Regular Full Time					
Single	497.00	456.65	40.35	92%	92%
Dual	919.00	498.02	420.98	54%	54%
Family	1,342.00	727.34	614.66	54%	54%
Transportation, Food Service & Other					
Single	497.00	385.31	111.69	78%	78%
Dual	919.00	420.22	498.78	46%	46%
Family	1,342.00	613.72	728.28	46%	46%
TLC High Deductible					
Regular Full Time					
Single	409.00	409.00	.00	100%	100%
Dual	757.00	465.25	291.75	61%	61%
Family	1,104.00	677.56	426.44	61%	61%
Transportation, Food Service & Other					
Single	409.00	345.11	63.89	84%	84%
Dual	757.00	392.57	364.43	52%	52%
Family	1,104.00	671.71	632.29	62%	52%

B. Account Contributions

Regular Full Time
TLC Health Savings Account Contribution (single)	47.65
TLC Health Savings Account Contribution (dual)	32.77
TLC Health Savings Account Contribution (family)	49.79

Transportation, Food Service & Other
TLC Health Savings Account Contribution (single)	40.20
TLC Health Savings Account Contribution (dual)	27.85
TLC Health Savings Account Contribution (family)	42.01

C. Total Employer Cost Per Group Health Member

Regular Full Time
Single Health	456.65
Dual Health	498.02
Family Health	727.34
TLC Single Health & "HSA"	456.65
TLC Dual Health & "HSA"	498.02
TLC Family Health & "HSA"	727.34

Transportation & Food Service
Single Health	385.31
Dual Health	420.22
Family Health	613.72
TLC Single Health & "HSA"	385.31
TLC Dual Health & "HSA"	420.22
TLC Family Health & "HSA"	613.72

Note: Where two employees are married, and they together opt for either a dual or family option, the employer will pay two times the single employer contribution for the plan option selected.

METHOD:
Force TLC employee single contribution to zero.
Proportion other rates to percentage contributions from prior year.
Force 250 employer contribution to same as 500 contribution.
Force "HSA" contribution so total employer equal across plans.

6. Affordable Care Act Issues

Please find documents attached from Anthem outlining the rollout of the A CA. We are receiving regular correspondence from various sources warning of the need to adjust policies, etc. These include how part-time employees are to be defined, whether employees are free to purchase their insurance from health insurance exchanges, notification requirements, automatic enrollment, etc.

Tom Judge advised that he had been researching the matter to determine the impacts. Highlights include:

— Anthem provided the *"Navigating the next phase of health care"* brochure included in the meeting packet.

— JV Arthur and BB&T are providing information to clients.

— Regulations are being rewritten.

— 30-hour employee calculation may affect Parks and Recreation staff, part-time school employees, long-term substitutes, etc.

— Employees will be automatically enrolled and it will be the employee's responsibility to reject.

— The new plan takes effect January 1, 2014.

Miscellaneous

Tom Judge distributed and summarized the article below.

Automatic budget cuts in Virginia

By The Associated Press.

The White House released lists for each state on Sunday of potential effects of automatic spending cuts set for Friday. The White House compiled the numbers from federal agencies and its own budget office. The numbers are based only on the $85 billion in cuts for this fiscal year, from March- September, that are set to take effect Friday. As to whether states could move money around to cover shortfalls, the White House said that depends on state budget structures and the specific programs. The White House did not have a list of which states or programs might have flexibility. The White House says the cuts that could affect Virginia include:

Military

About 90,000 civilian Department of Defense employees in Virginia would be furloughed. Funding for Army base operations would be cut by about $146 million. Air Force operations funding would be cut by about $8 million. Maintenance of 11 Navy ships in Norfolk would be canceled and four projects at Norfolk, Dahlgren and Oceana would be deferred. Other modernization and demolition projects would be delayed.

Teachers and schools

Virginia would lose about $14 million in funding for primary and secondary schools. About 190 teacher and aide jobs would be at risk. Virginia also would lose about $13.9 million in funding for about 170 teachers, aides, and staff who help children with disabilities.

Public health

Virginia would lose about $2.1 million in funding to help prevent and treat substance abuse. The state also would lose about $764,000 in funding to help improve its response to infectious diseases, natural disasters, and other public health threats. A $337,000 cut in funding for the Virginia State Department of Health would reduce the number of HIV tests by around 8,400. Virginia also would lose about $241,000 for vaccinations for children, including measles, mumps, rubella, tetanus, whooping cough, influenza, and Hepatitis B.

Environment

Virginia would lose nearly $3 million in funding for clean water, air quality and prevention of pollution from pesticides and hazardous waste. The state also would lose$ 826,000 for fish and wildlife protection.

Head Start

About 1,000 children in Virginia would lose Head Start and Early Head Start services.

Work-study

Aid would be provided to around 2,120 fewer low income students in Virginia to help them finance the costs of college. Funding for workstudy jobs would go to around 840 fewer students.

Law enforcement and public safety

Virginia would lose about $276,000 in grants for law enforcement, prosecution and courts, crime prevention and education, corrections and community corrections, drug treatment and enforcement, and crime victim and witness initiatives.

Job search assistance

Virginia would lose about $348,000 in funding for job search assistance, referral, and placement. About 18,390 people would be affected.

Domestic violence

Virginia could lose up to $172,000 in funding for services to victims of domestic violence.

Seniors

Virginia would lose about $ 1.2 million in funding to provide meals for seniors.

Next Meeting

The next regularly scheduled meeting of the Joint Administrative Services Board is Monday, March 18, 2013 at 1:00 pm in Meeting Room AB at the Berryville Clarke County Government Center.

Adjournment

At 2:34 pm, hearing no objection, Chairman Schutte, adjourned the meeting.

Minutes Recorded and Transcribed by Lora B. Walburn

ERP Implementation Guideline

I.   Communicate decision to affected employees. Clarification of business practices.

II.   Establish Team.

    a. Determine local Project Manager.
    b. Identify knowledgeable citizens for guidance.
    c. Build on previous focus groups to develop specialized expertise by function.
    d. Clarify roles of Boards, IT directors, Department heads, focus groups. Verify cooperation of semi-independent agencies.
    e. Seek sources of assistance from: VITA, Shenandoah University Institutional Computing, similarly situated communities (Portsmouth, Prince George, Staunton, and Alexandria), Center for Innovative Technology, etc.
    f. Evaluate whether we have identified the expertise to carry out the project, or whether a consultant should be hired to guide it.

III.   Establish Requirements.

    a. Detail specifications for each module.
    b. Cloud versus Server.
    c. Data Standards and Data Independence (lock-in avoidance).
    d. Best Practices.
    e. Phase-in versus Big Bang.
    f. Timing vis-à-vis tax year and fiscal year.
    g. Historical data vs. point forward.
    h. Web based.
    i. Disaster Recovery and Security.
    j. Web Training vs. Travel Training.
    k. Ability to interface with Rec-Trac, Café Enterprise, ESRI, Southern Software, etc.

IV.   Issue a Request for Proposals.

    a. List of Potential Vendors (Tyler, Sungard, New World, Microsoft Dynamics, OpenRDA, Edmunds, etc.)
    b. Demonstrations and site visits.
    c. Evaluation Criteria.
    d. JAS Board to evaluate.
    e. Financial Data and long range corporate commitment.
    f. Proceed to contract.

V.   Develop Implementation Plan.

NETWORKWORLD

This story appeared on Network World at
http://www.networkworld.com/news/2013/041013-gartner-cloud-security-268587.html

News

Gartner: Long hard climb to high level of cloud computing security

Gartner analyst Jay Heiser says Gartner clients often "disappointed" by what they see offered as security and reliability provisions in cloud contracts

By Ellen Messmer, Network World
April 10, 2013 12:24 PM ET

Network World - It's still a long, hard climb to get to a high level of security in cloud computing, according to Gartner research vice president Jay Heiser, who said business and government organizations with sensitive data appear likely to hold back from cloud-based services until things improve.

"Finance tends to be more conservative about cloud computing than small business," said Heiser in his online presentation to Gartner clientele yesterday. In "Prepare for and Minimize the Security Risk of Cloud Computing," Heiser expressed the view that it's somewhat simpler to establish a security baseline when using infrastructure-as-service (IaaS) than it is for software-as-service (SaaS) if only because there's more flexibility and

less dependence on the competence of the service provider. But overall, cloud service providers aren't as clear as they should be concerning matters such as their business continuity and disaster-recovery practices, making it hard to win customer confidence.

[RELATED: Gartner: 10 critical IT trends for the next five years]

[BACKGROUND: Evolving security standards a challenge for cloud computing, expert says]

"Gartner clients are almost universally disappointed" by what they regard as the incompleteness in cloud-computing contracts where they still don't see the level of specificity related to security they expect, said Heiser. "Cloud contracts are incomplete," he emphasized.

The struggle to define both technologies and legal obligations between the cloud and the customer is a topic that has been taken up by both the federal government in its FedRAMP program that seeks to certify cloud-service providers for government use, and the organization Cloud Security Alliance (CSA), which has several working groups pouring enormous effort into defining industry standards.

Heiser also pointed out that the American Institute of Certified Public Accountants (AICPA) has replaced its SAS70 certification with what's service provider certification called with SOC 1, and there's now a SOC 2 and SOC 3 as well to indicate service provider systems trust and security.

But while applauding all of these standardization efforts for security in cloud computing as significant, Heiser said FedRAMP, which is supposed to be operational next year, and the CSA standards are still early projects and their impact may be years away. Heiser had similar sentiments about the ISO/IEC 27017 cloud security standard and the 27018 cloud privacy standard. All of these cloud-computing security efforts are worthwhile but they will take somewhere between a year to five years to be considered mature, he says.

In the meantime, businesses and government have to pin down their requirements and evaluate potential cloud services and their security options as well as they can. The starting point should be looking at the sensitivity of the data going into the service, Heiser says. Companies have to ask questions such as what kind of impact would be the loss of it be, is it of critical competitive value, and is the data subject to regulatory concerns. "It comes down to determining the appropriateness of the service," he says.

The most mature and readily available security controls today in cloud computing are associated with identity and access management mechanisms and server-based encryption, he said. But cloud customers have to ask how encryption keys are managed and stored and if the risk is acceptable, he noted. Gateway-based encryption, or what's sometimes called a broker gateway or proxy, is another option, and it's changing quickly, he added. Forensics investigations are not really viable today, he noted, and in terms of overall security controls, it will probably take five to 10 years to really see a "solid set of technologies" for cloud computing.

The economic appeal of cloud computing is strong and sometimes it does appear economic benefits outweigh potential risks. Gartner is advising clients in general to allow low-sensitivity data to be considered for cloud services; but if it falls in the "medium" range of sensitivity, there's a strong need to conduct a risk assessment. And if the data is of high sensitivity, it should not be considered feasible or permissible for cloud services.

This process also means making sure that the business managers are engaged and realize they "own" the data, and are up to speed on the risks associated with cloud computing, says Heiser.

Nonetheless, cloud services providers rarely offer any indemnification against hacking, Heiser says. And SaaS remains more "mysterious" than IaaS in terms of making it clear how they really operate even as customers basically enter into a kind of supply chain cloud. Since one risk is that a cloud provider might go out of business, there needs to be assurance that the provider can return data or has a contingency plan for back-up. When the Mumboe SaaS went out of business two years ago, they gave customers two weeks to go get their data back, mentioned Heiser. That was a wake-up call of sorts that clouds sometimes do evaporate, and plans need to be made for these kind of downpours.

Even at some of the household names in cloud-computing today — Amazon, Google, Microsoft — there have been instances where data has disappeared, at least for a time, or never returned, says Heiser. "Restoration is not an easy process," he adds. "Put loss of service and availability at the top of your list." Live upgrades of services can lead to widespread data corruption, he pointed out.

IT managers have become accustomed to the idea they have control over what they can do in-house in terms of the application, services, servers, storage and network, and security. He says they need to fully realize that this accustomed level of flexibility isn't going to be there in cloud computing by its very nature.

Ellen Messmer is senior editor at Network World, an IDG publication and website, where she covers news and technology trends related to information security. Twitter: MessmerE. E-mail: emessmer@nww.com.

Read more about security in Network World's Security section.

PROPOSAL TO:

Clarke County, VA

FOR:

ERP Advisory Services

Government Finance Officers Association (GFOA)

Research and Consulting Center

April 16, 2013

The Research and Consulting Center
Government Finance Officers Association

April 16, 2013

Mr. Thomas Judge
Director of Finance
Clarke County, Virginia
524 Westwood Road
Berryville, VA 22611

Dear Tom:

The Government Finance Officers Association (GFOA) is pleased to present this proposal to the County of Clarke, VA. GFOA is excited about this opportunity and ready to assist the County's efforts to procure a financial management system. As a not-for-profit membership association, our mission-driven orientation means that we truly share common goals with the County and are able to place your government's success above all else. Our unique position allows us to be truly independent, objective, and focus solely on identifying the best approach for the County.

We very much look forward to the opportunity to work with you on this project. If there are any questions, please contact Dave Melbye, Consulting Solutions Manager (312-890-8523; dmelbye@gfoa.org).

Sincerely,

Anne Spray Kinney
Director, Research and Consulting Center
Government Finance Officers Association
203 N. LaSalle Street, Suite 2700
Chicago, IL 60601
Phone: (312) 977-9700
Email: akinney@gfoa.org

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Overview of GFOA

The **Government Finance Officers Association of the United States and Canada (GFOA)** is the premier association for public-sector finance professionals at state and local level. Founded in 1906, GFOA has more than 17,500 members who look to GFOA as the gold standard for identifying, developing, and communicating leading practices in government management.

GFOA's technology consulting practice was formed in 1998 to respond to GFOA members' need for objective, independent guidance on procurement and implementation of enterprise resource planning (ERP) systems in advance of Y2K. As a non-profit membership organization, we have no affiliation with any software or hardware vendors, and serve as a completely independent agent for the governments we work with.

Over the past 15 years, GFOA's technology consulting practice has grown to become the market leader in assisting local governments through the process of assessing current systems, understanding the vendor marketplace, facilitating procurement of new systems, and providing detailed analysis and contract negotiation assistance to protect the best interests of governments *and* help reduce implementation risk. In that time, we have assisted approximately 300 cities, counties, school districts, and special district governments with system selection, contract negotiation, and implementation readiness for ERP and human resource/payroll systems. The map below represents GFOA's ERP system selection projects.

In addition to bringing best practice examples from across the United States, GFOA is also very familiar with the State of Virginia. Over the past 13 years, GFOA has worked with over a dozen local governments within the State of Virginia. Below are some of our clients:

Cities:	*Counties:*
City of Alexandria	Fairfax County
City of Newport News	Chesterfield County
City of Chesapeake	Clarke County
City of Roanoke	
City of Virginia Beach	*Special Districts:*
City of Charlottesville	Newport News Public Schools
City of Norfolk	Fairfax County Public Schools
City of Portsmouth	Hampton Roads Sanitation District
	Alexandria Public Schools
	Norfolk Public Schools

Proposed Approach

GFOA is excited about the opportunity to become involved with the Clarke County and become a trusted partner as the County goes through this important project. For this project, GFOA will provide advisory services as described in the tasks below to assist as the County goes through a structured procurement process for an enterprise financial system. Required tasks represent GFOA's minimum level of involvement. Based on our past experience, not participating in these tasks makes it extremely difficult for us to participate in other phases of the project. Conversely, the County can elect that GFOA provide the optional tasks listed under each task. GFOA asks that the County provide reasonable notification of the County's intent to use GFOA services for optional tasks so that we can plan and schedule appropriate resources.

GFOA assumes that the County will follow the major steps of the GFOA procurement methodology described below.

Overview of GFOA's Procurement Methodology

GFOA's methodology relies on principles of fairness, attention to detail, and competition, yet remains flexible enough to adapt to local procurement laws or other unique situations. In addition, the approach is continually enhanced by feedback from the hundreds of public sector clients that we work with, our own staff experience, and the vendor community. The

GFOA's methodology is based on a series of elevation that "promote" proposals to the next level of evaluation. Through defined steps, vendors will be evaluated and scored according to pre-defined criteria with the top vendors moving on to compete at the next step. GFOA's standard evaluation process includes four steps in the table below.

Step	Vendors
Written Proposals	Unlimited
Software Demonstrations	3
Discovery	2
Final Contract Negotiations	1

Written Proposals:
The County will review all written proposals and identify three (3) proposals to elevate to software demonstrations. Vendors will be notified and scheduled for demos after the County's elevation meeting.

Software Demonstrations

Approximately two (2) weeks prior to each vendor's scheduled software demonstration, the County will send the vendor the demo scripts. Demos will be heavily scripted and require that the vendor go through system business processes. The focus of the software demos should be to evaluate system features and capabilities rather than to look at the "bells and whistles." It is expected that demonstrations will last approximately 3 days per vendor. At the conclusion of software demonstrations, the County will evaluate the demonstrations and elevate two (2) proposals for the Discovery phase.

Discovery

At the beginning of Discovery, GFOA will prepare request for clarification letters that define in detail the vendor's proposed implementation approach and begin to document project roles, responsibilities, scope, and schedules that will ultimately be used in the statement of work (SOW). Each vendor will then be on-site at the County for a one-day Discovery session where implementation details will be discussed. The purpose of this meeting is to get clarification on important implementation issues and to begin contract negotiations in a competitive environment. Following the Discovery session, the County will meet to elevate one vendor for final contract negotiations.

Contract Negotiations

GFOA will take a lead role in negotiating both a contract and statement of work with the County's chosen vendor. Completion of a detailed SOW will allow the County to move smoothly into the implementation project with all scope, schedule, resource, and rolls defined and documented.

Task 1: Review RFP

As part of this task, which GFOA expects to begin immediately after receiving notification from the County, GFOA will review the County's RFP draft. The focus of GFOA's review will be to ensure that the RFP is consistent with GFOA's procurement approach and GFOA's recommended practices for system procurement. GFOA will provide written comments **(Deliverable 1-1)** to the County that identifies potential issues and describes a recommended alternative. GFOA will also provide any standard templates and forms that we use in current RFPs.

Deliverable Number	Deliverable	Required/Optional	Price
1-1	**RFP Comments**	Required	$5,000
1-2	**Revised RFP**	Optional	$5,000
1-3	**Revised Requirements**	Optional	TBD

After receiving GFOA's comments, the County can elect for GFOA to assume responsibility for drafting the County's RFP **(Deliverable 1-2).** With this option, GFOA will take a lead role in preparing the County's RFP for issuance. In addition, GFOA can

provide additional services to revise and finalize the County's functional requirements **(Deliverable 1-3).** Typically this service will require on-site visit(s) and GFOA is unable to provide a cost until after we have the chance to review the draft requirements.

Task 2: Conduct Proposal Assessment

Upon receiving the written proposals from vendors the County's project team will begin a assessment and analysis of all proposals. GFOA can assist with this assessment by reviewing proposals and providing comments on potential risks, issues, and any significant weaknesses/gaps and/or strengths. GFOA can also leverage our extensive experience to compare each proposal to industry standards. GFOA can provide templates for comparing vendors on key metrics. (the County would input necessary information from proposals). All key findings will be documented in a brief proposal assessment report that identifies GFOA's findings. This report will also identify additional information that will be needed from vendors going forward. **(Deliverable 2-1).** The County can select which proposals it would like GFOA to review.

In addition, at the County's request, GFOA can provide training to the County's evaluation team on how to evaluate a proposal. GFOA's training will discuss common issues with proposals, vendor's "tricks," and an overview of important issues to look out for.

Deliverable Number	Deliverable	Required/Optional	Price
2-1	**Proposal Comments**	Optional	$1,500 / Proposal
2-2	**Evaluation Training**	Optional	$4,000

Task 3: Software Demos

GFOA staff will develop detailed demo scripts for each vendor and facilitate the demo sessions to guarantee that vendors stay on task and demonstrate essential features of the software, not marketing material or "bells and whistles." Demo scripts **(Deliverable 3-1)** will be heavily focused on the County's functional requirements. The County can also use GFOA services to facilitate the demos with each vendor **(Deliverable 3-2)**

Deliverable Number	Deliverable	Required/Optional	Price
3-1	**Demo Scripts**	Required	$1,000
3-2	**Demo Facilitation**	Optional	$5,000 / Vendor

Task 4: Discovery

Discovery acts as the County's final opportunity to clarify unresolved issues before it makes its final elevation. Prior to Discovery, GFOA will develop a request for clarification (RFC) letter **(Deliverable 4-1)** for each vendor that was elevated (Pricing

includes work effort for RFC for two proposal teams). Then, during Discovery, each remaining vendor is invited back on-site for one more day of presentation. During this presentation, any remaining issues with software functionality, implementation approach, data conversion, or scope are clarified and vendors are asked to make any necessary revisions to their proposal. The main focus of this session is to plan the implementation so that the County and vendor can later develop a detailed statement of work. GFOA will facilitate the Discovery session **(Deliverable 4-2)** for two proposal teams. Additionally, by clarifying outstanding issues at Discovery, development of the statement of work becomes easier. At the conclusion of Discovery, the County will enter contract negotiations with one vendor.

Deliverable Number	Deliverable	Required/Optional	Price
4-1	**RFC Letters**	Required	$4,000
4-2	**Discovery Facilitation**	Required	$5,000

Task 5: Contract Negotiations

GFOA will be involved with the development of a software license contract, software maintenance agreement, and implementation services agreement. In addition, GFOA will lead development of the statement of work (Deliverable 5-1). The statement of work is the critical document that outlines responsibility for the implementation. GFOA will ensure that the County's statement of work is defined to a fine level of detail to prevent any unnecessary issues or misunderstandings during implementation.

Deliverable Number	Deliverable	Required/Optional	Price
5-1	**Contract Negotiations**	Required	$8,000

GFOA Project Team

GFOA's highly qualified professionals represent the most comprehensive knowledge and experience for this type of work in the public sector. In addition to consulting engagements, proposed project team members have written extensively on the subject for GFOA publications, national journals and periodicals, and conducted training for GFOA's annual conference and national training seminars. GFOA will assign a team of highly qualified and experience individuals to work with the City's team throughout its engagement.

Dave Melbye: Dave is the Consulting Solutions Manager for GFOA, and manages GFOA's technology consulting practice.   Dave has led several technology and organizational assessment projects, including work done previously for Clarke County. Dave is currently working with the City of Philadelphia, PA, the Pasco County School District (FL), Boulder, CO, San Bernardino County, CA, Honolulu, HI, and Longmont, CO. Dave is actively involved in GFOA's change management practice, and is a sought after expert and speaker on incorporating change management into ERP implementation projects.

Mike Mucha: Mike is a senior manager and has led many technology assessment and procurement projects including engagements with the Pasco County School District (FL), the City of Hayward (CA), Sonoma County (CA), City of Spokane (WA), and the Encina Wastewater Authority (CA). Mike is currently working in Yuba County, CA, Hayward, CA; Pasco County School District (FL), and Longmont, CO. Mike specializes in technology projects for mid-sized and smaller governments. In addition, Mike is actively involved in GFOA market research efforts for ERP software, and often takes a lead role on contract negotiations.

Rob Roque: Rob is a senior manager and has been with GFOA for fifteen years. During his tenure, he helped develop GFOA's selection methodology, led selection projects, and has managed ERP projects.   His Virginia projects included Fairfax County, Fairfax County Public Schools, and Newport News and Newport News Public Schools. Rob is currently working with the City of Philadelphia on a Workforce Management System selection. He also contributes to GFOA publications on ERP and assists with contract negotiations.

Price and Schedule

Pricing

All pricing is provided as a fixed fee inclusive of all expenses. GFOA sees this engagement as a partnership centered on helping the County achieve its goals. Therefore, we are committed to providing quality services at affordable prices.

Deliverable		Price
	Required Tasks	
1-1	Deliverable 1-1: RFP Comments	$5,000
3-1	Deliverable 3-1: Demo Scripts	$1,000
4-1	Deliverable 4-1: RFC Letters	$4,000
4-2	Deliverable 4-2: Discovery	$4,000
5-1	Deliverable 5-1: Contract Negotiations	$8,000
	Total	**$22,000**
	Optional Tasks	
1-2	Deliverable 1-2: Revised RFP	$5,000
1-3	Deliverable 1-3: Revised Requirements	**TBD**
2-1	Deliverable 2-1: Proposal Comments	$1,500/Proposal
2-2	Deliverable 2-2: Evaluation Training	$4,000
3-2	Deliverable 3-2: Demo Facilitation	$5,000/Demo
	Estimated Total (optional items)	**$31,500***

*we are assuming there will be five proposals that you would like us to review, and three demonstrations to facilitate. Changing either of these estimates will change the estimated fees accordingly.

Schedule

GFOA has experienced a significant increase in demand for its consulting services in the last year. In order to maintain the highest quality of work in this environment, GFOA staff typically require two week's notice for off-site work, and four week's notice for on-site work. We will work with you to establish a schedule that both meets your desired timeframes and ensures adequate availability of our resources.

Project Assumptions

General Assumptions

❖ If it becomes necessary for your organization to request additional resources or expand scope, such additional work shall be secured as an amendment to the contract between your organization and GFOA, and the work will be performed at an hourly rate of $200 per hour plus travel. GFOA and the County may also agree on additional fixed fee deliverables and milestones based on the rate of $200 per hour plus travel costs.

❖ Your organization's staff will be reasonably available for interviews and will participate in the project as agreed upon and appropriate. Your organization agrees not to cancel meetings once established (which would raise our travel costs). In the event that County cancels meetings once schedule, the County will reimburse GFOA for any travel expenses resulting from the change such as airline change/cancellation fees.

❖ Unless otherwise stated, your organization agrees to confirm acceptance of deliverables within a mutually agreed upon number of business days. If a deliverable is not accepted, your organization must state in writing to the GFOA Project Manager the changes needed to the deliverable to garner its acceptance.

❖ GFOA conducts the majority of the engagement work on a fixed fee engagement, where payment is due upon completion of each phase for all the deliverables in that phase. GFOA will invoice for all completed phases at the end of each month. Any services billed hourly will be billed on a monthly basis.

❖ GFOA is a non-profit membership association made up of members representing organizations like the County. Therefore, GFOA's liability and indemnification under any agreement reached with your organization will be limited to the extent of claims paid by insurance coverage currently in force.

❖ When performing work on-site, GFOA staff will require meeting rooms and access to a projector.

❖ GFOA has proposed 1 on-site visits during this engagement as follows. GFOA is open to increasing its on-site presence, however additional costs may apply.

Visit	On-site Visits	On-site Days
1	Evaluation Training (optional)	2
2	Discovery	2

- ❖ Standard GFOA on-site visits include 1 consultant, however, GFOA may bring additional consultants on site as necessary.

- ❖ Your organization will hold an on-site Discovery session for the two vendors elevated for negotiations after the software demonstrations. One GFOA staff member will attend a maximum of two Discovery sessions lasting one day each. Discovery sessions for both vendors occur on consecutive days

- ❖ Additional GFOA staff may attend the Discovery sessions for research or for training purposes. There is no charge for these resources.

- ❖ Projects of this type often require multiple software contracts. GFOA has assumed it will be responsible for negotiating any required contracts that result from the County's selection of a finalist vendor(s).

Exhibits

Exhibit 1 – Standard GFOA Contract

See Attached Document

THE REAL IMPACT
OF ERP SYSTEMS
IN THE PUBLIC SECTOR

Microsoft Dynamics

consulting

Microsoft

SURVEY AT A GLANCE

OVERALL EXPERIENCE			Cost
🙂	😐	☹️	
42%	**40%**	**18%**	
MET EXPECTATIONS	SOMEWHAT BELOW EXPECTATIONS	BELOW EXPECTATIONS	WIDELY VARYING

About this survey

This survey was conducted by the Microsoft Dynamics U.S. Public Sector team in collaboration with the Government Finance Officers Association (GFOA). Our goal was to identify the expectations, strategies, and practices that public sector organizations use in implementing enterprise resource planning (ERP) systems. Our research objectives were to:

- Determine which organizations have implemented ERP systems in the past 10 years.
- Understand the experiences these organizations have had with their ERP systems.
- Uncover the expectations of GFOA members looking to acquire new ERP systems.
- Discover the obstacles that organizations face—and overcome—in replacing older ERP systems.
- Share our findings with the GFOA membership, other practitioners, and policymakers.

Survey framework

The survey included 39 multiple-choice and open-ended questions presented as follows:

- Organizations that had deployed a new system within the past 10 years were asked to rate their level of satisfaction with various aspects of the system and its implementation.
- Organizations operating older systems were asked whether they intended to implement a new system within the next five years. Then they were asked to rate their expectations about the intended new system's cost and benefits.

CONTENTS

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OVERVIEW

What is the real benefit—and cost—of an ERP system? According to our survey of 268 GFOA members, most are not having their expectations met. Most of your peers who have not modernized in the past decade don't know how much to expect to pay for a new system. And most of your peers with a newer system faced implementation hurdles that challenged their ability to gain the intended benefits of an ERP system.

Whether you manage a multi-billion budget for a major metropolitan area or a multi-million dollar budget for a for a city, county or local school district, the implementation of an ERP system is a major undertaking and a significant, long-term investment. Scarce funding and limited resources are the new reality, so organizations must scrutinize the impact of their investments. Yet most struggle to take full advantage of their ERP program. The benefits they do realize fall below their desired expectations and needs.

Our survey participants appreciate the benefits of ERP systems—so much so that they often extend their systems to various uses, such as tax and utility billing, fleet management, and permitting. However, we saw a correlation between extended functionality and dissatisfaction. Their comments revealed that the deficiencies in extended functions tend to delay projects, lower productivity, and promote *shelfware*—software that goes unused. Our conclusion: stick to the system that works, and let ERP do what it does best—financials, budgeting, purchasing, human resources (HR), and payroll.

Regardless of the size of the organization, a key to successful ERP implementations was buy-in from stakeholders within the organization—especially from executive members of the business and operational areas of the organization that traditionally exist outside of the IT office. Survey participants also told us how much they rely on the advice of experts outside their organization. Many associated the success of their ERP implementations to the expertise of independent consultants who helped them assess their complex requirements. However, respondents also told us how frequently their software vendors and implementers fell short of expectations by promising one thing and delivering another.

In the end, though, few organizations measured the benefit of their ERP deployments, making it difficult to assess the real cost and value of these large-scale systems. In this report, the GFOA members with modern ERP systems share the lessons they learned from their implementation projects and offer their recommendations.

KEY FINDINGS

75%
SAID IMPLEMENTATION WILL—OR DID—FALL SHORT OF EXPECTATIONS

69%
DID OR EXPECT TO EXPERIENCE PROJECT DELAYS

63%
SAID ADOPTION AND EASE OF USE FELL SHORT OF EXPECTATIONS

62%
SAID CUSTOMIZATIONS FELL SHORT OF EXPECTATIONS

60%
SAID FUNCTIONALITY FELL SHORT OF EXPECTATIONS

32%
HAVE SHELFWARE

Thanks to the 268 participating organizations and to all the financial leaders who participated in this survey for their time, candid assessments, and insightful responses.

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SURVEY DESIGN AND METHODOLOGY

Based on more than 20 years of experience working closely with state and local government, Microsoft conducted this survey with GFOA to poll members about their ERP systems. We designed the survey to provide an objective view of experiences and expectations so members can share lessons and best practices.
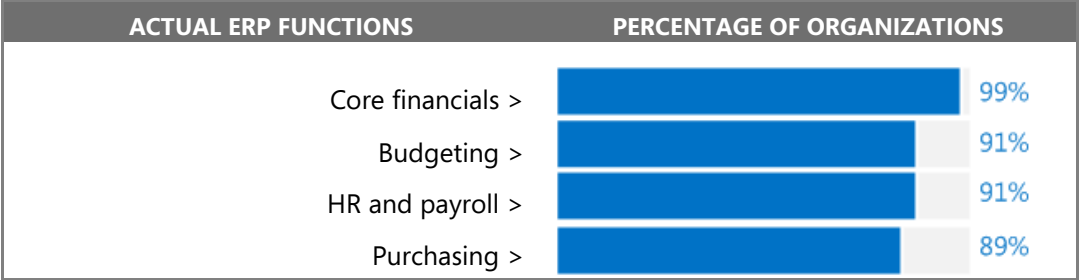
An invitation to participate was sent to all GFOA members in spring 2012, and 268 financial leaders responded, representing cities, counties, schools, colleges, water and utility districts, and other organizations from all over the country. Respondents work across a variety of operating budget sizes, as Figure 1 shows.

Figure 1. Profile of participants, by budget
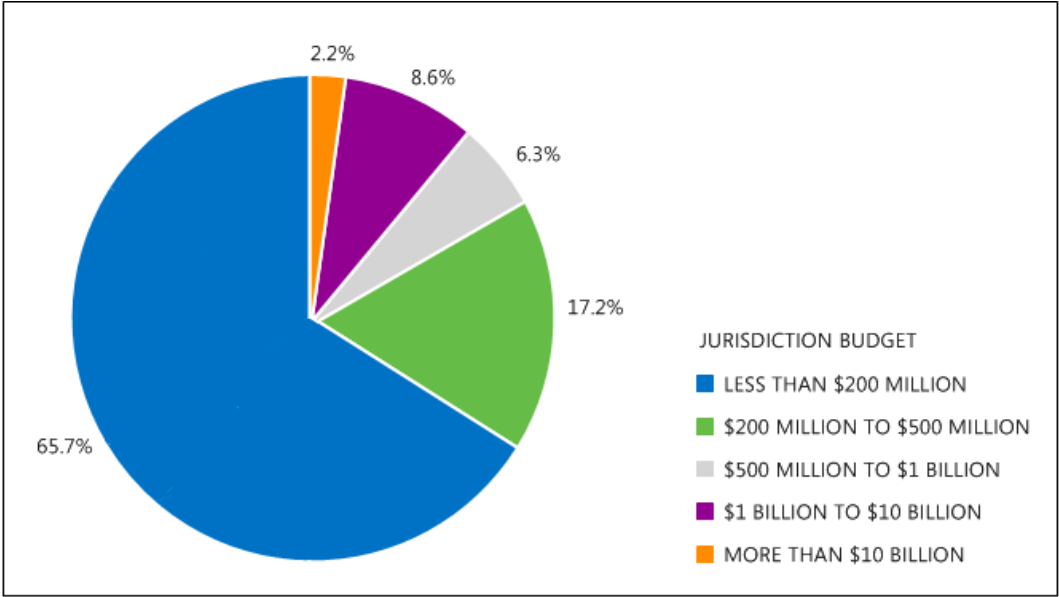
The respondents were split between those who had implemented a new ERP system within the past 10 years and those who had not modernized. Of the group with new systems, the great majority had implemented core ERP functions. (See Figure 2.)

Figure 2. ERP functions implemented, by organization

ACTUAL ERP FUNCTIONS	PERCENTAGE OF ORGANIZATIONS
Core financials >	99%
Budgeting >	91%
HR and payroll >	91%
Purchasing >	89%

FINDINGS AND ANALYSIS

From cities to public utilities to school districts, GFOA members have unique requirements and, all too often, constrained budgets. Many continue to run their operations using the

systems they implemented more than a decade ago. Organizations with newer systems are more satisfied with their experience, but almost none could quantify the benefits gained from their investment. So what is the exact value of ERP systems to public sector organizations?

Summary of survey participants

Overall, survey participants reported positive experiences of their ERP systems' capabilities, regardless of when those systems were deployed. Respondents fell into three groups:

- Those with a new system: 139 organizations. These GFOA members deployed new systems between 2002 and 2011, most within the past five years. Their expectations, measured as an aggregate, were met only 42 percent of the time, they reported. When it came to software cost and maintenance, respondents were more positive. The biggest issues were with implementation challenges, ease of use, and customization to meet business needs.

- Those planning to get a new system within the next five years: 84 organizations. These organizations expressed optimism about the expected capabilities to be provided by their new ERP systems—tempered by uncertainty about cost and by pessimism about the difficulty of implementation.

- Those with no plans: 62 organizations. Although funding and budget constraints were the most common reason cited by the group with no plans to replace their legacy systems, many also did not see the value of ERP to an organization of their size or function. Yet, of this group, only two organizations were satisfied with their legacy systems.

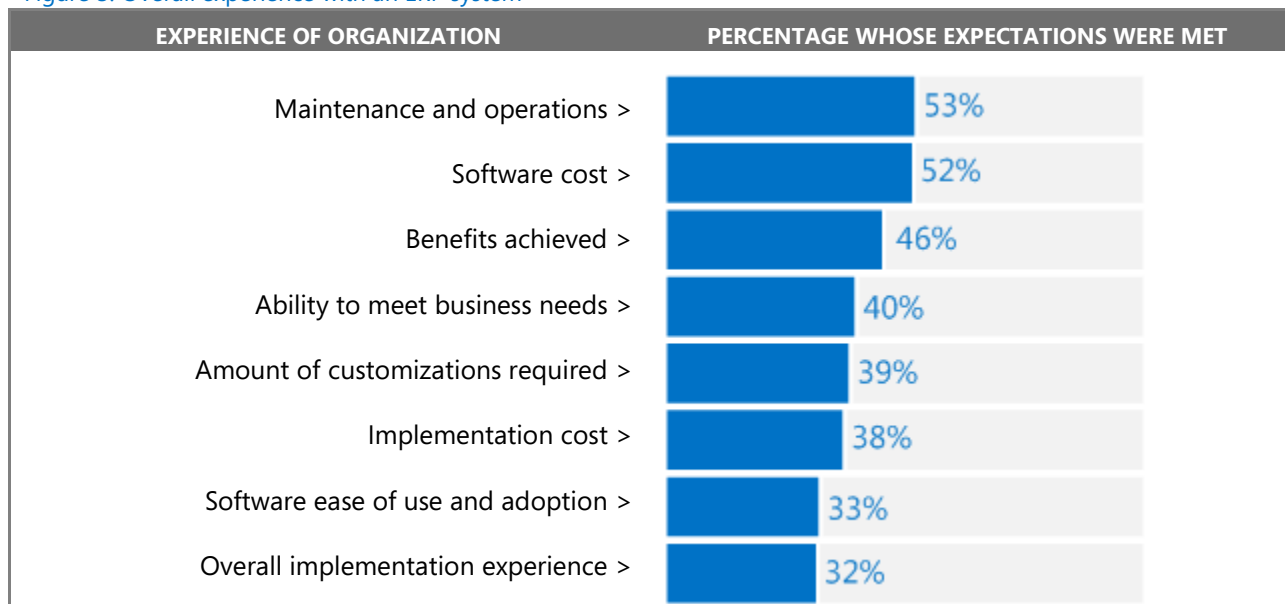## Value of ERP: perceptions vs. reality

The perceived value of ERP systems is high. Local organizations use these enterprise systems to manage traditional core functions, including finance, budgeting, purchasing, HR, and payroll. However, organizations often hope to—and do—use them for additional purposes, as well. The smaller the organization, the more likely it is to want one platform or a single-vendor solution to do everything. For example, the 139 organizations with newer ERP systems also used them for billing, permitting, code enforcement, inventory management, work orders, recruiting, revenue or cash management, time collection, and even court management.

So how valuable are these systems? For these 139 organizations, the new systems met their expectations to varying degrees, as Figure 3 shows. Project delays were often cited as a reason for dissatisfaction. For example, one county noted, "With regards to project delay, a major factor was the number of interfaces and conversions that had to be completed for various county-wide systems." Vendors and implementers proved problematic for others, and the following comment was typical: "Frankly, the vendor did not keep their sales promises. We also have difficulty with product support response."

Figure 3. Overall experience with an ERP system

EXPERIENCE OF ORGANIZATION	PERCENTAGE WHOSE EXPECTATIONS WERE MET
Maintenance and operations >	53%
Software cost >	52%
Benefits achieved >	46%
Ability to meet business needs >	40%
Amount of customizations required >	39%
Implementation cost >	38%
Software ease of use and adoption >	33%
Overall implementation experience >	32%

The majority of organizations did not assess their system's value after implementation. By contrast, the group planning to implement a new system expected that they *would* perform an ROI analysis. In reality, a formal systems analysis is the exception. (See Figure 4.)

> " So busy after implementation, ROI analysis has not been performed. "

Figure 4. Whether a formal ROI assessment will or did take place

ORGANIZATIONS PLANNING TO MODERNIZE: 30%, 70%

ORGANIZATIONS WITH NEW SYSTEMS: 31%, 69%

■ YES—PLAN TO / DID ASSESS ROI
■ NO—HAVE NO PLANS TO / DID NOT ASSESS ROI
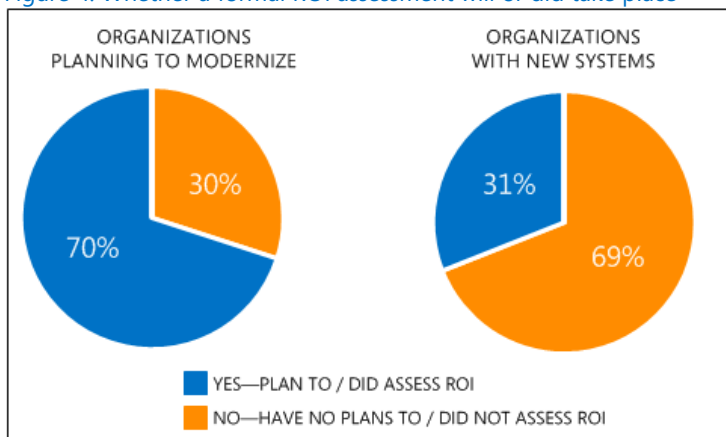
Predicting cost: an unexpected difficulty

For the 84 organizations considering a new system in the next five years, the cost forecast is very difficult to predict. Despite their pre-sales efforts, the participants had widely varying ideas about the real-world cost of ERP systems. Moreover, there was no correlation between the size of an organization and its estimate. Respondents thought a new system would cost anywhere from less than $500,000 to $10 million.

By comparison, the GFOA members with modern systems indicated that cost clearly correlated with size. (See Figure 5.) The larger the organization, the more expensive the system was to acquire and to maintain.

Assessing system benefits: expectations vs. experiences

When it comes to benefits, the size of the organization matters. Small-budget organizations tended to have *lower* expectations than their big-budget peers when it came to system implementation. The uniqueness of public sector requirements is a big factor. Experience has taught GFOA members that their complex business requirements cannot always be met by off-the-shelf systems.

Figure 5. Cost of ERP software by size of budget

Smaller organizations often lack the resources or expertise necessary for thorough system analysis, and they rely heavily on consultants to advise them during the process of planning, comparing, and selecting enterprise systems. That experience varies widely, according to survey respondents.

Overall, however, those planning to modernize had high expectations, which the actual experience did not always meet—such as the expectation that the system would provide integrated, reliable data that supported more-formed decision-making. (See Figure 6.)
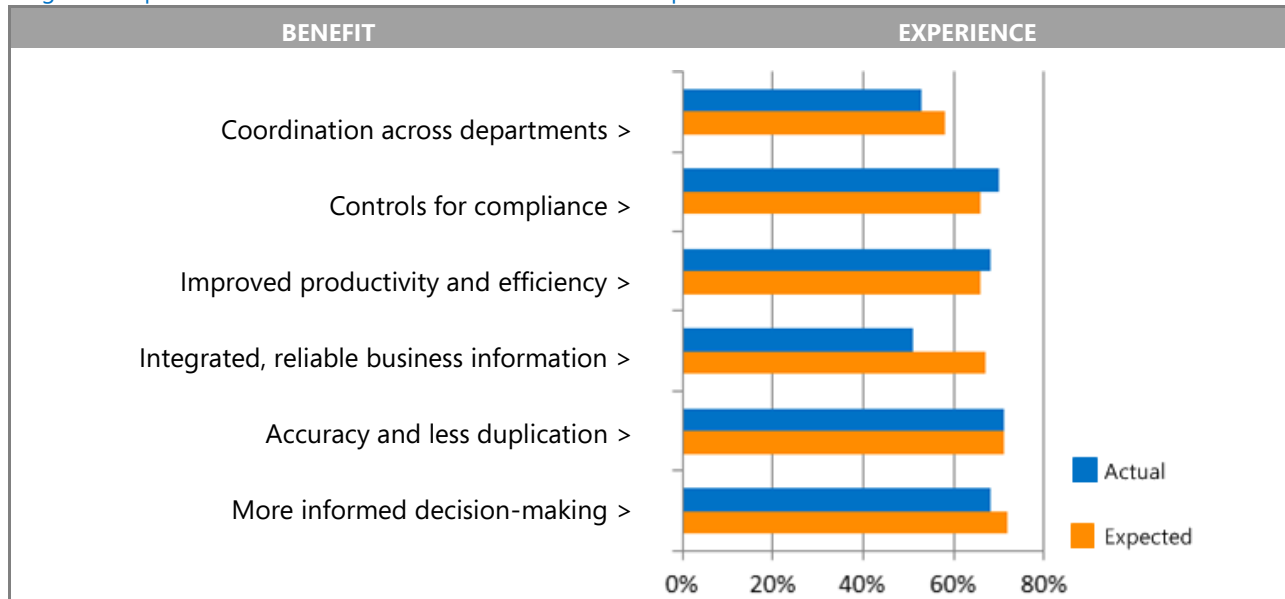
Figure 6. Expected benefits of ERP modernization vs. actual experience of benefits

Meeting project deadlines

How long should it take to deploy a new ERP system? Two-thirds of our respondents planning to do so hope to implement within 18 months or less; only one-third expected it to take longer. In reality, organizations had about a 50/50 chance of deploying their ERP systems within a year or less, according to those who had done it. (See Figure 7.)

> " There always seem to be hardware, wiring, space, or other third-party vendor delays/costs that are unanticipated. "

Project delays were frequently cited. Many GFOA members met resistance from users, who were slow to adapt to the new system. Staffing limitations or turnover caused some roadblocks. Several experienced unforeseen issues with their software vendors and systems integrators, as well—mixed messages, unforeseen functional gaps, extra customizations, and even old-fashioned incompetence. "We were not working with the 'A' implementation team," said one city leader.

Figure 7. Expected duration of ERP implementation project vs. actual experience
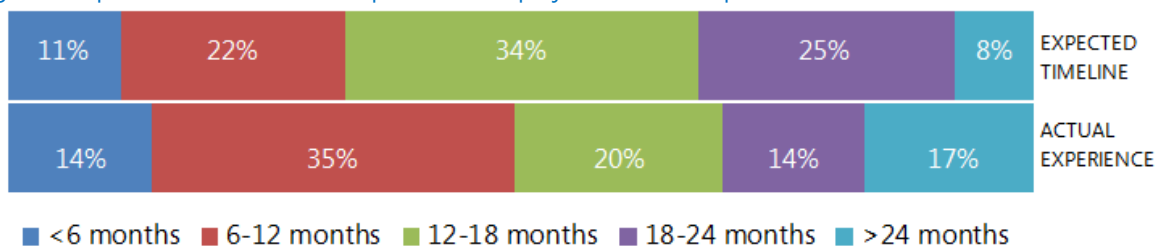
Considering the cloud

Our analysis shows a high degree of interest (50 percent) in incorporating cloud computing as a delivery option for future purchases. Cloud services can provide many benefits to agencies at any level. From a budgeting standpoint, the predictable operational expenses for many cloud services make them more predictable than the spikes in capital expenditures associated with staffing, maintaining servers, and other data center requirements. Service providers also handle maintenance and upgrades with little to no disruption to users, freeing agency resources for other priorities. Even with the promise of the cloud, only 18 percent of the respondents use those services today.

A small number (25 percent) indicated that they were unlikely to consider cloud computing solutions, primarily because they associated the cloud with a loss of control and security. (See Figure 8.)

> " The only way[*sic*] to lower the acquisition and implementation cost of ERP systems is to go with software as a service (SaaS) with remote access and training via the Internet. "

Figure 8. Anticipated cloud use vs. actual cloud use
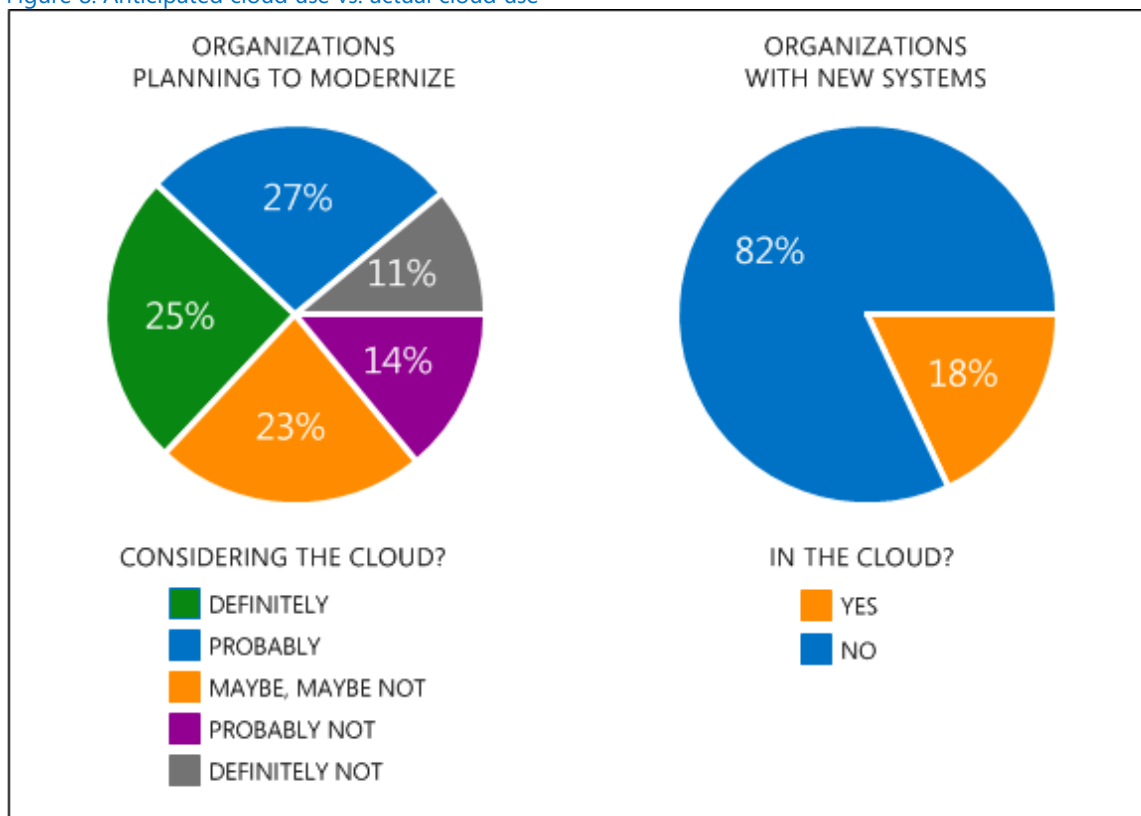
Moving forward: What do organizations think is realistic?

According to the GFOA members who have implemented modern systems in the past 10 years, it's realistic to expect some challenges and feature gaps. This may not be welcome news for those planning to get a new system, who, as a group, were more optimistic about the implementation experience compared to those who had undergone the process. For example, in this group, 66 percent expect that a new software package will meet their needs; only 34 percent anticipate gaps. (See Figure 9.)

> " I think there will be way more process change than anyone has any idea about. "

Figure 9. Assessment of experiences and future expectations

PLANNING TO MODERNIZE ERP			EXPECTATIONS	HAVE MODERN ERP		
☺	😐	☹		☺	😐	☹
66%	28%	6%	Ability to meet business needs	40%	45%	15%
38%	51%	11%	Amount of customization	39%	43%	18%
39%	41%	20%	Software ease of use and adoption	33%	51%	16%
39%	44%	17%	Resources for maintenance	54%	31%	15%
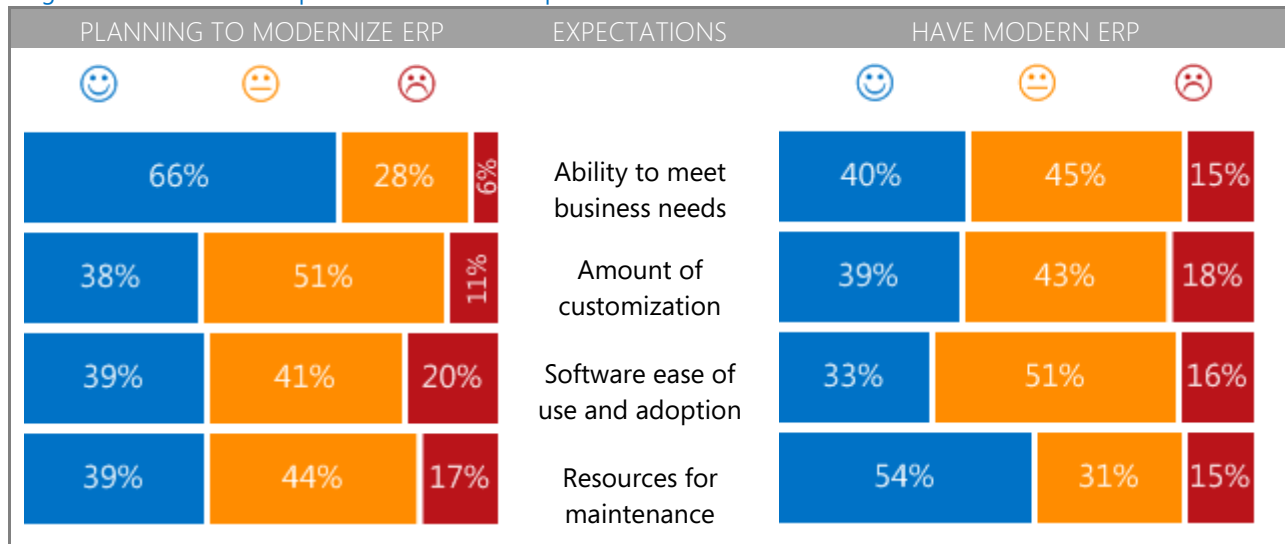
However, according to those with modern systems, gaps are the reality. When it came to meeting business requirements, 60 percent experienced minor or major gaps with their implementations, 61 percent required at least some customization, and change orders (which typically cost an additional 5 to 10 percent of the original contract value) were the rule for the majority.

Figure 10. Realistic expectations, according to organizations with modern systems

EXPERIENCE OF ORGANIZATION	NUMBER OF ORGANIZATIONS
Had delay in go-live date >	66%
Required change orders to modify scope >	70%
Had issues with change management >	73%
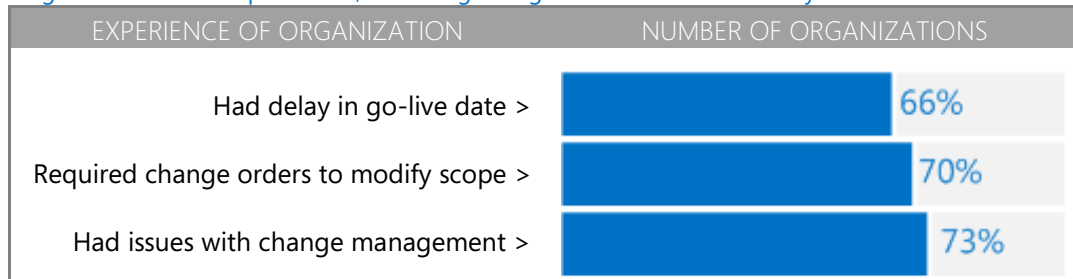
On the positive side, system maintenance is not as dreadful as imagined, which begs the question: Are expectations too low? More than 60 percent of those with legacy systems expect gaps in their ability to maintain a planned new system. The reality, according those who've done it, is that there may be gaps in resources, but for the majority, the new systems met their expectations for maintenance and operations.

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Reasons for success

Organizations with modern systems cited several critical factors in the success of their implementation projects:

- **Size.** Simply put, the smaller the organization, the better the overall experience. With less complex requirements and operations, smaller organizations experienced fewer problems and delays than did the others in the survey.

> " I think it is feasible to lower the acquisition and implementation cost and improve user adoption/experience to achieve the desired business benefits. If time is invested up front, the change may be more acceptable to staff and other stakeholders. "

- **Planning.** Up-front due diligence lent success to endeavors. Many noted that they spent significant time in planning and setup and commented that this effort made their implementation projects successful. As one put it, "We had exceptional planning…and had a hard stop with desupport of our existing system. You could say we burned the *Bounty* and had to move to the new system. Failure was not an option."

- **Management endorsement.** Strong endorsement from the top trickled down and positively motivated implementation efforts. Executive leadership needed to provide ongoing communications and ensure appropriate staffing.

- **Vendor and implementer partnership.** Having a committed and forthright software vendor was a key factor in an organization's satisfaction with their ERP solution. Those who closely partnered with their software implementers, and who had appropriate support from the grassroots to the executive level, felt more satisfied with the outcomes. If the implementer was familiar with the existing legacy environment, so much the better.

Reasons for concern

When newly implemented systems fell short of expectations, reasons for dissatisfaction ran the gamut from legislative obstacles to licensing fees, but these areas stood out:

> " We are a small city and have not implemented the Purchasing module, because so far it is beyond the grasp of our corporate culture. "

- **Lack of technological expertise.** Many of the smaller organizations felt that their lack of IT resources limited them during ERP planning and implementation projects. Many mentioned that they simply had too few specialists on staff who could perform needs or cost assessments, and they relied heavily on outside vendors for help.

- **The power of human resistance.** In the less-successful implementation projects, issues with culture and staff stood out. Survey participants cited lack of vision from the top or resistance from bottom—or both. Many organizations noted that training users was more complicated than expected, either because people were reluctant to learn something new, employees were dissatisfied with the training program, or users couldn't easily learn the complex system. Without the executive leadership consistently setting a vision and expectations, changes to culture are either non-existent or slow to take effect.

- **Vendors and implementers.** Local governments and small organizations find themselves at the mercy of vendors who may not fully understand public sector business processes. Many organizations reported project delays and cost overruns because of vendor inexperience or overzealous software salespeople. The consensus was that implementers overpromise and underdeliver.

RECOMMENDATIONS FROM GFOA MEMBERS

In their comments, GFOA financial leaders clarify the reasons for their successes and express concerns around planning and implementing an ERP system.

> " Because of the status of the current software, a change was going to be made. The direction we went was the least costly for the power purchased. "

Consider their lessons learned and best practices during an ERP modernization effort:

- **Think partnership—inside and outside the organization.** GFOA members relied heavily on outside implementation consultants and attributed successful implementations to a partnership. Inside the organization, survey participants underscore the need to get buy-in from all the groups who will be using the system so they have a say in its implementation and functionality.

- **Get help with planning.** It can be helpful to work with an independent consultant on the many phases of an ERP project, including planning and Independent Verification and Validation (IV&V). Third parties can help you frame system requirements, but they can never be the expert that you are in your business, accounting, and operating practices.

- **Consider staffing.** Many smaller organizations juggled resources creatively to cover all operational tasks during their implementation project. Some kept project team members assigned to the existing system while implementing the new so that day-to-day operations remained as seamless as possible. Others backfilled positions (if they had the budget) or used both employees and vendor personnel in a cooperative blending of development and implementation resources.

- **Stay flexible.** Although software customization was not as great a problem for smaller organizations as it was for the larger ones, it is always a best practice to avoid the expense of customization whenever possible. Some organizations did this by changing their business practices to better match the functionality of their new ERP system.

- **Set expectations—and communicate frequently.** When faced with change, people often find reasons to complain. GFOA members noted that the more they set appropriate expectations up front and looped everyone into the planning process, the more satisfied they were with user adoption.

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MICROSOFT POINT OF VIEW

The benefits of ERP systems seem to be difficult for public sector organizations to quantify, even though most expect improved operations as a result of implementation.

After hearing about the experiences of GFOA members, we saw a common theme in the way they work with software vendors and systems integrators. Public sector organizations have unique requirements—managing grants and budgets to name just two. From the perspective of our survey participants, the available products will always have gaps in feature sets. Not only do they see the gaps as an issue, but also they think software companies overpromise and oversell.

We see the need for open, objective dialogue. The vendor community can afford to be forthright in articulating what their systems can and cannot do for public sector organizations. Moreover, vendors should step forward with innovations that bring greater value to government workers and the constituents they serve.

Based on key performance indicators and environmental drivers, public sector entities can better prioritize IT modernization efforts. Increasing operational efficiency and improving citizen services should be the primary purpose for replacing an ERP system.

Key takeaways

- Get *built for government.* Some organizations told us that they planned to reengineer their operations to match the systems they had implemented in the belief that doing so would improve efficiency. Yet government operations are unique. Systems that are flexible—and able to meet public sector requirements out of the box—ease implementation and offer greater business value.

- Focus on your core needs. The just-right system must fit the sophisticated needs of the public sector without being overly complex. You should use ERP where ERP works best: financials, budgeting, purchasing, HR, and payroll. Other functions should be implemented separately—preferably using software that also interoperates with the ERP platform.

ARE YOU GETTING THE MOST OUT OF YOUR VENDORS AND SYSTEMS INTEGRATORS?

We cannot overstate the degree of frustration that survey participants revealed in their comments about third-party software vendors. One government agency manager noted that its staff members had worked at software companies, so they knew the lengths to which a salesperson would go to win a project. "Software company sales staff will promise anything… It does not matter how detailed the one-on-one meetings with software companies before you purchase. Also, software products still have bugs that take more time to research and fix."

As a software company with a long history of working in partnership with governments at all levels around the world, we know that vendors can do better. Partnerships between the public and private sector can succeed with a collaborative process and well-defined, common goals.

We agree with the participant who said, "A good ERP system should be able to meet the needs of an organization—especially if there is ample communication between the organization and vendor prior to selection of the system to lay out a detailed description of the needs of the organization and expectations after implementation."

- **Look for ease of use.** Adopt technologies that you commonly use. Organizations should expect their systems to work in a familiar manner, like other desktop tools that employees know and use. That way, users get up to speed and productive quickly, which can help reduce training costs and can lessen user frustration and resistance to the new system.

- **Minimize costs.** Do not purchase additional modules until you are ready to implement the extended functionality. Cost evaluation criteria should include both the application software licenses *and* the database software. Reduce change orders, and limit software customizations only to those that address regulatory requirements.

- **Define the benefits.** Are organizations gaining the intended benefits of their ERP systems? The perception of ERP's value may not match the reality for public sector organizations—but the truth is, the data simply is not there to say for certain. Nonetheless, those planning to modernize because others have done it may be underestimating the cost and overestimating the benefit. New approaches to planning, procuring, implementing, and assessing the impact of ERP must be considered.

- **Start with the end in mind.** Before an organization embarks on any effort involving a significant investment, it should define success. With ERP implementations specifically, that definition must come from all they key sponsors—both within the organizations and across its vendors. A clear view of expected results up front, plus attention to the key success factors, should drive every decision before, during, and after your ERP solution is implemented.

Next steps for organizations using legacy software

The time will come when you must modernize. Take the time to learn from other GFOA members and to get clear on your requirements. Then:

- **Start with an independent opinion.** Use third-party experts who can help you evaluate the current state, future vision, and required investments to transform your organization.

- **Consider the cloud.** Determine whether cloud solutions can provide business benefits, and incorporate cloud options as part of a holistic ERP systems evaluation.

- **Do your homework.** Before issuing an RFP, assess the marketplace to gain a better understanding of the available capabilities—and get product demonstrations from software vendors.

- **Prioritize ease of use**—not just because it increases user satisfaction and adoption rates, but also because it promotes self-sufficiency and reduces the need for extensive training.

- **Ensure agility.** Get a flexible solution that enables your organization to effectively respond to constituent needs and legislative mandates.

- **Select a reliable vendor.** Make sure your software vendor provides future innovations and not just maintenance fees year after year. Find out whether other system integrators support the solution so you have more choices and don't get locked into one vendor for upgrades and support.

Next steps for organizations using new ERP software

If your organization implemented an ERP system within the past 5 or 10 years, you can look for ways to make the most of your investment:

- **Make sure your employees are proficient with the system.** Ask them for their feedback. You'll gain useful information about needed improvements and foster inclusiveness, which contributes to user adoption. The power of productivity starts with them.

- **Stay current with your vendor's software releases.** Work with your vendor to assess your gaps. Determine if the next release offers new functionality you can take advantage of to deliver additional business value.

- **Ask your vendor about the future.** All too often, specialized vendors do not significantly invest in future innovations, limiting the ongoing value you get from your ERP system. Find out how much they invest in research and development for their solutions. After all, you're paying an ongoing maintenance fee, so you deserve a system that not only works today but also delivers on the promise of the next-generation ERP advances built for public sector.

In our view, these requirements, capabilities, and demands are the bare minimum you should expect any ERP vendor to meet with their solution. Just as today's citizens have higher expectations for the services they receive from you, so you should from your vendor. Work closely with your vendor to maximize the benefits of your new system. Public sector entities and the citizens they serve deserve nothing less.

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THE ECONOMICS OF THE CLOUD FOR THE US PUBLIC SECTOR

Computing is undergoing a seismic shift from client/server to the cloud, a shift similar in importance and impact to the transition from mainframe to client/server. Speculation abounds on how this new era will evolve in the coming years, and IT leaders have a critical need for a clear vision of where the industry is heading. We believe the best way to form this vision is to understand the underlying economics driving the long-term trend. In this paper, we will assess the economics of the cloud by using in-depth modeling. We then use this framework to better understand the long-term IT landscape.

1. INTRODUCTION

When cars emerged in the early 20th century, they were initially called "horseless carriages". Understandably, people were skeptical at first, and they viewed the invention through the lens of the paradigm that had been dominant for centuries: the horse and carriage. The first cars also looked very similar to the horse and carriage (just without the horse), as engineers initially failed to understand the new possibilities of the new paradigm, such as building for higher speeds, or greater safety. Incredibly, engineers kept designing the whip holder into the early models before realizing that it wasn't necessary anymore.

FIG. 1: HORSELESS CARRIAGE SYNDROME

Initially there was a broad failure to fully comprehend the new paradigm. Banks claimed that, "*The horse is here to stay but the automobile is only a novelty, a fad".*
Even the early pioneers of the car didn't fully grasp the potential impact their work could have on the world. When Daimler, arguably the inventor of the automobile, attempted to estimate the long-term auto market opportunity, he concluded there could never be more than 1 million cars, because of their high cost and the shortage of capable chauffeurs[1].

By the 1920s the number of cars had already reached 8 million, and today there are over 600 million cars – proving Daimler wrong hundreds of times over. What the early pioneers failed to realize was that profound reductions in both cost and complexity of operating cars and a dramatic increase in its importance in daily life would overwhelm prior constraints and bring cars to the masses.

Today, IT is going through a similar change: the shift from client/server to the cloud. Cloud promises not just cheaper IT, but also faster, easier, more flexible, and more effective IT.

Just as in the early days of the car industry, it's currently difficult to see where this new paradigm will take us. **The goal of this whitepaper is to help build a framework that allows IT leaders in governments to plan for the cloud transition**[2]. We take a long-term view in our analysis, as this is a prerequisite when evaluating decisions and investments that could last for decades. As a result, we focus on the economics of cloud rather than on specific technologies or other driving factors like organizational change, as economics often provide a clearer understanding of transformations of this nature.

In Section 2, we outline the underlying economics of cloud, focusing on what makes it truly different from client/server. In Section 3, we will assess the implications of these economics for the future of government IT. We will discuss the positive impact cloud will have on governments but will also discuss the obstacles that still exist today. Finally, in Section 4, we will discuss what's important to consider as IT leaders in the public sector embark on the journey to the cloud.

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[1] Source: Horseless Carriage Thinking, William Horton Consulting.
[2] Cloud in this context refers to cloud computing architecture, encompassing both public and private clouds.

Microsoft

2. ECONOMICS OF THE CLOUD

Economics are a powerful force in shaping industry transformations. Today's discussions on the cloud focus a great deal on technical complexities and adoption hurdles. While we acknowledge that such concerns exist and are important, historically, underlying economics have a much stronger impact on the direction and speed of disruptions, as technological challenges are resolved or overcome through the rapid innovation we've grown accustomed to (Fig. 2). During the mainframe era, client/server was initially viewed as a "toy" technology, not viable as a mainframe replacement. Yet, over time the client/server technology found its way into organizations of all types (Fig. 3). Similarly, when virtualization technology was first proposed, application compatibility concerns and potential vendor lock-in were cited as barriers to adoption. Yet underlying economics of 20 to 30 percent savings[3] compelled CIOs to overcome these concerns, and adoption quickly accelerated.

The emergence of cloud services is again fundamentally shifting the economics of IT. Cloud technology standardizes and pools IT resources and automates many of the maintenance tasks done manually today. Cloud architectures facilitate elastic consumption, self-service, and pay-as-you-go pricing.

FIG. 2: CLOUD OPPORTUNITY

	Technology	Economic	Business Model
Mainframe	Centralized compute and storage Thin clients	Optimized for efficiency because of the high cost	High up-front costs for hardware and software
Client/ Server	PCs and servers for distributed compute, storage, and so on	Optimized for agility because of the low cost	Perpetual license for OS and application software
Cloud	Large DCs, ability to scale, commodity hardware, devices	Efficiency and agility an order of magnitude better	Ability to pay as you go, and only for what you use

Source: Microsoft.

FIG. 3: BEGINNING THE TRANSITION TO CLIENT/ SERVER TECHNOLOGY

Source: "How convention shapes our market" longitudinal survey, Shana Greenstein, 1997.

Cloud also allows core IT infrastructure to be brought into large data centers that take advantage of significant economies of scale in three areas:
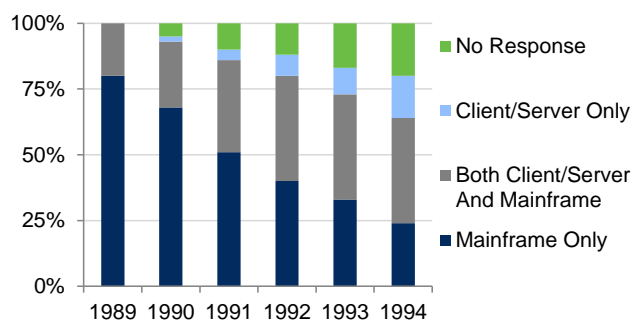
- **Supply-side savings.** Large-scale data centers (DCs) lower costs per server.
- **Demand-side aggregation.** Aggregating demand for computing smooths overall variability, allowing server utilization rates to increase.
- **Multi-tenancy efficiency.** When changing to a multitenant application model, increasing the number of tenants (i.e., customers or users) lowers the application management and server cost per tenant.

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[3] Source: "Dataquest Insight: Many Midsize Businesses Looking Toward 100% Server Virtualization". Gartner, May 8, 2009.

Microsoft

2.1 Supply-Side Economies of Scale

Cloud computing combines the best economic properties of mainframe and client/server computing. The mainframe era was characterized by significant economies of scale due to high up-front costs of mainframes and the need to hire sophisticated personnel to manage the systems. As required computing power – measured in MIPS (million instructions per second) – increased, cost declined rapidly at first (Fig. 4), but only large central IT organizations had the resources and the aggregate demand to justify the investment. Due to the high cost, resource utilization was prioritized over end-user agility. Users' requests were put in a queue and processed only when needed resources were available.

FIG. 4: ECONOMIES OF SCALE (ILLUSTRATIVE)
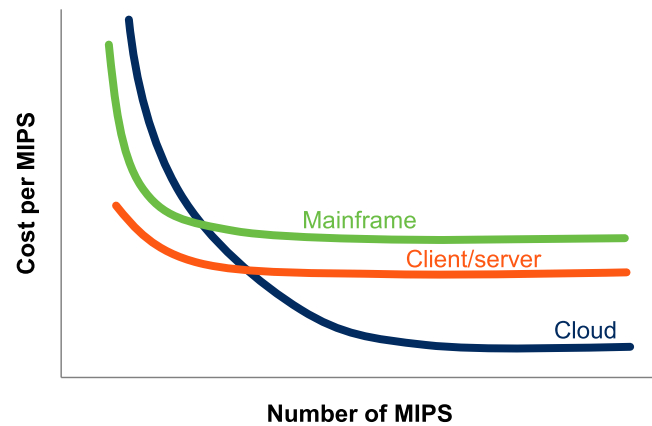
Source: Microsoft.

With the advent of minicomputers and later client/server technology, the minimum unit of purchase was greatly reduced, and the resources became easier to operate and maintain. This modularization significantly lowered the entry barriers to providing IT services, radically improving end-user agility. However, there was a significant utilization tradeoff was, resulting in the current state of affairs: datacenters sprawling with servers purchased for whatever needed existed at the time, but running at just 5%-10% utilization[4].

Cloud computing is not a return to the mainframe era as is sometimes suggested, but in fact offers users economies of scale and efficiency that exceed those of a mainframe, coupled with modularity and agility beyond what client/server technology offered, thus eliminating the tradeoff.

The economies of scale emanate from the following areas:

- **Cost of power.** Electricity cost is rapidly rising to become the largest element of total cost of ownership (TCO),[5] currently representing 15%-20%. Power Usage Effectiveness (PUE)[6] tends to be significantly lower in large facilities than in smaller ones. While the operators of small data centers must pay the prevailing local rate for electricity, large providers can pay less than one-fourth of the national average rate by locating its data centers in locations with inexpensive electricity supply and through bulk purchase agreements.[7] In addition, research has shown that operators of multiple data centers are able to take advantage of geographical variability in electricity rates, which can further reduce energy cost.

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[4] Source: *The Economics of Virtualization: Moving Toward an Application-Based Cost Model*, IDC, November 2009.
[5] Not including app labor. Studies suggest that for low-efficiency datacenters, three-year spending on power and cooling, including infrastructure, already outstrips three-year server hardware spending.
[6] Power Utilization Effectiveness equals total power delivered into a datacenter divided by "critical power" – the power needed to actually run the servers. Thus, it measures the efficiency of the datacenter in turning electricity into computation. The best theoretical value is 1.0, with higher numbers being worse.
[7] Source: U.S. Energy Information Administration (July 2010) and Microsoft. While the average U.S. commercial rate is 10.15 cents per kilowatt hour, some locations offer power for as little as 2.2 cents per kilowatt hour

Microsoft

- **Infrastructure labor costs.** While cloud computing significantly lowers labor costs at any scale by automating many repetitive management tasks, larger facilities are able to lower them further than smaller ones. While a single system administrator can service approximately 140 servers in a traditional enterprise,[8] in a cloud data center the same administrator can service thousands of servers. This allows IT employees to focus on higher value-add activities like building new capabilities and working through the long queue of user requests every IT department contends with.
- **Security and reliability.** While often cited as a potential hurdle to public cloud adoption, increased need for security and reliability leads to economies of scale due to the largely fixed level of investment required to achieve operational security and reliability. Large commercial cloud providers are often better able to bring deep expertise to bear on this problem than a typical corporate IT department, thus actually making cloud systems more secure and reliable.
- **Buying power.** Operators of large data centers can get discounts on hardware purchases of up to 30 percent over smaller buyers. This is enabled by standardizing on a limited number of hardware and software architectures. Recall that for the majority of the mainframe era, more than 10 different architectures coexisted. Even client/server included nearly a dozen UNIX variants and the Windows Server OS, and x86 and a handful of RISC architectures. Large-scale buying power was difficult in this heterogeneous environment. With cloud, infrastructure homogeneity enables scale economies.

Going forward, there will likely be many additional economies of scale that we cannot yet foresee. The industry is at the early stages of building data centers at a scale we've never seen before (Fig. 5). The massive aggregate scale of these mega DCs will bring considerable and ongoing R&D to bear on running them more efficiently, and make them more efficient for their customers. Providers of large-scale DCs, for which running them is a primary business goal, are likely to benefit more from this than smaller DCs which are run inside enterprises or public sector agencies.

FIG. 5: RECENT LARGE DATA-CENTER PROJECTS

Company	Location	Cost ($ in millions)	Size (in sq. feet)
Internet Villages JUL 2009	Annandale, Scotland	1,600	3,000,000
National Security Admin. JUL 2009	Camp Williams, Utah	2,000	1,000,000
Lockerbie Data Centers DEC 2009	Lockerbie, Scotland	1,500	N/A
Microsoft SEP 2009	Chicago, Illinois	500	700,000
I/O Data Centers JUN 2009	Phoenix, Arizona	N/A	538,000
Apple MAY 2009	Maiden, North Carolina	1,000	500,000
Microsoft JUN 2010	Dublin, Ireland	500	N/A
U.S. Social Security Admin. FEB 2009	Baltimore, Maryland	400	N/A
Facebook FEB 2010	Princeville, Oregon	N/A	307,000
Next Generation Data MAR 2010	Cardiff, Wales	301	N/A

Sources: Press releases.

2.2 Demand-Side Economies of Scale

The overall cost of IT is determined not just by the cost of capacity, but also by the degree to which the capacity is efficiently utilized. We need to assess the impact that demand aggregation will have on costs of actually utilized resources (CPU, network, and storage).[9]

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[8] Source: James Hamilton, Microsoft Research, 2006.
[9] In this paper, we talk generally about "resource" utilization. We acknowledge there are important differences among resources. For example, because storage has fewer usage spikes compared with CPU and I/O resources, the impact of some of what we discuss here will affect storage to a smaller degree.

In the non-virtualized data center, each application/workload typically runs on its own physical server.[10] This means the number of servers scales linearly with the number of server workloads. In this model, utilization of servers has traditionally been extremely low, around 5 to 10 percent.[11] Virtualization enables multiple applications to run on a single physical server within their optimized operating system instance, so the primary benefit of virtualization is that fewer servers are needed to carry the same number of workloads. But how will this affect economies of scale? If all workloads had constant utilization, this would entail a simple unit compression without impacting economies of scale. In reality, however, workloads are highly variable over time, often demanding large amounts of resources one minute and virtually none the next. This opens up opportunities for utilization improvement via demand-side aggregation and diversification.

We analyzed the different sources of utilization variability and then looked at the ability of the cloud to diversify it away and thus reduce costs.

We distinguish five sources of variability and assess how they might be reduced:

1. **Randomness.** End-user access patterns contain a certain degree of randomness. For example, people check their email at different times (Fig. 6). To meet service level agreements, capacity buffers have to be built in to account for a certain probability that many people will undertake particular tasks at the same time. If servers are pooled, this variability can be reduced.

2. **Time-of-day patterns.** There are daily recurring cycles in people's behavior: consumer services tend to peak in the evening, while workplace services tend to peak during the workday. Capacity has to be built to account for these daily peaks but will go unused during other parts of the day causing low utilization. This variability can be countered by running the same workload for multiple time zones on the same servers (Fig. 7) or by running workloads with complementary time-of-day patterns (for example, consumer services and enterprise services) on the same servers.

FIG. 6: RANDOM VARIABILITY (EXCHANGE SERVER)
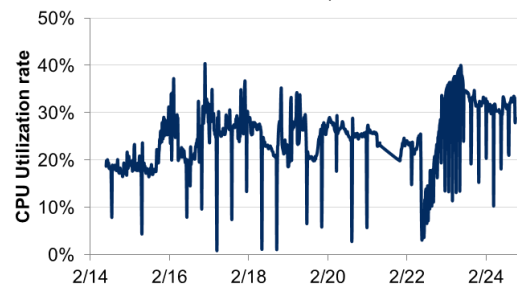
Source: Microsoft.

**FIG. 7:** TIME-OF-DAY PATTERNS FOR SEARCH
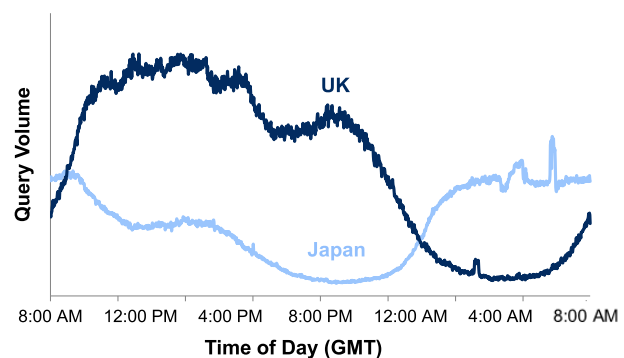
Source: Bing Search volume over 24-hour period.

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[10] Multiple applications can run on a single server, of course, but this is not common practice. It is very challenging to move a running application from one server to another without also moving the operating system, so running multiple applications on one operating system instance can create bottlenecks that are difficult to remedy while maintaining service, thereby limiting agility. Virtualization allows the application plus operating system to be moved at will.
[11] Source: *The Economics of Virtualization: Moving Toward an Application-Based Cost Model*, IDC, November 2009.

Microsoft

November 2010

3. **Industry-specific variability.** Some variability is driven by industry dynamics. Retail firms see a spike during the holiday shopping season while U.S. tax firms will see a peak before April 15 (Fig. 8). There are multiple kinds of industry variability — some recurring and predictable (such as the tax season or the Olympic Games), and others unpredictable (such as major news stories). The common result is that capacity has to be built for the expected peak (plus a margin of error). Most of this capacity will sit idle the rest of the time. Strong diversification benefits exist for industry variability.
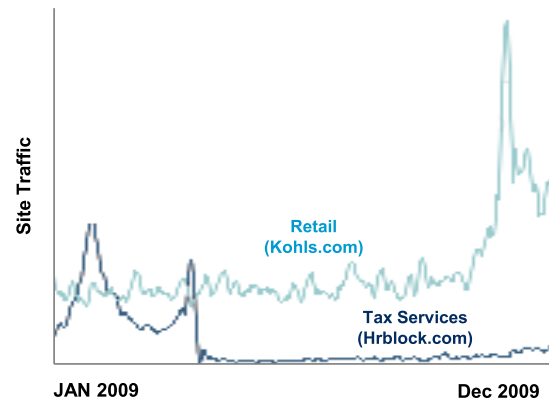
4. **Multi-resource variability.** Compute, storage, and input/output (I/O) resources are generally bought in bundles: a server contains a certain amount of computing power (CPU), storage, and I/O (e.g., networking or disk access). Some workloads like search use a lot of CPU but relatively little storage or I/O, while other workloads like email tend to use a lot of storage but little CPU (Fig. 9). While it's possible to adjust capacity by buying servers optimized for CPU or storage, this addresses the issue only to a limited degree because it will reduce flexibility and may not be economic from a capacity perspective. This variability will lead to resources going unutilized unless workload diversification is employed by running workloads with complementary resource profiles.

5. **Uncertain growth patterns.** The difficulty of predicting future need for computing resources and the long lead-time for bringing capacity online is another source of low utilization (Fig. 10). For startups in the private sector, this is sometimes referred to as the "TechCrunch effect." Public sector organizations need to secure approval for IT investments well in advance of actually knowing their

FIG. 8: INDUSTRY-SPECIFIC VARIABILITY

Source: Alexa Internet.

FIG. 9: MULTIRESOURCE VARIABILITY (ILLUSTRATIVE)

Source: Microsoft.

FIG.10: UNCERTAIN GROWTH PATTERNS

Source: Microsoft.

Microsoft

November 2010
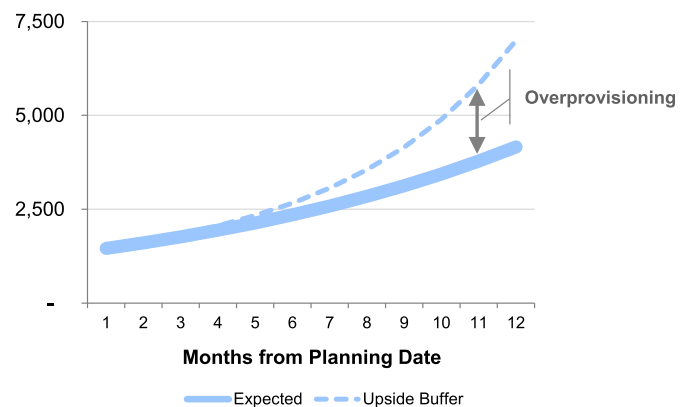
demand for infrastructure. Even large private companies face this challenge, with firms planning their purchases six to twelve months in advance (Fig. 10). By diversifying among workloads across multiple customers, cloud providers can reduce this variability, as higher-than-anticipated demand for some workloads is canceled out by lower-than-anticipated demand for others.

A key economic advantage of the cloud is its ability to address variability in resource utilization brought on by these factors. By pooling resources, variability is diversified away, evening out utilization patterns. The larger the pool of resources, the smoother the aggregate demand profile, the higher the overall utilization rate, and the cheaper and more efficiently the IT organization can meet its end-user demands.
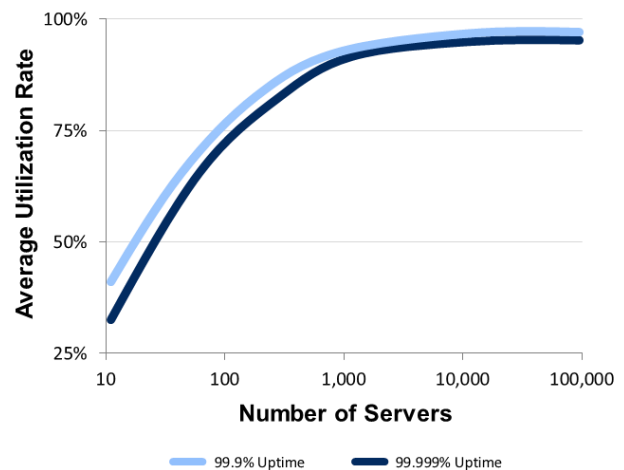
We modeled the theoretical impact of **_random variability_** of demand on server utilization rates as we increase the number of servers.[12] Fig. 11 indicates that a theoretical pool of 1,000 servers could be run at approximately 90% utilization without violating its SLA. This only holds true in the hypothetical situation where random variability is the only source of variability and workloads can be migrated between physical servers instantly without interruption. Note that higher levels of uptime (as defined in a service level agreement or SLA) become much easier to deliver as scale increases.

Clouds will be able to reduce **_time-of-day variability_** to the extent that they are diversified amongst geographies and workload types. Within an average organization, peak IT usage

FIG. 11: DIVERSIFYING RANDOM VARIABILITY

Source: Microsoft.

can be twice as high as the daily average. Even in large, multi-geography organizations, the majority of employees and users will live in similar time zones, bringing their daily cycles close to synchrony. Also, most organizations do not tend to have workload patterns that offset one another: for example, the email, network and transaction processing activity that takes place during business hours is not replaced by an equally active stream of work in the middle of the night. Pooling organizations and workloads of different types allows these peaks and troughs to be offset.

Industry variability results in highly correlated peaks and troughs throughout each firm (that is, most of the systems in a retail firm will be at peak capacity around the holiday season (e.g., web servers, transaction processing, payment processing, databases).[13] Fig. 12 shows industry variability for a number of different industries, with peaks ranging from 1.5x to 10x average usage.

---

[12] To calculate economies of scale arising from diversifying random variability, we created a Monte Carlo model to simulate data centers of various sizes serving many random workloads. For each simulated DC, workloads (which are made to resemble hypothetical web usage patterns) were successively added until the expected availability of server resources dropped below a given uptime of 99.9 percent or 99.99 percent. The maximum number of workloads determines the maximum utilization rate at which the DC's servers can operate without compromising performance.

[13] Ideally, we would use the server utilization history of a large number of customers to gain more insight into such patterns. However, this data is difficult to get and often of poor quality. We therefore used web traffic as a proxy for the industry variability.

Microsoft

Microsoft services such as Windows Live Hotmail and Bing take advantage of *multi-resource diversification* by layering different subservices to optimize workloads with different resource profiles (such as CPU bound or storage bound). It is difficult to quantify these benefits, so we have not included multi-resource diversification in our model.

FIG. 12: INDUSTRY VARIABILITY

Company	Peak Traffic/ Average Traffic
Tax Services	10x
General Retail	4x
Sports (NFL)	2.5x
Travel (airlines, hotels)	1.5x
News	1.5x – 2.0x

Source: Corporate Strategy Group, Alexa Internet, Inc.

Some *uncertain growth pattern variability* can be reduced by hardware standardization and just-in-time procurement, although likely not completely. Based on our modeling, the impact of growth uncertainty for organizations with up to 1,000 servers is 30 to 40 percent overprovisioning of servers relative to a public cloud service. For smaller companies (for example, Internet startups), the impact is far greater.

So far we have made the implicit assumption that the degree of variability will stay the same as we move to the cloud. In reality, it is likely that the variability will significantly increase, which will further increase economies of scale. There are two reasons why this may happen:

- **Higher expectation of performance.** Today, users have become accustomed to resource constraints and have learned to live with them. For example, users will schedule complex calculations to run overnight, avoid multiple model iterations, or decide to forgo time-consuming and costly supply chain optimizations. The business model of cloud allows a user to pay the same for 1 machine running for 1,000 hours as he would for 1,000 machines running for 1 hour. Today, the user would likely wait 1,000 hours or abandon the project. In the cloud, there is virtually no additional cost to choosing 1,000 machines and accelerating such processes. This will have a dramatic impact on variability. Pixar Animation Studios, for example runs its computer-animation rendering process on Windows Azure because every frame of their movies takes eight hours to render today on a single processor, meaning it would take 272 years to render an entire movie. As they said, "We are not that patient." With Azure, they can get the job done as fast as they need. The result is huge spikes in Pixar's usage of Azure as they render on-demand.

- **Batch processes will become real time.** Many processes — for example, accurate stock availability for online retailers — that were previously batch driven, will move to real-time. Thus, multi-stage processes that were once sequential will now occur simultaneously, such as a manufacturing firm that can tally its inventory, check its order backlog, and order new supplies at once. This will amplify utilization variability.

FIG. 13: VARIABLE PRICING IN ELECTRICITY

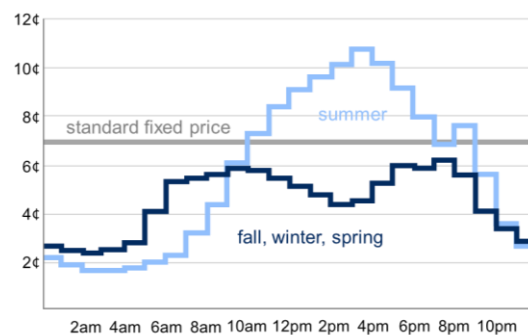

Source: Ameren Illinois Utilities.

We note that even the largest public clouds will not be able to diversify away all variability; market level variability will likely remain. To further smooth demand, sophisticated pricing can be employed. For example, similar to the

electricity market (Fig. 13), customers can be incented to shift their demand from high utilization periods to low utilization periods. In addition, a lower price spurs additional usage from customers due to price elasticity of demand. Demand management will further increase the economic benefits of cloud.

2.3 Multi-tenancy Economies of Scale

The previously described supply-side and demand-side economies of scale can be achieved independent of the application architecture, whether it be traditional scale-up or scale-out, single tenant or multitenant. There is another important source of economies of scale that can be harnessed *only* if the application is written as a multitenant application. That is, rather than running an application instance for each customer – as is done for on-premises application and most hosted applications such as dedicated instances of Microsoft Office 365 – in a multitenant application, multiple customers use a single instance of the application simultaneously, as in the case of *shared* Office 365. This has two important economic benefits:

- **Fixed application labor amortized over a large number of customers.** In a single-tenant instance, each customer has to pay for its own application management (that is, the labor associated with update and upgrade management and incident resolution). We've examined data from customers, as well as Office 365-D and Office 365-S to assess the impact. In dedicated instances, the same activities, such as applying software patches, are performed multiple times – once for each instance. In a multi-tenant instance such as Office 365-S, that

FIG. 14: UTILIZATION OVERHEAD

Source: Microsoft.

cost is shared across a large set of customers, driving application labor costs per customer towards zero. This can result in a meaningful reduction in overall cost, especially for complex applications.
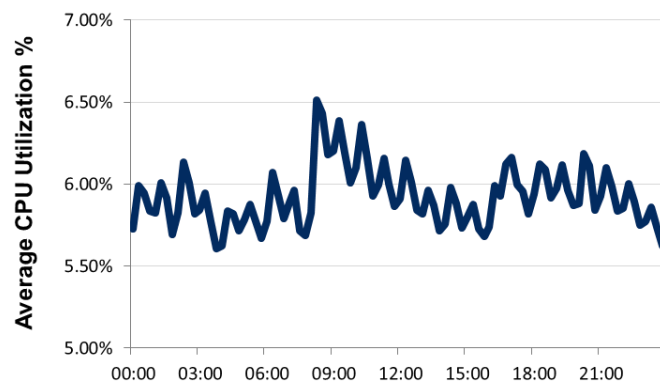
- **Fixed component of server utilization amortized over large number of customers.** For each application instance, there is a certain amount of server overhead. Fig. 14 shows an example from Microsoft's IT department in which intraday variability appears muted (only a 16 percent increase between peak and trough) compared to actual variability in user access. This is caused by application and runtime overhead, which is constant throughout the day. By moving to a multitenant model with a single instance, this resource overhead can be amortized across all customers. We have examined Office 365-D, Office 365-S, and Microsoft Live@edu data to estimate this overhead, but so far it has proven technically challenging to isolate this effect from other variability in the data (for example, user counts and server utilization) and architectural differences in the applications. Therefore, we currently assume no benefit from this effect in our model.

Applications can be entirely multitenant by being completely written to take advantage of these benefits, or can achieve partial multi-tenancy by leveraging shared services provided by the cloud platform. The greater the use of such shared services, the greater the application will benefit from these multi-tenancy economies of scale.

2.4 Overall Impact

The combination of supply-side economies of scale in server capacity (amortizing costs across more servers), demand-side aggregation of workloads (reducing variability), and the multi-tenant application model (amortizing costs across multiple customers) leads to powerful economies of scale. To estimate the magnitude, we built a cost scaling model which estimates the long term behavior of costs.

Fig. 15 shows the output for a workload that utilizes 10 percent of a traditional server. The model indicates that a 100,000-server datacenter has an 80% lower total cost of ownership (TCO) compared to a 1,000-server datacenter.

FIG. 15: ECONOMIES OF SCALE IN THE CLOUD
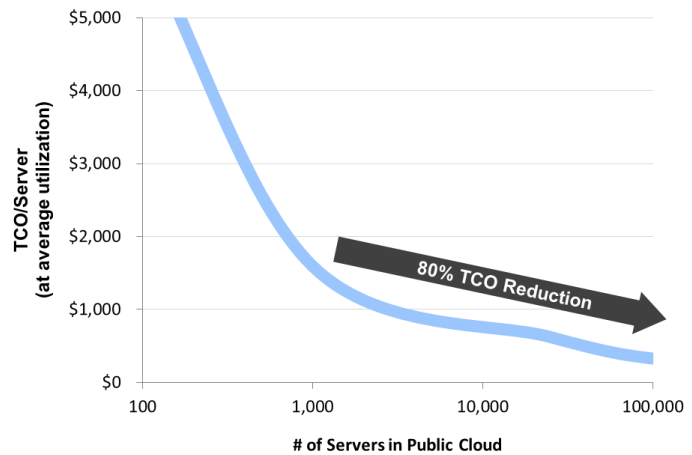
Source: Microsoft.

This raises the question: what impact will the Cloud Economics we described have on the IT budget? From customer data, we know the approximate breakdown between the infrastructure costs, costs of supporting and maintaining existing applications, and new application development costs (Fig. 16). Cloud impacts all three of these areas. The supply-side and demand-side savings impact mostly the

infrastructure portion, which comprises over half of spending. Existing app maintenance costs include update and patching labor, end-user support, and license fees paid to vendors. They account for roughly a third of spending and are addressed by the multi-tenancy efficiency factor.

New application development accounts for just over a tenth of spending[14], even though it is seen as the way for IT to innovate. Therefore IT leaders generally want to increase spending here. The economic benefits of cloud computing described here will enable this by freeing up room in the budget to do so. We will touch more on this aspect in the next paragraph as well as in Section 3.

FIG. 16: IT SPENDING BREAKDOWN
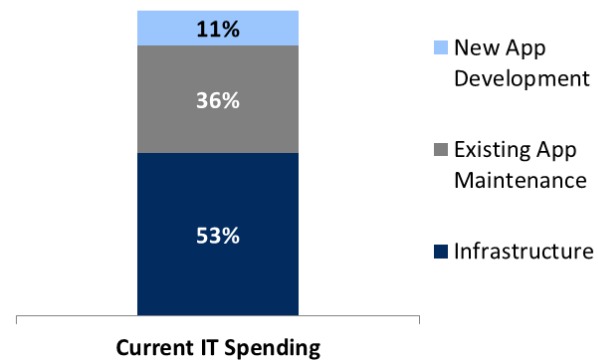
Source: Microsoft.

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[14] New application development costs include only the cost of designing and writing the application and excluding the cost of hosting them on new infrastructure. Adding these costs results in the 80% / 20% split seen elsewhere.

Microsoft

November 2010

## 2.5 Harnessing Cloud Economics

Capturing the benefits described above is not a straightforward task with today's technology. Just as engineers had to fundamentally rethink design in the early days of the car, so too will developers have to rethink design of applications. Multi-tenancy and demand-side aggregation is often difficult for developers or even sophisticated IT departments to implement on their own. If not done correctly, it could end up either significantly raising the costs of developing applications (thus at least partially nullifying the increased budget room for new app development); or capturing only a small subset of the savings previously described. The best approach in harnessing the cloud economics is different for packaged apps vs. new/custom apps.

Packaged applications: While virtualizing packaged applications and moving them to cloud virtual machines (e.g., virtualized Exchange) can generate some savings, this solution is far from ideal and fails to capture the full benefits outlined in this Section. The cause is twofold. First, applications designed to be run on a single server will not easily scale up and down without significant additional programming to add load-balancing, automatic failover, redundancy, and active resource management. This limits the extent

FIG. 17: CAPTURING CLOUD BENEFITS

Source: Microsoft.

to which they are able to aggregate demand and increase server utilization. Second, traditional packaged applications are not written for multi-tenancy, and simply hosting them in the cloud does not change this. For packaged apps, the best way to harness the benefits of cloud is to use SaaS offerings like Office365, which have been architected for scale-out and multi-tenancy to capture the full benefits.

New/custom applications: Infrastructure-as-a-Service (IaaS) can help capture some of the economic benefits for existing applications. Doing so is, however, a bit of a "horseless carriage" in that the underlying platform and tools were not designed specifically for the cloud. The full advantage of cloud computing can only be properly unlocked through a significant investment in intelligent resource management. The resource manager must understand both the status of the resources (networking, storage, and compute) as well as the activity of the applications being run. Therefore, when writing new apps, Platform as a Service, most effectively captures the economic benefits. PaaS offers shared services, advanced management, and automation features that allow developers to focus directly on application logic rather than on engineering their application to scale.

To illustrate the impact, a startup named Animoto used Infrastructure-as-a-Service (IaaS) to enable scaling – adding over 3,500 servers to their capacity in just 3 days as they served over three-quarters of a million new users. Examining their application later, however, the Animoto team discovered that a large percentage of the resources they were paying for were often sitting idle – often over 50%, even in a supposedly elastic cloud. They re-architected their application and eventually lowered operating costs by 20%. While Animoto is a cloud success story, it was only after an investment in intelligent resource
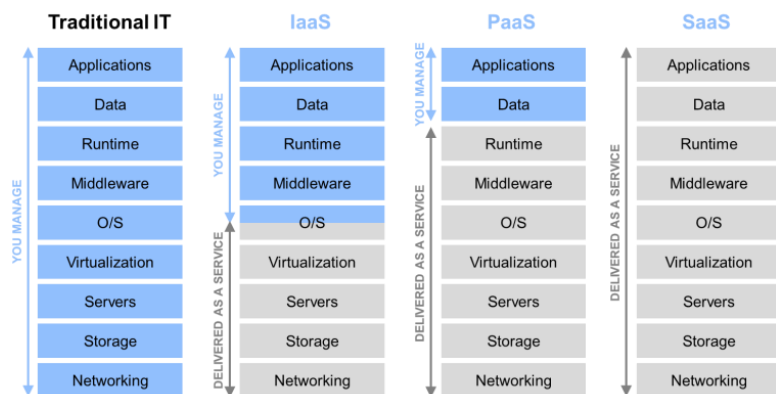
management that they were able to harness the full benefits of cloud. PaaS would have delivered many of these benefits "out-of-the-box" without any additional tweaking required.

3. IMPLICATIONS

In this section, we will discuss the implications of the previously described economics of cloud on Public Sector. We recognize the dual function of governments as both a *consumer* of cloud services and as an *enabler* of cloud services. Within public sector agencies and departments, CIOs and other IT leaders will make decisions about what types of cloud computing to use to run their operations. As legislators and regulators, governments will impact how and to what degree their citizens will be able to take advantage of cloud technology. In this section, we focus primarily on considerations for governments as *consumers* of cloud but in the last paragraph we will also briefly allude to the broader *enabler* aspects. We will also discuss the ability of private clouds to address some of the barriers to cloud adoption and assess the cost gap between public and private clouds.

3.1 Possibilities & Obstacles to Cloud in the Public Sector

The economics we described in section 2 will have a profound impact on IT. Many IT leaders today are faced with the problem that 80% of the budget is spent on "keeping the lights on," maintaining existing services and infrastructure. This leaves few resources available for innovation or addressing the never-ending queue of new business and user requests. Cloud computing will free up significant resources that can be redirected to innovation. Demand for general purpose technologies like IT has historically proven to be very price elastic (Fig. 18). Thus, many IT projects that previously were cost prohibitive will now become viable thanks to cloud economics. However, lower TCO is only one of the key drivers that will lead to a renewed level of innovation within IT:

FIG. 18: PRICE ELASTICITY OF STORAGE

Cost of Storage ($/GB, LHS)
Total Capacity Shipped (Exabytes, RHS)
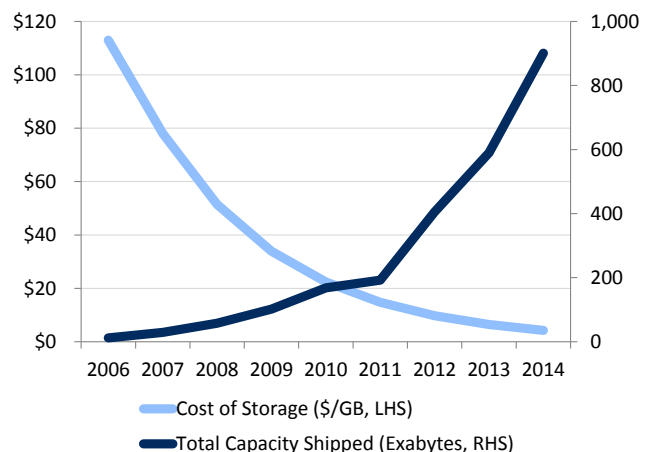
Source: Coughlin Associates.

1. **Elasticity is a game-changer** because, as described before, renting 1 machine for 1,000 hours will be nearly equivalent to renting 1,000 machines for 1 hour in the cloud. This will enable users and agencies to rapidly accomplish complex tasks that were previously prohibited by cost or time constraints. Being able to both scale up and scale down resource intensity nearly instantly enables a new class of experimentation and entrepreneurship.
2. **Elimination of capital expenditure** will significantly lower the risk premium of projects, allowing for more experimentation. This both lowers the costs of starting an operation and lowers the cost of failure or exit – if an application no longer needs certain resources, they

can be decommissioned with no further expense or write-off. The full economic benefits of this are wide-reaching and more fully explored in research by economist Federico Etro.[15]

3. **Self-service.** Provisioning servers through a simple web portal rather than through a complex IT procurement and approval chain can lower friction in the consumption model, enabling rapid provisioning and integration of new services. Such a system also allows projects to be completed in less time with less risk and lower administrative overhead than previously.

4. **Reduction of complexity**. Complexity has been a long standing inhibitor of IT innovation. From an end-user perspective SaaS is setting a new bar for user friendly software. From a developer perspective Platform as a Service (PaaS) greatly simplifies the process of writing new applications, in the same way as cars greatly reduced the complexity of transportation.

These factors will significantly increase the value add delivered by IT. Elasticity enables applications like public health data analysis, financial market monitoring, logistics planning, and environmental simulation, as these workloads exhibit nearly infinite demand for IT resources. The result will be massively improved experience, including scenarios like real-time business intelligence analytics and HPC for the masses.

This will enable governments to better deliver on some of its key priorities:

- **Fiscal responsibility:** In times of tight budgets, cloud can help governments achieve necessary spending cuts without cutting into essential services. Cloud also avoids long-dated service contracts and commitments to specialized vendors. Such commitments are time consuming and expensive to put in place and can often run over budget.
- **Better serve its citizens:** Cloud can help make governments more responsive to the needs of its citizens. It can increase the collaboration and coordination between departments. Through projects like Data.gov and Recovery.gov in the US, cloud has demonstrated that it can increase interaction with the public, allowing for more feedback and easier contact with interested parties.
- **Lower emissions:** New cloud facilities are less power-hungry than existing IT infrastructure and require fewer servers to generate the same output by running them more efficiently. This can dramatically reduce the carbon footprint of IT.

While IT professionals in the public sector alike are eager to take advantage of these qualities of cloud, they also have very specific concerns about cloud because of the nature of their operation. We discuss some of these concerns below.

3.2 Public Sector Cloud Concerns

13Our conversations with government and agency leaders and many surveys show that significant concerns currently exist around cloud computing. As Fig. 19 shows, security, privacy, governance, and compliance are the top concerns. Many CIOs also worry about legacy compatibility: it is often not straightforward to move existing applications to the cloud.

- **Security and Privacy** – Public sector CIOs must be able to report to legislators on how data is being kept private and secure. Many departments handle data such as intelligence reports, citizen identification information, or national security details which require high sensitivity and carry complex security requirements. Legacy systems have typically been highly customized to achieve these goals, and moving to a cloud architecture can be challenging. Furthermore, experience with

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[15] Federico Etro, "The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe" 2009

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the built-in, standardized security capabilities of cloud is still limited and many CIOs still feel more confident with legacy systems in this regard.

Source: World Economic Forum 2009 Cloud Computing Survey.

- **Switching Costs** – Governments are weary of the lock-in brought about by long-dated service contracts and high upfront investments in customized systems and worry that cloud might present similar problems
- **Governance** – Existing IT has complex governance and reporting policies in place for the provision and use of IT systems. CIOs are uncertain how to adapt these policies for the on-demand nature of cloud.
- **Compliance and Data Sovereignty** – Government agencies are subject to audits and oversight, both internal and external. While clouds can actually *help* agencies become compliant with transparency-related regulations (e.g., Freedom of Information Act, FOIA), CIOs ask: which clouds can comply with these systems and what needs to be done to make them compliant?

While many of these concerns can be addressed by cloud today, concerns remain and are prompting IT leaders to explore private clouds as a way of achieving the benefits of cloud while solving these problems. Next, we will explore this in more detail and also assess the potential tradeoffs.

3.3 Private Clouds

Microsoft distinguishes between public and private clouds based on whether the IT resources are shared between many distinct organizations (public cloud) or dedicated to a single organization (private cloud). This taxonomy is illustrated in Fig. 20. Compared to traditional virtualized datacenters, both private and public clouds benefit from automated management (to save on repetitive labor) and homogenous hardware (for lower cost and increased flexibility). Due to the broadly-shared nature of public clouds, a key difference between private and public clouds is the scale and scope at which they can pool demand.

- **Traditional virtualized datacenters** generally allow pooling of resources within existing organizational boundaries — that is, the corporate IT group virtualizes its workloads, while departments may or may not do the same. This can diversify away some of the random, time-of-day (especially if the company has offices globally), and workload-specific variability, but the size of the pool and the difficulty in moving loads from one virtual machine to another (exacerbated by the lack of homogeneity in hardware configurations) limits the ability to capture the full benefits. This is one of the reasons why even virtualized data centers still suffer from low utilization. There is no app model change so the complexity of building apps is not reduced.
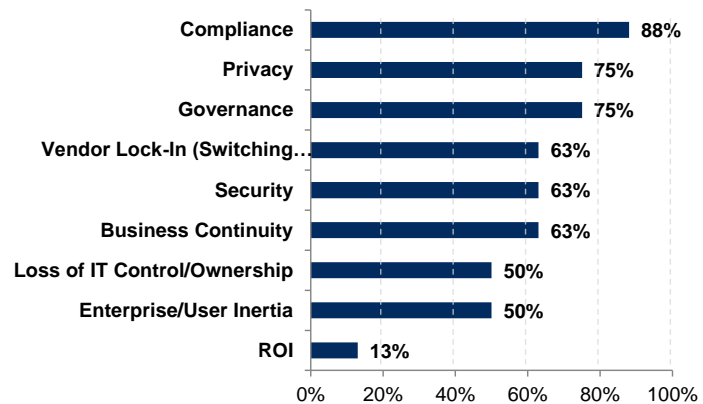
- **Private clouds** move beyond virtualization. Resources are now pooled across the entire organization rather than by department,[16] and workloads are moved seamlessly between physical servers to ensure optimal efficiency and availability. This further reduces the impact of random, time-of-day, and workload variability. In addition, new, cloud-optimized application models (Platform as a Service such as Azure) enable more efficient app development and lower ongoing operations costs.

FIG. 20: COMPARING VIRTUALIZATION, PRIVATE CLOUD, AND PUBLIC CLOUD

Source: Microsoft. Shaded checks indicate an optional characteristic.

- **Public clouds** have all the same architectural elements as private clouds, but bring massively higher scale to bear on all sources of variability. Public clouds are also the only way to diversify away industry-specific variability, the full geographic element of time-of-day variability, and bring multi-tenancy benefits into effect.

Private clouds can address some of the previously mentioned adoption concerns. By having dedicated hardware, they are easier to bring within the organizational firewall, which may ease concerns around **security and privacy**. Bringing a private cloud on-premise can make it easier to address some of the **regulatory, compliance and sovereignty** concerns that can arise with services that cross jurisdictional boundaries. In cases where these concerns weigh heavily in an IT leader's decision, an investment in a private cloud may be the best option.

Private clouds do not really differ from public cloud regarding other concerns, such as **maturity and performance and switching costs**. Public and private cloud technologies are developing in tandem and will mature together. A variety of performance levels will be available in both public and private form, so there is little reason to expect that one will have an advantage over another.[17] With respect to switching costs, private clouds may in some cases have higher switching costs than public clouds due to the up-front infrastructure investment they require. Like traditional IT projects, any type of cloud architecture will come with a degree of commitment to a certain software platform, a particular set of tools, or a vendor.

While private clouds can alleviate some of the concerns, in the next paragraph we will discuss whether they will offer the same kind of savings described earlier.

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[16] Aggregation across organizational units is enabled by two key technologies: live migration, which moves virtual machines while remaining operational, thereby enabling more dynamic optimization; and self-service provisioning and billing.
[17] Private clouds do allow for a greater degree of customization than public clouds, which could enhance performance for a certain computational task. Customization requires R&D effort and expense, however, so it is difficult to make a direct price/performance comparison.

3.4 Cost Trade-Off

While it should be clear from the prior discussion that conceptually the public cloud has the greatest ability to capture diversification benefits, we need to get a better sense of the magnitude. Fig. 21 shows that while the public cloud addresses all sources of variability the private cloud can address only a subset.

FIG. 21: DIVERSIFICATION BENEFITS

|	Sources of Variability			
	Random	Time of day	Industry	Multiple Resource
Private Cloud	✔	✔	✘	✔
Public Cloud	✔	✔	✔	✔

Source: Microsoft.

For example, industry variability cannot be addressed by a private cloud, while growth variability can be addressed only to a limited degree if an organization pools all its internal resources in a private cloud. We modeled all of these factors, and the output is shown in Fig. 22.

The lower curve shows the cost for a public cloud (same as the curve shown in Fig. 15). The upper curve shows how the cost of a private cloud. The public cloud curve is lower at every scale due to the greater impact of demand aggregation and the multi-tenancy effect. Global scale public clouds are likely to become extremely large, at least 100,000 servers in size, or possibly much larger, whereas the size of an organization's private cloud will depend on its demand and budget for IT.

Fig. 22 also shows that for organizations with a very small installed base of servers (<100), private clouds are prohibitively expensive compared to public cloud. The only way for these small organizations or departments to share in the benefits of at scale cloud computing is by moving to a public cloud. **For large agencies with an installed base of approximately 1,000 servers, private clouds are feasible but come with a significant cost premium of about 10 times the cost of a public cloud for the same unit of service, due to the combined effect of scale, demand diversification and multi-tenancy.**

FIG. 22: COST BENEFIT OF PUBLIC CLOUD

40x cost benefit for small agencies/depts.

10x cost benefit for large agencies
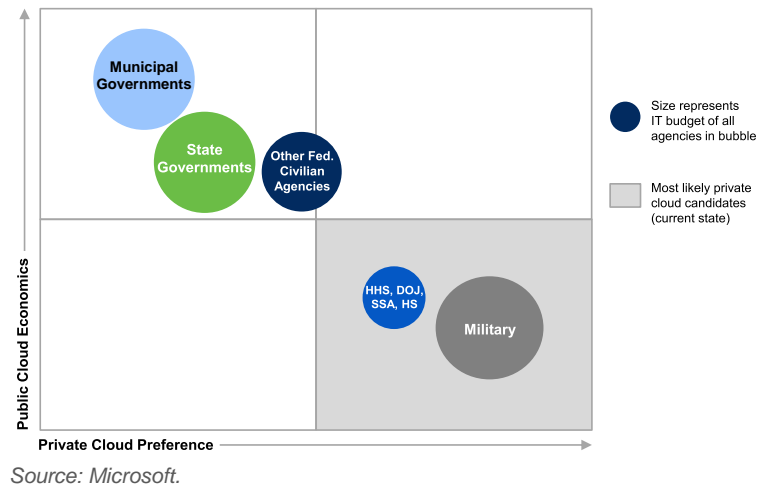
Public Cloud Cost at Scale
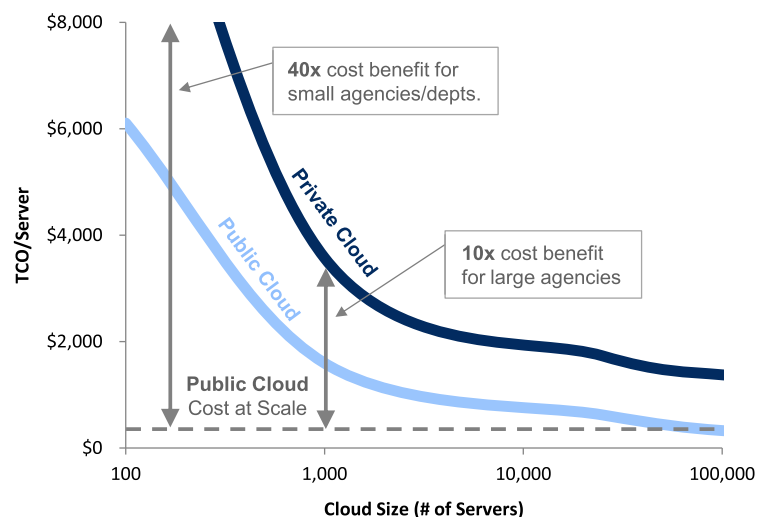
Source: Microsoft.

In addition to the increase in TCO, private clouds also require upfront investment to deploy – an investment that must accommodate peak demand requirements. This involves separate budgeting and commitment, increasing risk. Public clouds, on the other hand, can generally be provisioned entirely on a pay-as-you-go basis.

3.5 Finding Balance Today: Weighing the Benefits of Private Cloud against the Costs

We've mapped a view of how public and private clouds measure up in Figure 23. The vertical axis measures the public cloud cost advantage. From the prior analysis we know public cloud has inherent economic advantages that will partially depend on customer size, so the bubbles' vertical position is dependent on the size of the server installed base. The horizontal axis represents the organization's preference for private cloud. The size of the circles reflects the total IT budget allocated to organizations of each type. The bottom right quadrant thus represents the most attractive areas for private clouds (relatively low cost premium, high preference).

FIG. 23: COST AND BENEFIT OF PUBLIC AND PRIVATE CLOUDS

Source: Microsoft.

We mapped some of the key Public Sector entities on this chart. The IT operations of municipal governments are, on average, much smaller than those of state governments, thus resulting in a higher public cloud cost advantage. In many cases, they also are handling lower-security data and, due to their size, have less complex IT installations, meaning that their preference for private cloud is generally lower. On the other extreme are the various arms of the military, each of which has an extremely large IT department and a strong desire for security and secrecy. In the middle are most other federal agencies and state governments. We have separated out Health & Human Services, the Department of Justice, the Social Security Administration and Homeland Security as these agencies have particularly sensitive missions with private and highly confidential data. They also have some of the largest IT organizations in the Federal government.

We've made a number of assumptions in Figure 23. For example, it assumes that, at the Federal level, each agency group is a single customer. Some governments have expressed a desire to construct a cloud for all departments and agencies in this way. Pooling resources could dramatically improve the economics and appeal of a private cloud. But this is a highly simplified view. It may be challenging to get all civilian or military agencies within a government to put the entirety of their IT on the same private cloud. Agencies have different needs, requirements, dependencies, work cycles, legacy requirements, and budgets and simply may not want to have their IT decisions made outside the agency. If we take the view that the agencies are not all able to be consolidated onto one private cloud, we would see a result similar to Figure 24.

Another important nuance is that IT is not monolithic within any of these agencies. Each organization's IT operation is segmented into workload types, such as email or ERP. Each of these has a different level of sensitivity and scale, and Public Sector CIO surveys reveal that preference for public cloud solutions currently varies greatly across workloads (Fig. 26). Furthermore, a Microsoft survey of public sector CIOs has indicated that 80 percent of data stored is not "classified" – even within interior departments.

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An additional factor is that many app portfolios have been developed over the past 15 to 30 years and are tightly woven together. This particularly holds true for ERP and related custom applications at larger companies who have more sizable application portfolios. Apps that are more 'isolated' such as CRM, collaboration, or new custom apps may be more easily deployed in the cloud. Some of those apps may need to be integrated back to current on-premises apps.

Before we draw final conclusions, we need to make sure we avoid the "horseless carriage syndrome" and consider the likely shift along the two axes (economics and private preference).

**FIG. 24** CLOUD-READY WORKLOADS (2010)
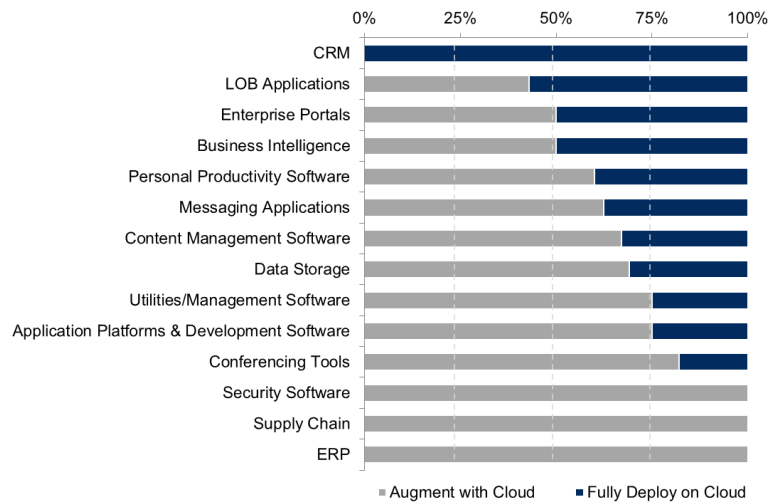
Source: Microsoft survey question "In the next 12-24 months, please indicate if a cloud offering would augment on-premises offering or completely replace it".

3.6 The Long View: Cloud Transition Over Time

As we pointed out in the introduction of this paper, it is dangerous to make decisions during the early stages of a disruption without a clear vision of the end state. IT leaders need to design their architecture with a long term vision in mind. We therefore need to consider how the long term forces will impact the position of the bubbles on Fig. 23.

We expect two important shifts to take place. First, **the economic benefit of public cloud will grow over time**. As more and more work is done on public clouds, the economies of scale we described in Section 2 will kick in, and the cost premium on private clouds will increase over time. Customers will increasingly be able to tap into

FIG. 27: EXPECTED PREFERENCE SHIFT FOR PUBLIC AND PRIVATE CLOUD
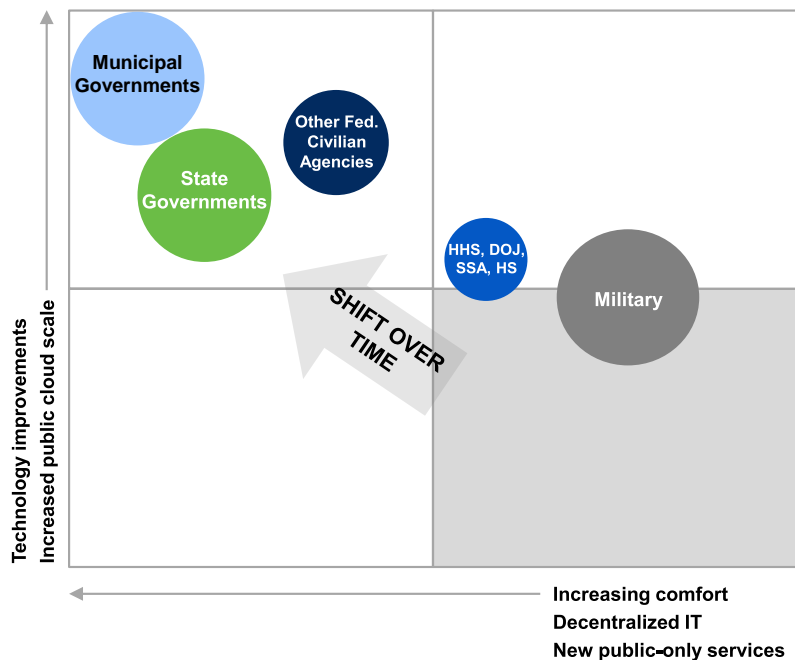
Source: Microsoft.

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the supply-side, demand-side and multi-tenancy savings as discussed previously. As shown in Fig. 27 this leads to an upward shift along the vertical axis.

At the same time, **some of the barriers to cloud adoption will begin to fall**. Many technology case studies show that, over time, concerns over issues like compatibility, security, reliability, and privacy will be addressed. This will likely also happen for the cloud, which would represent a shift to the left on Fig. 27. Below we will explore some of the factors that cause this latter shift.

Cloud security will evolve

Public clouds are in a relatively early stage of development, so naturally critical areas like reliability and security will continue to improve. Data already suggests that public cloud email is more reliable than most on-premises implementations. In PaaS, the automatic patching and updating of cloud systems greatly improves the security of all data and applications, as the majority of exploited vulnerabilities take advantage of systems that are out-of-date. Many security experts argue there are no fundamental reasons why public clouds would be less secure; in fact, they are likely to become more secure than on premises due to the intense scrutiny providers must place on security and the deep level of expertise they are developing.

Clouds will become more compliant

Compliance requirements can come from within an organizational, industry, or government (e.g., SOX, SAS Type II, European Data Protection Directive) and may currently be challenging to achieve with cloud without a robust development platform designed for government needs. As cloud technologies improve, and as compliance requirements adapt to accommodate cloud architectures, cloud will continue to become more compliant, and therefore feasible for more organizations and workloads. This was the case, for example, with, e-signatures, which were not accepted for many contracts and documents in the early days of the Internet. As authentication and encryption technology improved and as compliance requirements changed, e-signatures became more acceptable. Today, most contracts (including those for opening bank accounts and taking out loans) can be signed with an e-signature.

The large group of customers who are rapidly increasing reliance on public clouds — small and medium organizations, departments, and individuals — will be a formidable force of change in this area. This growing constituency will continue to ask governments to accommodate the shift to cloud by modernizing legislation. This regulatory evolution will make public cloud a more viable alternative for large enterprises and thus move segments along the horizontal axis toward public cloud preference.

Decentralized IT (also known as 'rogue IT') will continue to lead the charge

Many prior technology transitions were led not by CIOs but by departments, business decision makers, developers, and end users – often in spite of the objections of CIOs. For example, both PCs and servers were initially adopted by end users and departments before they were officially embraced by organizational IT policies. More recently, we saw this with the adoption of mobile phones, where consumer adoption is driving IT to support these devices. We're seeing a similar pattern in the cloud: developers and departments have started using cloud services, often without the knowledge of the IT group (hence the name "rogue clouds"). Many of the departmental customers will not wait for their IT group to provide them with a private cloud; for these users, productivity and convenience often trump policy. It is not just impatience that drives "rogue clouds"; ever-increasing budgetary constraints can lead users and even departments to adopt cheaper public cloud solutions that would not be affordable from

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traditional channels. For example, when Derek Gottfrid wanted to process all 4TB of the *New York Times* archives and host them online, he went to the cloud without the knowledge of the Times' IT department.[18] Similarly, the unprecedented pricing transparency that the public cloud offers, will put further pressure from the CEO and CFO on CIOs to move to the public cloud.

CIOs should acknowledge that these behaviors are commonplace early in a disruption and either rapidly develop and implement a private cloud with the same capabilities or adopt policies which incorporate some of this behavior, where appropriate, in IT standards.

Perceptions are rapidly changing

Strength in SaaS adoption in large enterprises serves as proof of changing perceptions (Fig. 28) and indicates that even large, demanding enterprises are moving to the left on the horizontal axis (i.e., reduced private preference). Just a few years ago, very few large companies were willing to shift their email, with all the confidential data that it contains, to a cloud model. Yet this is exactly what is happening today. As positive use cases continue to spur more interest in cloud technology, this virtuous cycle will accelerate, driving greater interest in and acceptance of cloud.

FIG. 28: INCREASING ADOPTION OF SOFTWARE AS A SERVICE (SAAS)
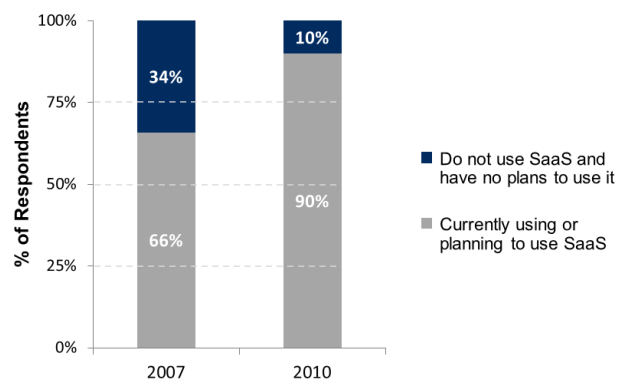
Source: Gartner.

In summary, while there are real hurdles to cloud adoption today, these will likely diminish over time. While new, unforeseen hurdles to public cloud adoption may appear, the public cloud economic advantage will grow stronger with time as cloud providers unlock the benefits of economics we discussed in Section 2. While the desire for a private cloud is mostly driven by security and compliance concerns around *existing* workloads, the cost effectiveness and agility of the public cloud will enable *new* workloads.

3.7 Government as Regulator and Enabler of Cloud

As mentioned previously, Governments have a dual role in the cloud transformation: they are *consumers* of cloud, and they are *enablers* of cloud. Through policies and legislation, governments around the world will shape how and at what speed cloud computing can be adopted and the benefits realized. While this paper is focused on the benefits of cloud for the government as consumer, we will also briefly describe some of the key benefits of governments enabling cloud for the broader society.

Cloud enables a Greener Society

The energy-efficiency and "greenness" of IT is directly related to server utilization rates and the sophistication of engineering applied to the hardware and datacenter design – factors which are both improved dramatically by the cloud. Server, storage, and networking hardware all consume a great deal of power, with the servers worldwide consuming an estimated 65 billion kilowatt-hours of electricity

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[18] http://open.blogs.nytimes.com/2007/11/01/self-service-prorated-super-computing-fun/

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worldwide every year. The energy used to cool and store these servers roughly doubles this amount to a total of 130 billion kWh, roughly equivalent to the total energy consumption of Poland. By improving utilization rates, we estimate large-scale clouds can lead to 40% lower consumption. In addition, the Power Utilization Effectiveness (PUE) rating of cloud datacenters is as much as twice as good as smaller facilities. The net result is a reduction in energy consumption of up to 70%.

In addition, clouds have a more consistent power draw than standalone servers or existing datacenters. This means cloud datacenters will be primarily users of "base load" power like hydro or nuclear rather than "peaker" capacity like oil or gas.

FIG. 29: GREENER IT THROUGH CLOUD – SERVER ENERGY CONSUMPTION (KWH)

Source: Microsoft.

Cloud enables a more vibrant Economy

Cloud also creates jobs, both within IT and in the private sector. IT jobs pay 80% more than average jobs,[19] making IT a highly desirable area to encourage employment. One of the benefits of cloud computing is the automation of management labor. The impact of this will be a shift in the efforts of IT staff from managing servers to writing and customizing applications, a much more creative and higher-value task. In the private sector, cloud computing lowers the barriers to starting a business or project. By one estimate, the rapid adoption of cloud computing could create up to 1.5 million jobs in the EU alone.[20]

Revisiting our "horseless carriage" analogy, we see that cars became a huge success not simply because they were faster and better (and eventually more affordable) than horse-drawn carriages. The entire transportation ecosystem had to change. Highway systems, driver training programs, accurate maps and signage, targeted safety regulation, and a worldwide network of fueling infrastructure all had to be developed to enable this transition. Each successive development improved the value proposition of the car. In the end, even people's living habits changed around the automobile, resulting in the explosion of the suburbs in the middle part of the 20th century. This created "net new" demand for cars by giving rise to the commuting professional class. This behavioral change represented a massive positive feedback loop that inexorably made the automobile an essential, irreplaceable component of modern life.

Similarly, we believe cloud will be enabled and driven not just by economics and qualitative developments in technology and perception, but by a series of shifts from IT professionals, regulators, telecom operators, ISVs, systems integrators, and cloud platform providers. As cloud is embraced more thoroughly, its value will increase.

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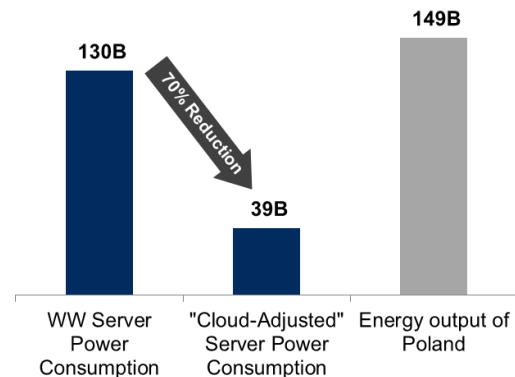
[19] London School of Economics, "Digital Recovery Study" 2010.
[20] Federico Etro, "The Economic Impact of Cloud Computing on Business Creation, Employment and Output in Europe" 2009.
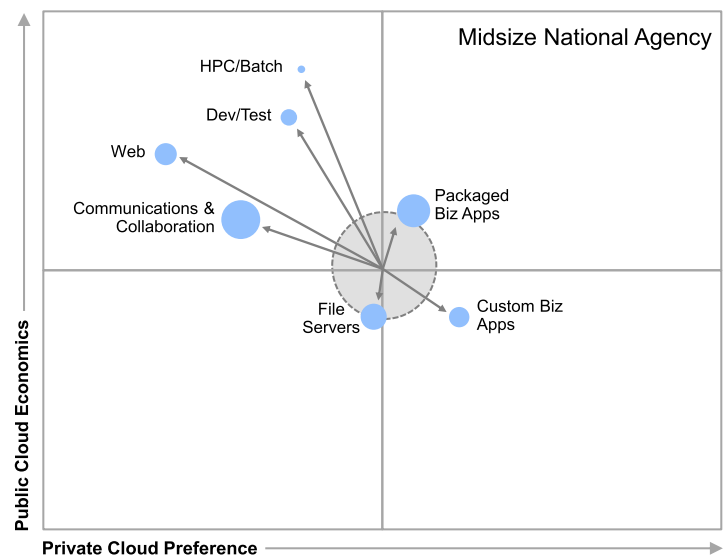
4. THE JOURNEY TO THE CLOUD

Because we are in the early days of the cloud paradigm shift, there is much confusion about the direction of this ongoing transformation. In this paper, we looked beyond the current technology and focused on the underlying economics of cloud to define the destination – where all of this disruption and innovation is leading our industry. **Based on our analysis, we see a long-term shift to cloud driven by three important economies of scale**: (1) larger datacenters can deploy computational resources at significantly lower cost than smaller ones; (2) demand pooling improves the utilization of these resources, especially in public clouds; and (3) multi-tenancy lowers application maintenance labor costs for large public clouds. Finally, the cloud offers unparalleled levels of elasticity and agility that will enable exciting new solutions and applications.

For IT organizations, the cloud represents tremendous opportunity. It represents an opportunity to break out of the longstanding tradition of IT professionals spending 80 percent of their time and budget "keeping the lights on," with few resources left to focus on innovation. **Cloud services will enable IT groups to focus more on innovation while leaving non-differentiating activities to reliable and cost-effective providers.** Cloud services will enable IT leaders to offer new solutions that were previously seen as either cost prohibitive or too difficult to implement. This is especially true of cloud platforms (Platform as a Service), which significantly reduce the time and complexity of building new apps that take advantage of all the benefits of the cloud.

This future won't materialize overnight. IT leaders need to develop a new 5- to 10-year vision of the future, recognizing that they and their organizations will play a fundamentally new role in their company. They need to plot a path that connects where they are today to that future. An important first step in this is to segment their portfolio of existing applications (Fig. 30). For some apps the economic and agility benefits may be very strong so they should be migrated quickly. However, barriers do exist today, and while we outlined in section 3 that many of them will be overcome over time, cloud may not be ready for some apps today. For tightly integrated apps with fairly stable usage patterns, it may not make sense to move them at all, similar to how

FIG. 30: SEGMENTING IT PORTFOLIO

Source: Microsoft.

some mainframe apps were never migrated to client/server. While new custom apps don't have the legacy problem, designing them in a scalable, robust fashion is not always an easy task. Cloud optimized platforms (Platform as a Service) can dramatically simplify this task.

This transition is a delicate balancing act. If the IT organization moves too quickly in areas where the cloud is not ready, it can compromise operational continuity, security, and compliance – critical issues in the public sector. If it moves too slowly, it can result in budgetary problems and create an outward impression of being inefficient and ineffective. Moving too slowly also increases the risk that different

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groups or individuals within the organization will each adopt their own cloud solution in a fragmented and uncontrolled fashion ("rogue IT"), wresting control over IT from the CIO. IT leaders who stay ahead of the cloud trend will be able to control and shape this transition; those who lag behind will increasingly lose control.

To lead the transition, IT leaders need to think about the long term architecture of their IT. Some see a new role emerging, that of a Cloud Services Architect, who determines which applications and services move to the cloud and exactly when such a move takes place based on a business case and a detailed understanding of the cloud capabilities available. This should start by taking inventory of the organization's resources and policies. This includes an application and data classification exercise to determine which policy or performance requirements (such as confidential or top secret data retention requirements) apply to which applications and data. Based on this, IT leaders can determine what parts of their IT operation are suitable for public cloud and what might justify an investment in private cloud. Beginning in this manner takes advantage of the opportunity of cloud while striking balance between economics and security, performance, and risk.

To accomplish this, IT leaders need a partner who is firmly committed to the long-term vision of the cloud and its opportunities, one who is not hanging on to legacy IT architectures. At the same time, this partner needs to be firmly rooted in the realities of today's IT so it understands current challenges and how to best navigate the journey to the cloud. IT leaders need a partner who is neither incentivized to push for change faster than is responsible nor to keep IT the same. Customers need a partner who has done the hard work of figuring out how best to marry legacy IT with the cloud, rather than placing that burden on the customer by ignoring the complexities of this transformation.

At Microsoft, we are "all in" on the cloud. We provide both commercial SaaS (Office 365) and a cloud computing platform (Windows Azure Platform). Office 365 features the applications customers are familiar with like Exchange email and SharePoint collaboration, delivered through Microsoft's cloud. Windows Azure is our cloud computing platform, which enables customers to build their own applications and IT operations in a secure, scalable way in the cloud. Writing scalable and robust cloud applications is no easy feat, so we built Windows Azure to harness Microsoft's expertise in building our cloud-optimized applications like Office 365, Bing, and Windows Live Hotmail. Rather than just moving virtual machines to the cloud, we build a Platform as a Service that reduces complexity for developers and IT administrators.

Microsoft also brings to the cloud the richest partner community in the world. We have over 600,000 partners in more than 200 countries servicing millions of businesses. We are already collaborating with thousands of our partners on the cloud transition. Together we are building the most secure, reliable, scalable, available, cloud in the world.

Over the last three decades, Microsoft has developed strong relationships with IT organizations, their partners, and their advisors. This offers us an unparalleled understanding of the challenges faced by today's IT organizations. Microsoft is both committed to the cloud vision *and* has the experience to help IT leaders on the journey.

Microsoft has a long history of bringing to life powerful visions of the future. Bill Gates founded Microsoft on the vision of putting a PC in every home and on every desktop in an era when only the largest corporations could afford computers. In the journey that followed, Microsoft and our partners helped bring PCs to over one billion homes and desktops. Millions of developers and businesses make their living on PCs and we are fortunate to play a role in that.

Now, we have a vision of bringing the power of cloud computing to every home, every office, and every mobile device. The powerful economics of cloud drive all of us towards this vision. Join Microsoft and our partners on the journey to bring this vision to life.

We're all in.

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