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CLASS
Conference 2014
CloudAssisted Services

The open source cloud: adoption patterns, economic impact and how it changes European SMEs, PAs and service providers

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CloudWeavers ltd

Cloud economics

… is apparently unavoidable

EMEA: Cumulative Economic Benefits 2010-2015

	France	Germany	Italy	Spain	UK	EMEA
	€ mil	€ mil	€ mil	€ mil	€ mil	€ mil
Business development opportunities	24,599	32,642	23,995	16,866	29,555	127,657
Business creation	51,377	69,507	43,305	30,939	20,026	215,153
Net total cost savings *of which:*	26,323	37,740	28,463	22,008	26,206	140,740
– IT CapEx savings	*28,653*	*36,378*	*30,461*	*23,013*	*36,176*	*154,682*
– IT OpEx savings (FTEs / productivity)	*13,818*	*18,139*	*14,533*	*10,396*	*16,943*	*73,829*
– IT OpEx savings (power & cooling)	*11,107*	*14,345*	*11,821*	*8,510*	*10,566*	*56,349*
– additional cloud services expenditure (PAYG) *	- *27,255*	- *31,122*	- *28,353*	- *19,910*	- *37,481*	- *144,120*
Indirect GVA	60,450	81,351	55,007	40,737	42,202	279,747
Total Economic Benefit	**162,749**	**221,239**	**150,770**	**110,550**	**117,989**	**763,297**
Direct and Indirect employment ('000s)	**469.4**	**789.4**	**455.8**	**392.5**	**289.0**	**2,396.2**

** This category of spend is captured for private cloud through lower firm-level CapEx and OpEx savings. The firm-level CapEx and OpEx savings are higher under hybrid and public cloud, but there can expect to also be incurred new spend on external cloud services*

Source: Cebr analysis

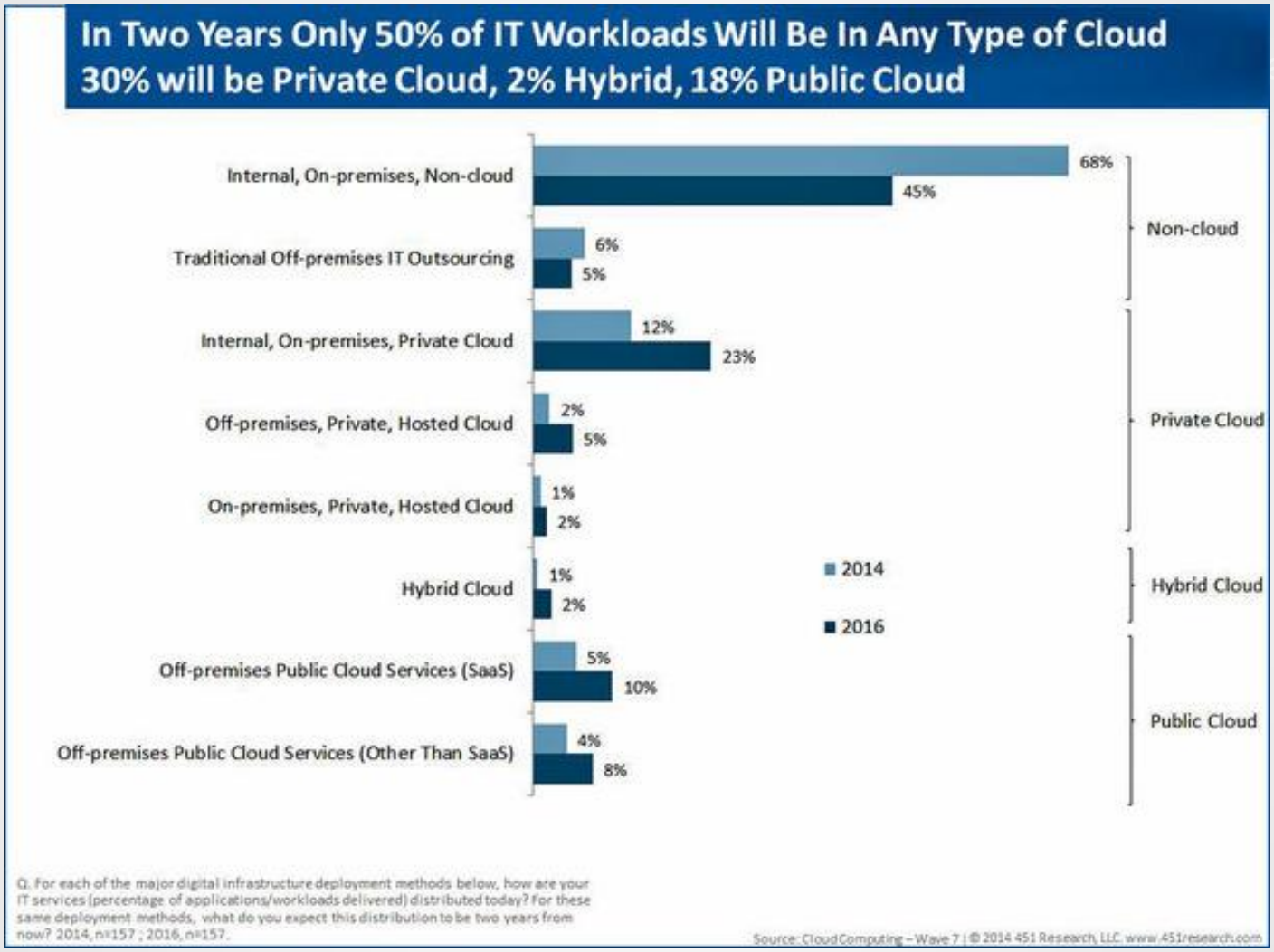
Cloud economics

… or maybe not

- But is based on extremely generous assumptions: “We assume a progressive shift of business workloads into cloud infrastructure, beginning with a 20% shift of workloads in 2010 to a **100% shift** by 2014” (CEBR - “THE CLOUD DIVIDEND: The economic benefits of cloud computing to business and the wider EMEA economy”, part 1, page 16)

Cloud economics

… or maybe not



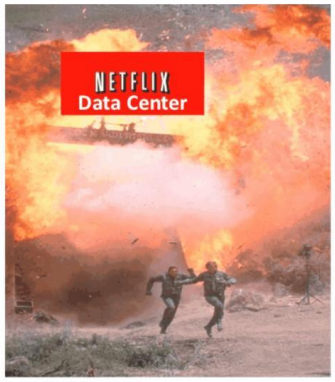
Cloud economics

… is dependent on variability

- “Business development benefits are modelled as incremental revenues estimated to be achievable from effective seasonal demand management and from efficiencies related to IT scalability. However, the proportion of the total incremental revenues achievable from these improvements is assumed to be proportionate to the size of IT budgets relative to total turnover.”

Cloud economics

… is dependent on variability



Netflix could not build new datacenters fast enough

Capacity growth is accelerating, unpredictable

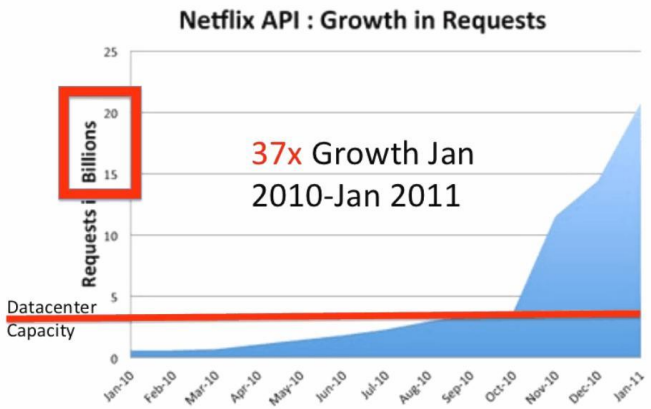
Product launch spikes - iPhone, Wii, PS3, XBox

NETFLIX

Insert Caption Here

Out-Growing Data Center

http://techblog.netflix.com/2011/02/redesigning-netflix-api.html

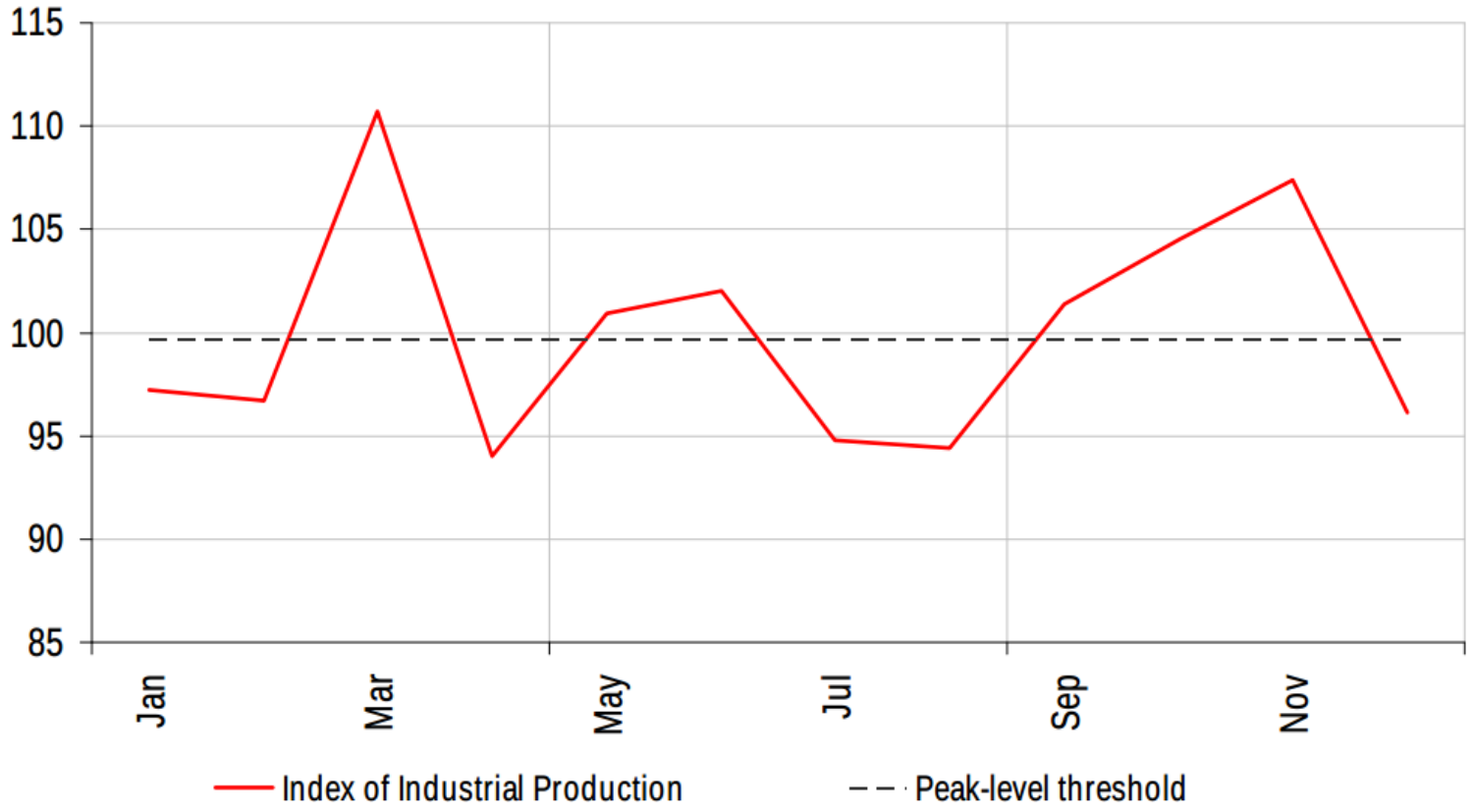


NETFLIX

Cloud economics

… but variability is on average very small

Figure 4: Non-seasonally adjusted index of production and peak level threshold (2006 index)



Source: Office for National Statistics, Cebr Analysis

Cloud economics

… but variability is on average very small

Table 7: SME productivity gains from IT scalability, annual growth in productivity

Industry	Potential SME productivity benefits of IT scalability as a percentage of total annual output
Agriculture, Forestry & Fishing	0.13%
Energy & Utilities	0.14%
Manufacturing	0.20%
Construction	0.10%
Distribution, Retail & Hotels	0.27%
Transport & Communications	0.20%
Finance & Business Services	0.28%
Government, Education & Health	0.17%
Other Services	0.20%

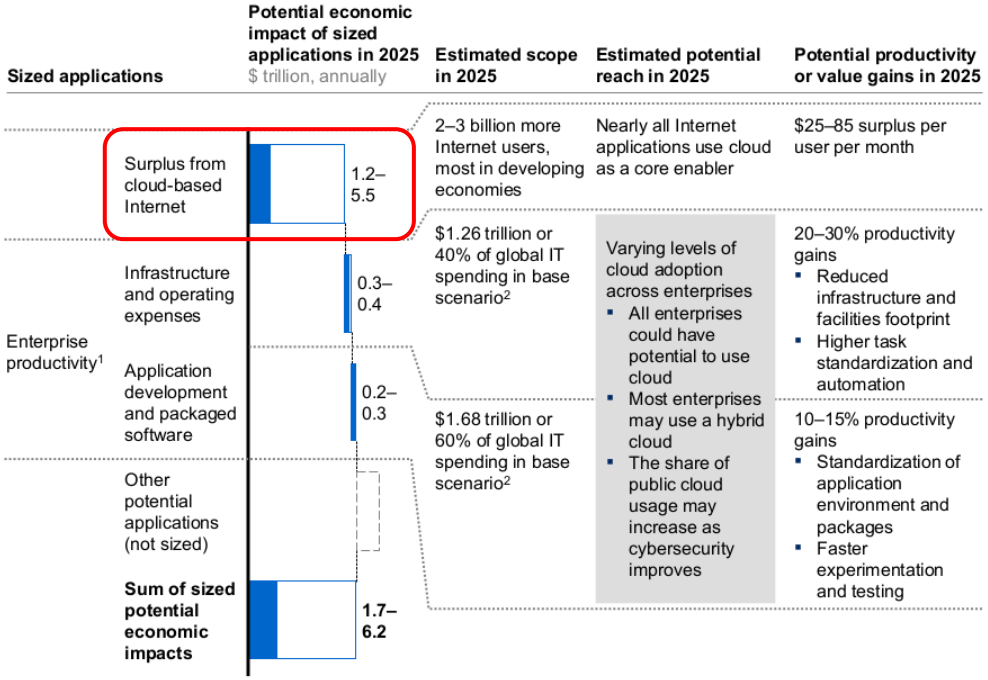
Source: Cebr Analysis

Cloud economics

… other estimates are similar

Exhibit 6

Sized applications of cloud technology could have economic impact of $1.7 trillion to $6.2 trillion per year in 2025



1 We have not sized the impact of increased flexibility and convenience to enterprises.
2 Estimates for enterprise cloud based on a global IT budget that does not include telecommunications.
NOTE: Estimates of potential economic impact are for some applications only and are not comprehensive estimates of total potential impact. Estimates include consumer surplus and cannot be related to potential company revenue, market size, or GDP impact. We do not size possible surplus shifts among companies and industries, or between companies and consumers. These estimates are not risk- or probability-adjusted. Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Cloud economics

… is suspiciously similar to pure virtualization advantages

- Estimates of the economic advantage of moving from physical to the cloud: 17.3% private cloud, 31.1% hybrid cloud, 39.9% public cloud
- Estimates of the advantage of moving to virtualization: 35% on average (Source: Everest Global)
- IDC: “Cloud savings are less than 10% for 70% of organisations”
- “Data centre construction, direct staffing and jobs created in the ICT hardware sector supplying data centres explain **almost all the short term net gains in IT jobs**. (Da: Modelling the Cloud Employment effects in two exemplary sectors in The United States, the United Kingdom, Germany and Italy”, London School of Economics)”

Cloud economics

… and there are very few servers to move anyway

Table 3: Estimated Number of Servers Based on Employment Size

Industry/NAICS	<20 Emps	20-49 Emps	50-99 Emps	100-299 Emps	300-499 Emps	500-999 Emp	1000+ Emps
Education[1] 61	0-1	0-3	3-6	6-18	19-32	32-63	63+
Finance, Bank, Insurance 52	0-1	0-1	1-3	3-10	10-16	16-32	32+
Healthcare 62	0-1	0-1	1-2	2-7	7-12	12-24	24+
Manufacturing, Mining, Media Construction 11, 21, 23, 31-33, 51	0-1	0-1	0-2	2-6	6-10	10-19	19+
Retail, Entertainment, Accommodations, Food Service 44-45, 71, 72	0-1	0-1	0-1	1-3	3-5	5-10	10+
Services 42, 53, 54, 55, 56, 81	0-1	0-1	1-2	2-7	7-11	11-22	22+
Transportation 48-49	0-1	0-1	0-1	1-4	4-7	7-13	13+
Utilities 22	0-1	0-1	1-2	2-7	7-12	12-24	25+

Source: Applied Computer Research, Inc.[1,2]

Cloud economics

… and it explains a small Amazon AWS mystery

Insert Caption Here

	2013	2012	2011
Net Sales:			
North America			
Media	$ 10,809	$ 9,189	$ 7,959
Electronics and other general merchandise	29,985	23,273	17,315
Other (1)	3,723	2,351	1,431
Total North America	$ 44,517	$ 34,813	$ 26,705
International			
Media	$ 10,907	$ 10,753	$ 9,820
Electronics and other general merchandise	18,817	15,355	11,397
Other (1)	211	172	155
Total International	$ 29,935	$ 26,280	$ 21,372
Consolidated			
Media	$ 21,716	$ 19,942	$ 17,779
Electronics and other general merchandise	48,802	38,628	28,712
Other (1)	3,934	2,523	1,586
Total consolidated	$ 74,452	$ 61,093	$ 48,077
Year-over-year Percentage Growth:			
North America			
Media	18%	15%	16%
Electronics and other general merchandise	29	34	57
Other	58	64	73
Total North America	28	30	43
International			
Media	1%	9%	23%
Electronics and other general merchandise	23	35	55
Other	22	11	24
Total International	14	23	38
Consolidated			
Media	9%	12%	19%
Electronics and other general merchandise	26	35	56
Other	56	59	66
Total consolidated	22	27	41

AMAZON COM INC (AMZN)
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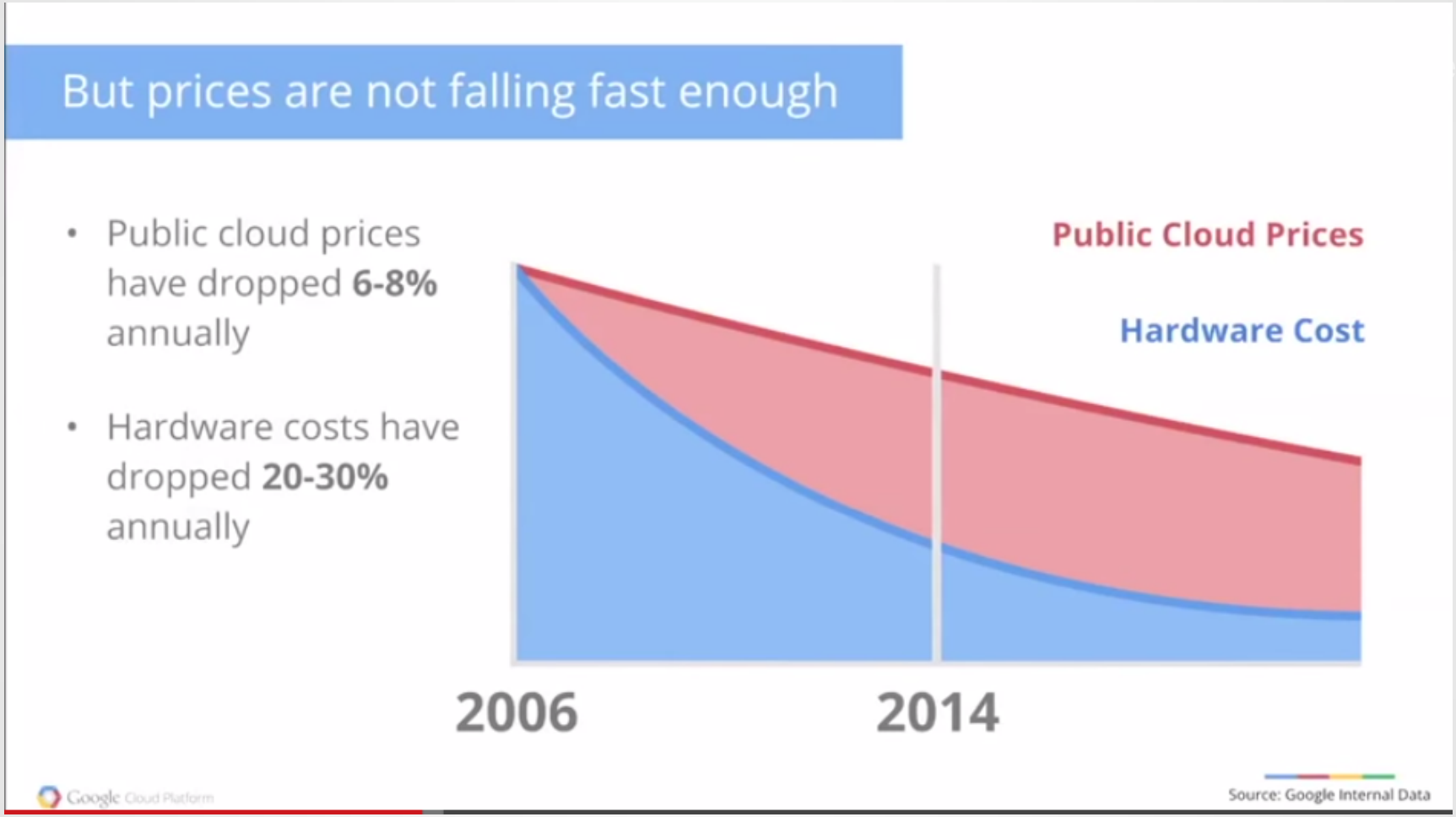
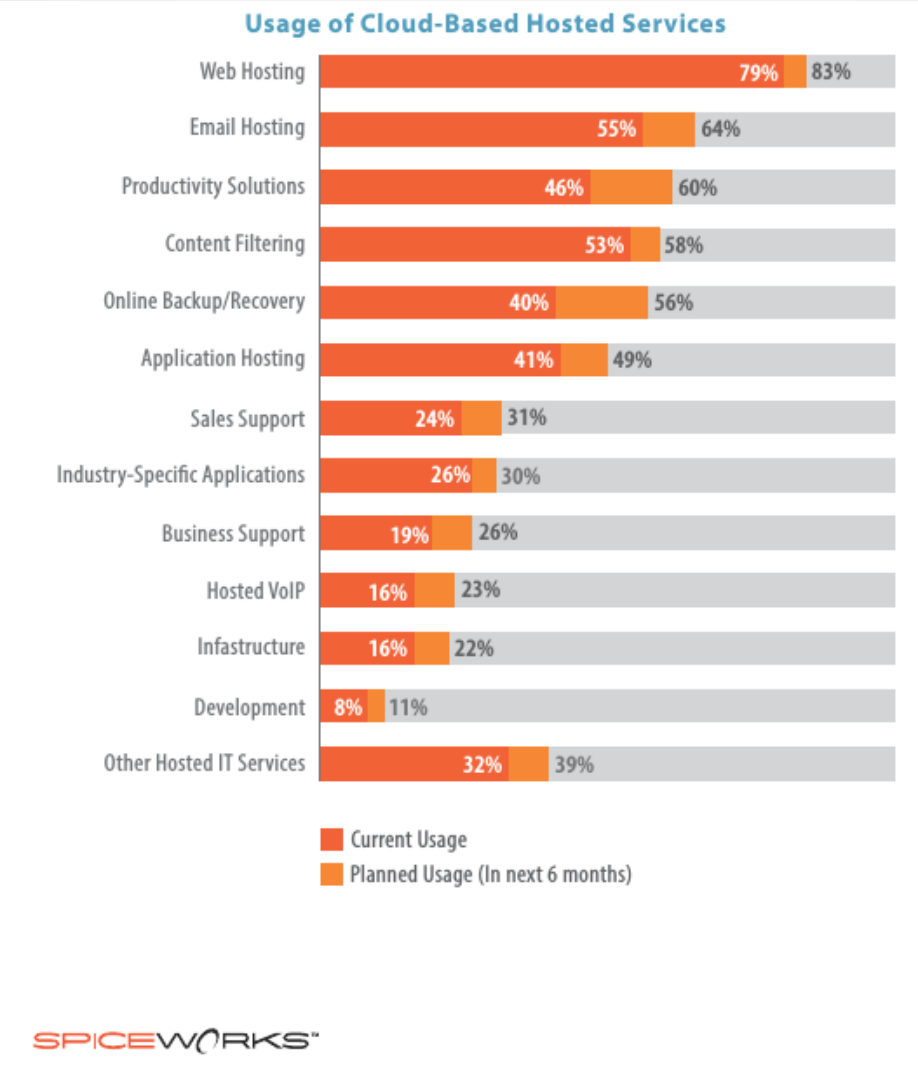
Cloud economics

… Provisioning advantages are not transferred fully to the customer



Current cloud apps are standardized

… because it's easier to adopt/move



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New “cloud” applications are structurally different

The Reality: The Cloud is Very Different

Cloud Technology Partners

Traditional Architectures

- Scale Up
- Monolithic
- Stateful
- Infra Dependent
- Fixed Capacity
- LAN Located dependencies
- Latency intolerant
- Tightly coupled
- Consolidated / clustered DB
- Rich / chatty client
- Commercial licenses
- Infra Supported Availability
- Semi-automated build/deploy
- Manual fault recovery
- Active/Passive/DR
- Perimeter Security
- Allocated costs

The “Old World”

Refactor

Cloud Aligned Architectures

- Scale Out
- Distributed
- Stateless
- Infra Agnostic
- Elastic capacity
- WAN, Location transparency
- Latency tolerant
- Loosely coupled
- Sharded / replicated / distributed DB
- Mobile/thin client
- PaaS / Open Source
- App Supported Availability
- Continuous Integration/Delivery
- Self healing, fault tolerant
- Active/Active
- Defense in depth
- Pay as you go

The “New World”

Automate

vmware

openstack

amazon web services™

rackspace

SaaS

The Targets

6

New “cloud” applications are structurally different

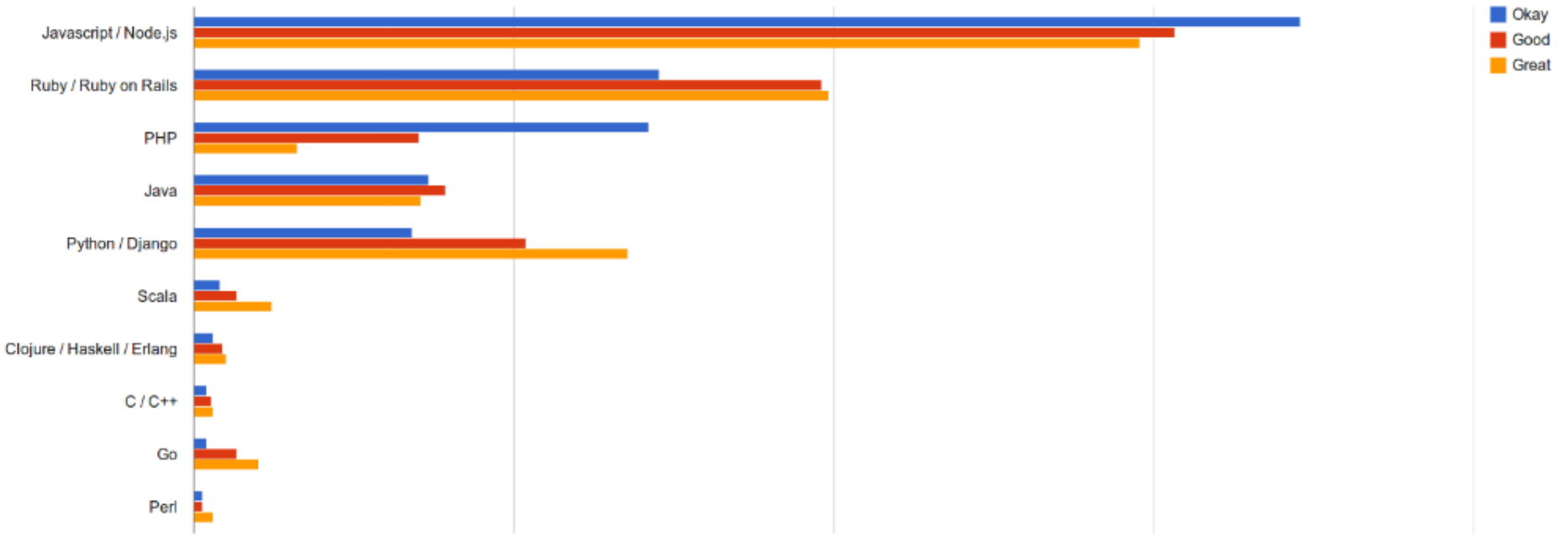
… and this is where the economics is real

- Taking advantage of the cloud in a real way (elasticity, idempotence of nodes, transparency of data sources) requires a complete reengineering/rewrite
- **This** is where there is a real advantage …
- … because most of the new applications are based on the following assumptions:
  - HTML5 user interfaces (and thus less dependency on traditional clients, easy integration of mobile/tablets/new devices)
  - inherently scalable (because they take advantage of naturally sharded apps like NoSQL)
  - inherently reliable (because they must ran on AWS, where VMs may disappear/fault)

New apps are inherently OSS-dependent

… written in OSS languages and tooling …

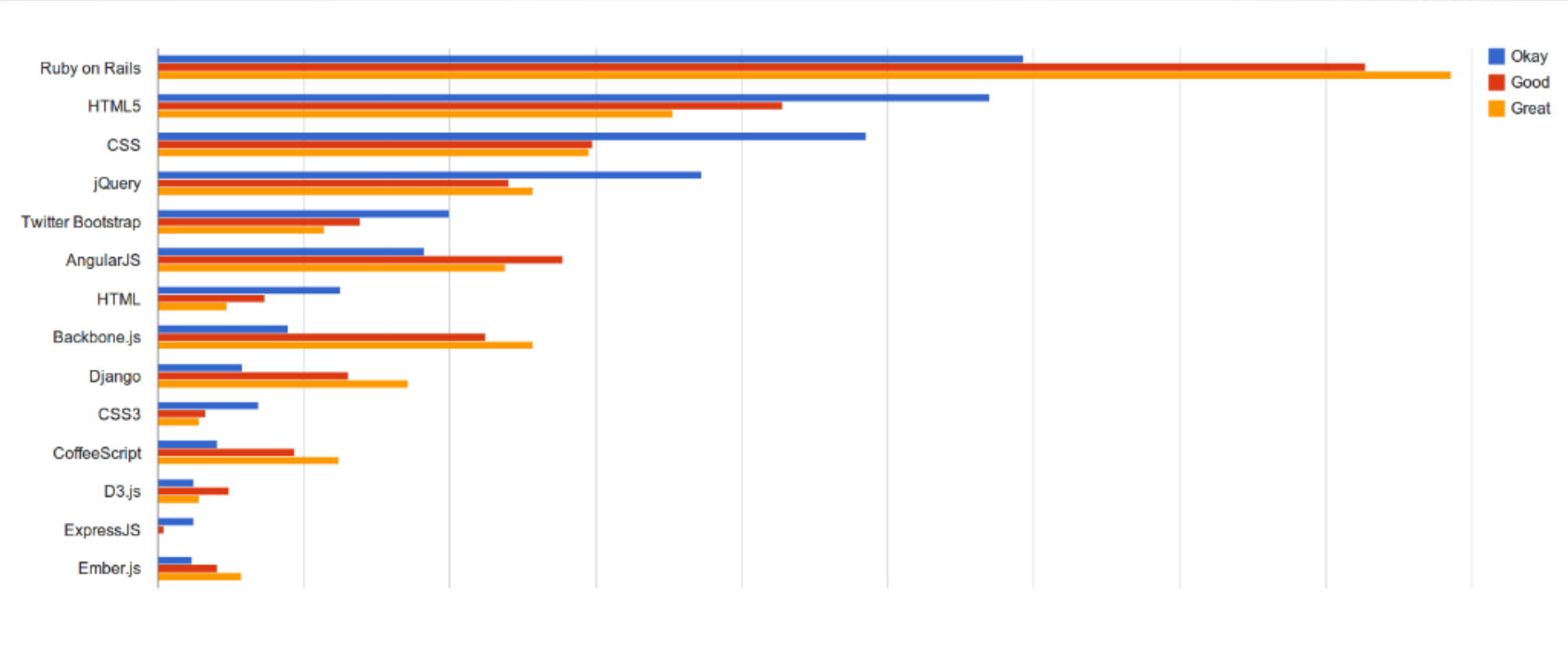
Insert Caption Here



"An exploration of AngelList data", Leo Polovets, Susa Ventures

New apps are inherently OSS-dependent

… with OSS-based frontends (web based) …



New apps are inherently OSS-dependent

… using mainly OSS-based datastores

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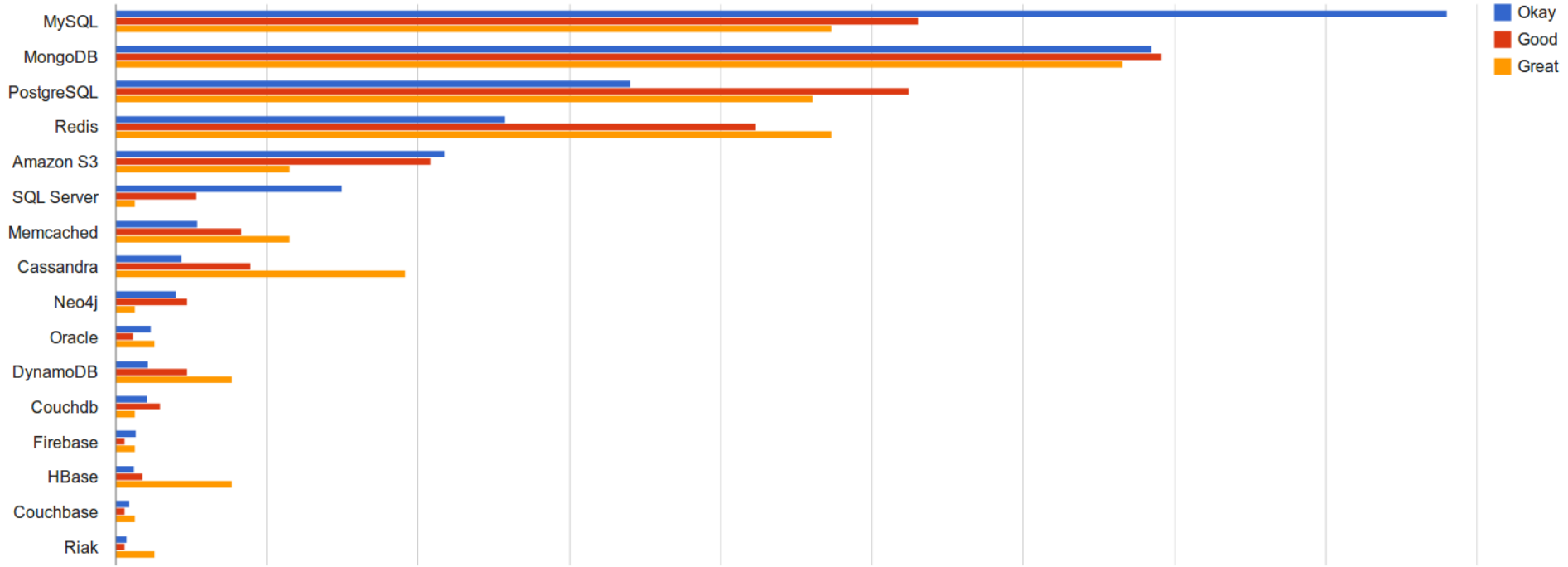

Open Source is inherently efficient

… as long as we talk about “living” projects

OPEN ACCESS Freely available online

PLOS ONE

How Much Is the Whole Really More than the Sum of Its Parts? 1⊞1 = 2.5: Superlinear Productivity in Collective Group Actions

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1 Department of Management, Technology and Economics, ETH Zurich, Zurich, Switzerland, **2** School of Information, UC Berkeley, Berkeley, California, United States of America, **3** Department of Informatics, University of Zurich, Zurich, Switzerland

Abstract

In a variety of open source software projects, we document a superlinear growth of production intensity ($R \sim c^{\beta}$) as a function of the number of active developers c, with a median value of the exponent $\beta \simeq 4/3$, with large dispersions of β from slightly less than 1 up to 3. For a typical project in this class, doubling of the group size multiplies typically the output by a factor $2^{\beta} = 2.5$, explaining the title. This superlinear law is found to hold for group sizes ranging from 5 to a few hundred developers. We propose two classes of mechanisms, *interaction-based* and *large deviation*, along with a cascade model of productive activity, which unifies them. In this common framework, superlinear productivity requires that the involved social groups function at or close to criticality, or in a “superradiance” mode, in the sense of the appearance of a cooperative process and order involving a collective mode of developers defined by the build up of correlation between the contributions of developers. In addition, we report the first empirical test of the renormalization of the exponent of the distribution of the sizes of first generation events into the renormalized exponent of the distribution of clusters resulting from the cascade of triggering over all generation in a critical branching process in the non-meanfield regime. Finally, we document a size effect in the strength and variability of the superlinear effect, with smaller groups exhibiting widely distributed superlinear exponents, some of them characterizing highly productive teams. In contrast, large groups tend to have a smaller superlinearity and less variability.

Citation: Sornette D, Maillart T, Ghezzi G (2014) How Much Is the Whole Really More than the Sum of Its Parts? 1⊞1=2.5: Superlinear Productivity in Collective Group Actions. PLoS ONE 9(8): e103023. doi:10.1371/journal.pone.0103023

Editor: Matjaz Perc, University of Maribor, Slovenia

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OSS is inherently efficient

by facilitating Lead Users in the design

Table 1 LU vs. Non-LU Funded Ideas (Census)

	LU ideas (n = 5)[2]	Non-LU ideas (n = 42)[3]	Sig.
Factors related to value of idea			
Novelty compared with competition[1]	9.6	6.8	0.01
Originality/newness of customer needs addressed[1]	8.3	5.3	0.09
% market share in Year 5	68%	33%	0.01
Estimated sales in Year 5 (deflated for forecast error)	$146m	$18m	0.00
Potential for entire product family[1]	10.0	7.5	0.03
Operating profit	22%	24.0%	0.70
Probability of success	80%	66%	0.24
Strategic importance[1]	9.6	7.3	0.08
Intellectual property protection[1]	7.1	6.7	0.80
Factors related to organizational fit of idea			
Fit with existing distribution channels[1]	8.8	8.0	0.61
Fit with existing manufacturing capabilities[1]	7.8	6.7	0.92
Fit with existing Strategic Plan[1]	9.8	8.4	0.24

[1]These items were measured using a 10-point rating scale, where 10 = high, 1 = low.

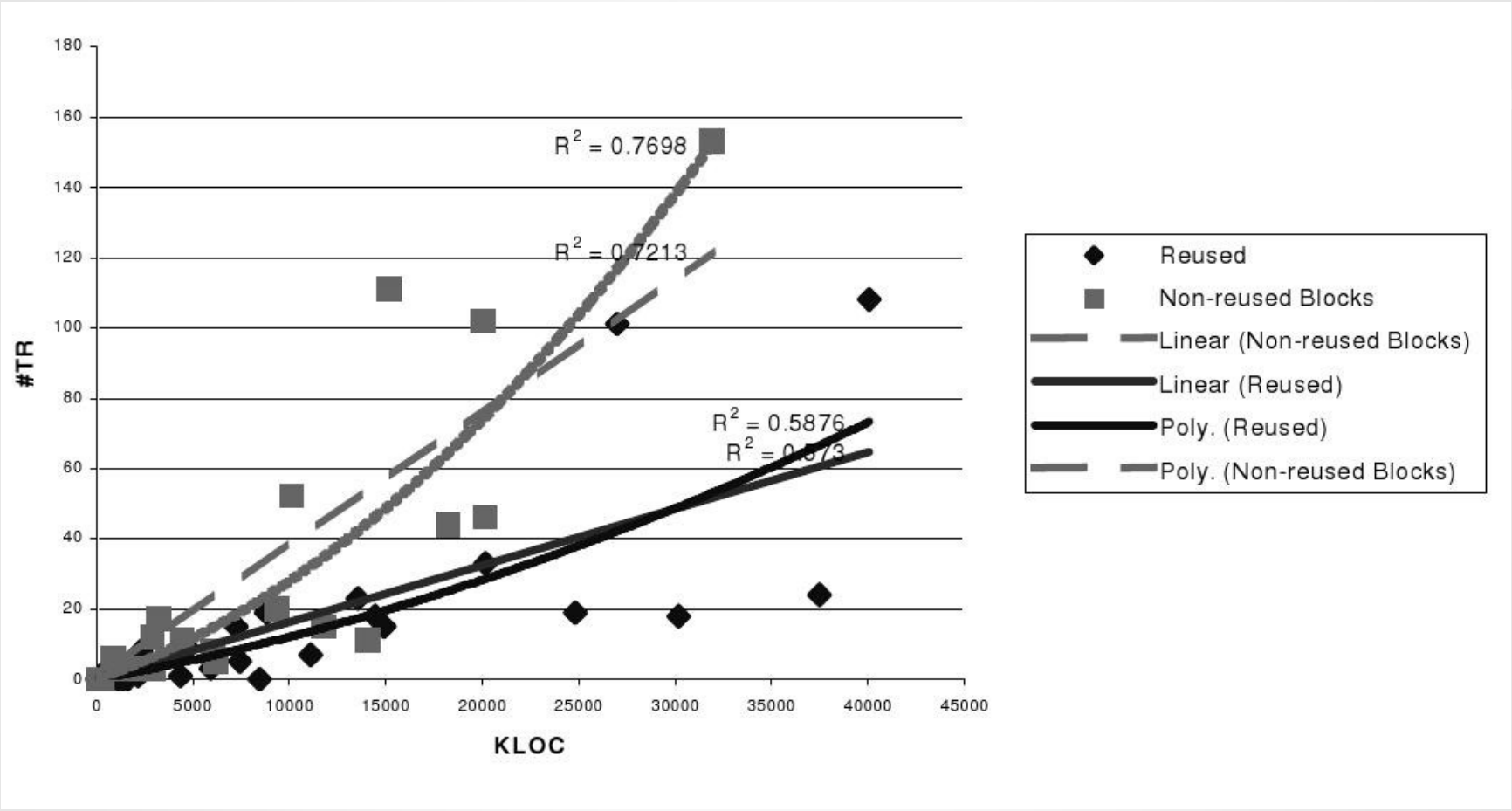
[2]Funded LU ideas: all are for major product lines.

[3]Funded non-LU ideas: one is for a major product line, 41 are incremental ideas.

Source: Lilien, Gary, Pamela D. Morrison, Kathleen Searls, et al. "Performance Assessment of the Lead User Idea-Generation Prcoess," *Management Science*, (2002) Vol. 48, No. 8 p. 1051

OSS is inherently efficient

by leveraging reuse to improve bug density



(Mohagheghi, Conradi, Killi and Schwarz “An Empirical Study of Software Reuse vs. Defect-Density and Stability”)

OSS is inherently efficient

by leveraging reuse to improve time-to-market and reduce effort

Project size (lines of code)	% of OSS	total cost (Keuro)	Savings	duration (years)	avg. staffing
100000	0	1703	0%	1.7	20.5
100000	50	975	43%	1.3	15.4
100000	75	487	71%	0.9	8.6
1000000	0	22000	0%	3.3	141.7
1000000	50	12061	45%	2.6	103.2
1000000	75	3012	86%	2	32
10000000	0	295955	0%	7.5	818
10000000	50	160596	46%	5.9	631.2
10000000	75	80845	73%	3.8	421

(Abts, Boehm, Bailey Clark “Empirical observations on COTS software integration effort based on the initial COCOTS calibration database”, analysys by Daffara)

OSS is inherently efficient

by leveraging reuse to improve bug density

- OSS maintenance effort is substantially lower than the average (Capra E., Francalanci C., Merlo F., “The economics of community open source software projects: an empirical analysis of maintenance effort”)
- Using a model by Jones and Bonsignour, traditional code costs 2000$ per function point, while code developed in a shared approach costs 1200$/FP
- Efficiency is higher when OSS savings are reinvested in IT:

Revenue per employee rating (FLOSS firms vs. Industry average)	
Computer Equipment	182%
Software consultancy and supply	427%
Services (excl. software cons. and supply)	211%
Manufacturing (excl. computer equip.)	136%
Other	204%
ALL:	**221%**

Source: MERIT

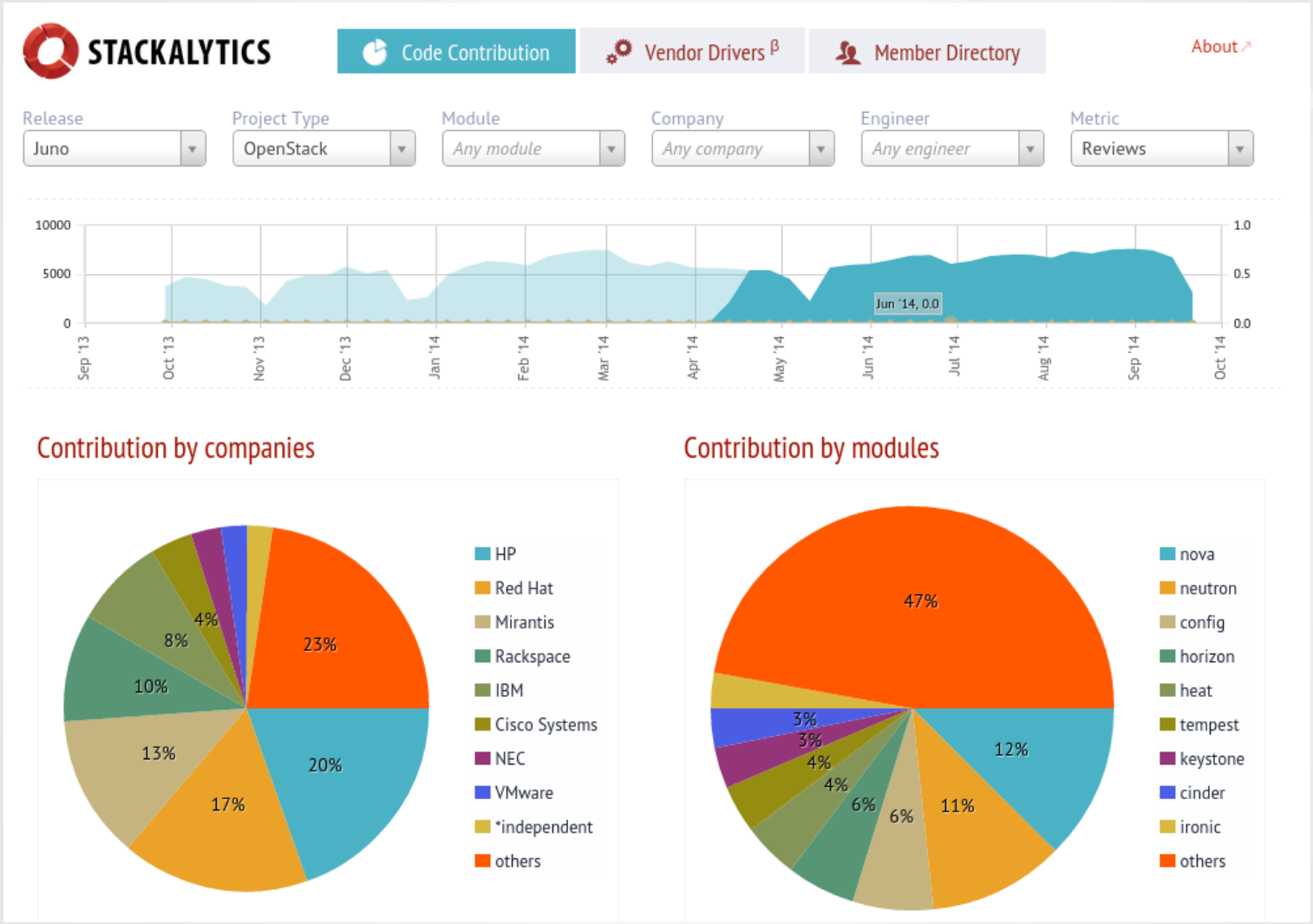
OSS is inherently efficient

by leveraging reuse to improve development speed

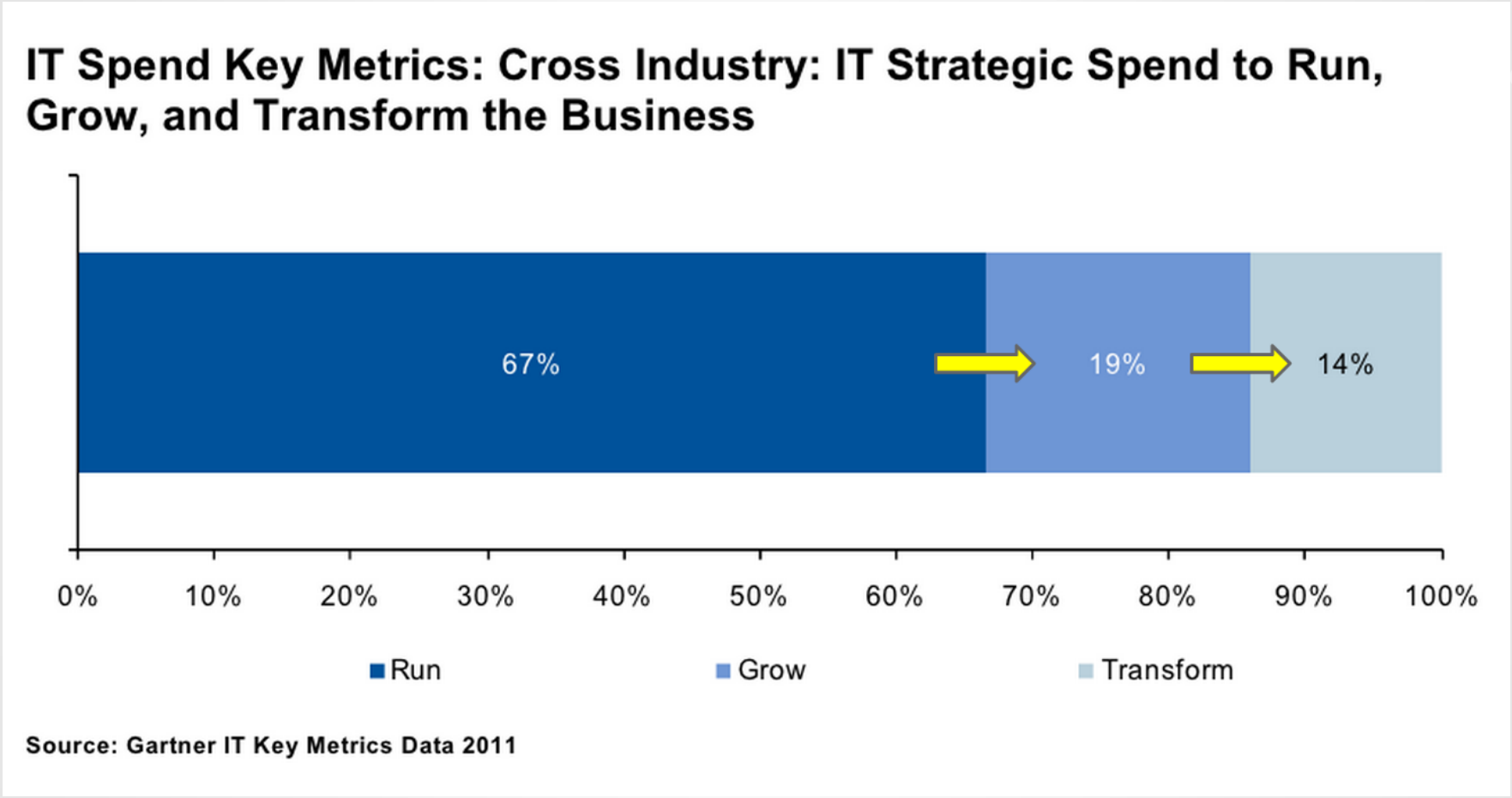
- Amazon AWS added 280 new features in 2013, 105 just in Q1 2014
- AWS changes code every 16 seconds
- Difficult for **any** vendor to match that rate
- Open Source does, through coopetition
- And at the same time, it commoditize part of its own ecosystem
- … which means that if you try to partially close it, you will find some of your own users compete through forking or module development …
- … if you are a vendor, you need to **understand** and **adapt** to a potentially different business model

OSS is inherently efficient

… allows R&D leverage of 5 times or more



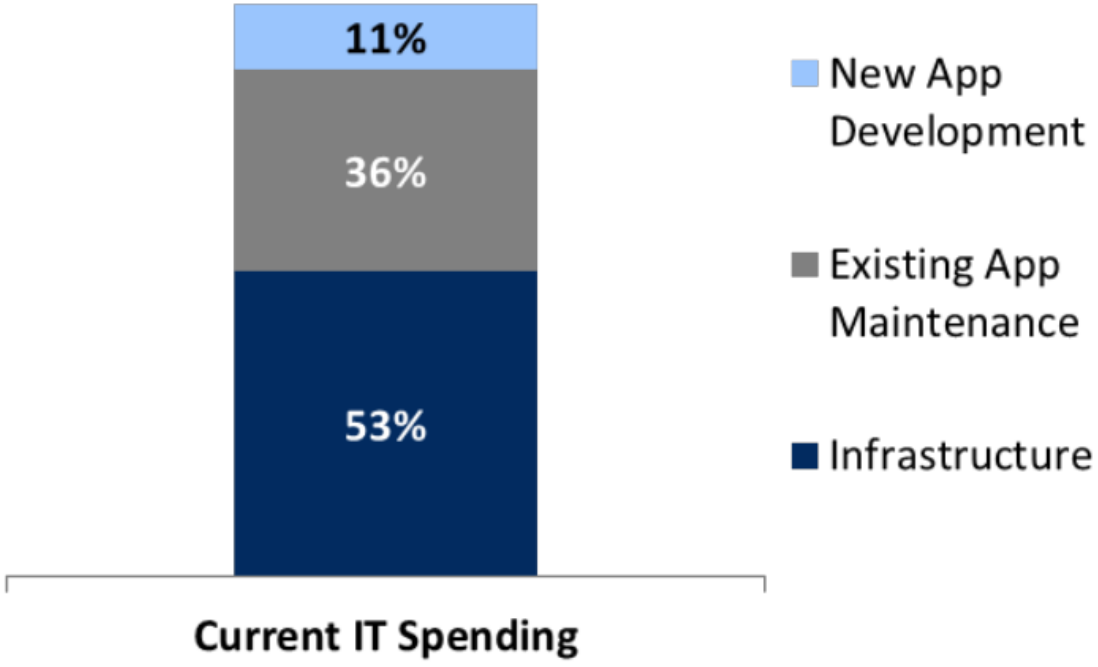
IT investing has different returns



IT investing has different returns

in particular for new software development

FIG. 16: IT SPENDING BREAKDOWN



Source: Microsoft.

IT investing has different returns

even for different sectors/company size

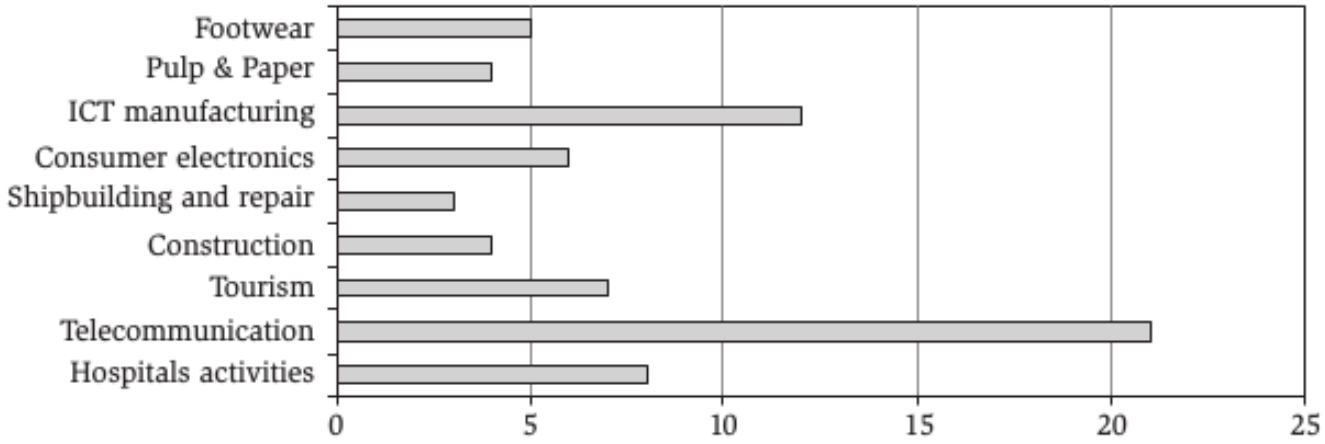


Figure 1. Average share of the ICT budget as % of total costs (by sector).

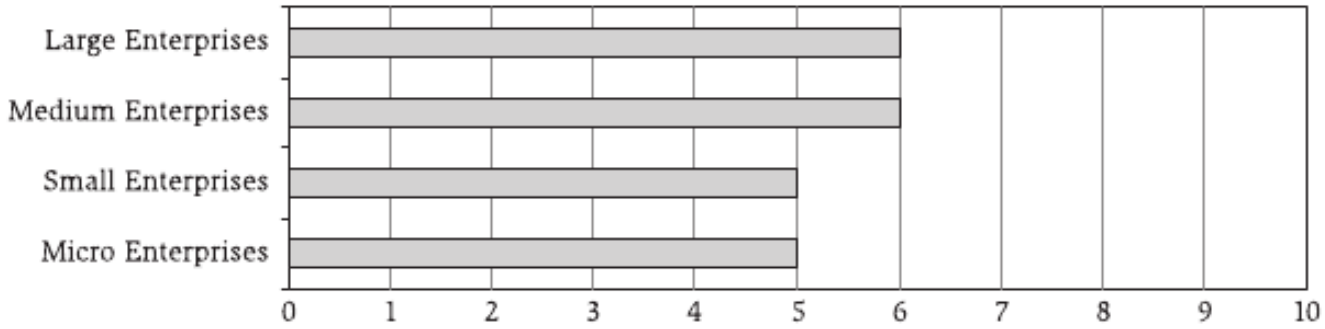


Figure 2. Average share of the ICT budget as % of total costs.

Caption Here

Economic impact of cloud

… for real this time

- Assuming that 75% of new apps are developed using a mainly OSS basis we can estimate a reduction in cost per year of 188B$ (assuming 3.8T$ world IT expenditure in 2014, source: Gartner) just in the “new apps” category
- If they are are completely reinvested in IT using the key metrics percentages we have a return of 329B$
- Later on, as the share of old apps/new apps moves towards 50%, the savings due to lower maintenance costs provide an additional 260B$/year

Adoption patterns

how to take advantage of all of this

- For vendors: decide what market you want to be in, today (tomorrow will arrive too fast to reach the leaders)
- Prepare for sudden change (eg. Docker: 42 people, 1 year and now most IT vendors had to adapt/adopt it)
- Adapt the cloud approach **for real** (partial substitutes do have none of the advantages and all the disadvantages)
- For users: be bold in asking something new from your vendors, and in looking for new vendors
- For PAs: most of the things you are looking for are probably already have been developed by others like you …
- … so go around and look at what others are doing
- Don't be afraid to experiment and develop, through small efforts (to force the use of OSS)

Thank You

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