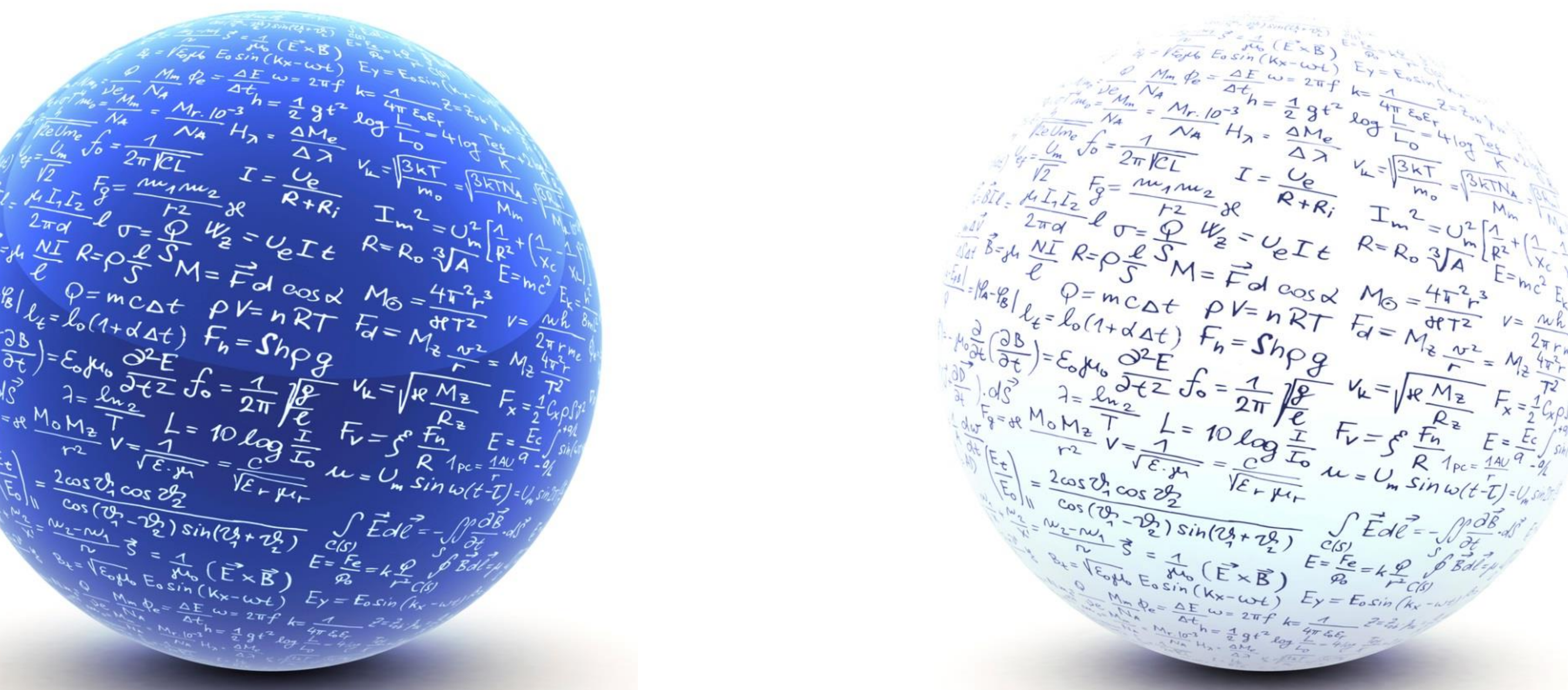
Introducing the T-Greeks™:

Techno-Operational Analytics
For Financial Services Enterprises



May 2016

About

Alphacution Research Conservatory

The Alphacution Research Conservatory is the first digitally-oriented research and strategic advisory business model focused on providing data, analytics and technical infrastructure intelligence to all institutional participants in the financial services ecosystem. Founded by Paul Rowady, Alphacution is specifically designed with a dual mission: 1) To deliver uncommon and data-driven intelligence for data, analytics and technology narratives related to the financial services industry, and 2) to leverage digital-era tools, technologies and methods in the development and delivery of its products and services, as well as to exemplify the cultural and organization dynamics that are integral to such an effort. Alphacution's core research and advisory services are based on its composite modeling for enterprise and business segment total cost of ownership (TCO) and other FSI technology market sizing, including its trademarked T-Greeks™ Operational Analytics Framework for TCO benchmarking. More information can found at www.alphacution.com. Please send inquiries to info@alphacution.com and follow on Twitter: @alphacution.

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Paul Rowady is the Founder and Director of Research for Alphacution Research Conservatory, the first digitally-oriented research and strategic advisory business model focused on providing data, analytics and technical infrastructure intelligence within the financial services industry. Most recently the founding principal of TABB Group's technology, analytics and data advisory practice, Paul is in his 27th year of senior-level research, technology, capital markets and proprietary trading roles with firms like O'Connor & Associates, Quantlab, Ritchie Capital Management and TABB Group; and has depth of background in trading strategy research, risk analytics systems and technology development. He also has specific expertise in derivatives, highly automated trading systems, and numerous data management initiatives. Paul is a featured speaker at global markets, technology, data, analytics, and visualization events; regularly quoted in national, financial and industry media; and has provided live and recorded commentary for national and client media channels. Paul's most recent research and consulting focus has related primarily to digital transformation, technology spending / total cost of ownership (TCO) benchmarking, big data analytics, high performance computing (HPC) technologies, OTC derivatives reforms and quantitative trading methods. He earned a Master of Management from the J. L. Kellogg Graduate School of Management at Northwestern University and a B.S. in Business Administration from Valparaiso University. He was also awarded a patent related to data visualization and information design for trading and research systems in 2008.

Table of Contents

Table of Exhibits

Introduction

Transformation – and, more specifically, "digital transformation" – lingers in the air like a thick morning fog. By all accounts – and our own estimation – this fog will continue to linger for many years to come. In this post-global financial crisis (GFC) era, large and complex incumbents – pressured by the converging forces of unprecedented regulatory interventionism, disintermediation from an explosion of generalized and specialized FinTech innovations, and persistent disorientation from new global economic realities – must now atone for their sins. For our purposes here, these *sins* include decades of bolting disparate business units together without making the effort to properly engage in enterprise integration and seek overall operational agility. Today, with most market opportunities deflated from their prior, pre-GFC state, enterprise transformation in the service of operational agility is now on the tips of everyone's tongues – and particularly those who have lived at the proprietary, secretive and wholesale end of the financial services industry (FSI) spectrum.

In other words, there is a growing acceptance that a faster and more radical form of disruption is here to stay. And with that acceptance comes the overwhelming sense that a fixation with the topic of transformation must quickly morph into *actual, rubber-meets-the-road transformation*. Alphacution recommends that all market participants commit to matching their targeted level of operational agility with their expectation for persistent and disruptive levels of change in their fields of business. This balancing act is the transformation piece. However, in order to embark on this type of exercise, market participants also need the right tools and the right strategies to measure, manage and monitor an increasingly fluid configuration of technical and human factors that contribute to operational agility. How enterprises mix human capital and technology – as well as how they mix skills and specific solutions within these macro categories – will be critical to success on the road ahead. In many cases, these concepts are merely warmed-over messages and partially-learned lessons from prior change management eras. Now, as we cross the proverbial chasm from the "analog" era to the digital era, lip-service will not cut it; a fresh look at a much more radical version of enterprise transformation is required. Our bet is that this "fresh look" is synonymous with a need for new tools.

In anticipation of these needs, Alphacution has developed a new method and new language to describe the relationship between operational agility and radical levels of change, and ultimately quantify the "return on technology" (RoT): Market participants – particularly the largest global banks and other complex enterprises who are also the largest buyers of technology in the ecosystem – need to persistently strive to "*widen the spread*" between their performance and the cost of the components to produce that performance.

Conceptually, this means having actionable, data-driven intelligence around operational analytics that showcase the nature of enterprise performance and allow for tactical transformation decision to be made. As such, Alphacution is cultivating a standardized framework to help firms better navigate their own transformation. In practice, the spread we are referring to here is the spread between revenue per employee (RPE) –

otherwise known as "the performance" – and total cost of ownership, or TCO, per employee (TPE) – which is otherwise known as the "cost of performance."

This research aims to introduce and define Alphacution's standardized analytical framework - including ongoing benchmarking - that quantifies the reality of transformation among key market participants – and thereby seeks to improve the precision with which strategic recommendations can be made in the future.

Introducing the T-Greeks™ Operational Analytics Framework[1]

In the pages that follow, we will define; provide background on; and a sampling of initial practical applications for the key components of this new language, which we are calling the T-Greeks™ Operational Analytics Framework (T-Greeks™). These metrics are actually "techno-operational" analytics that are designed to measure RoT while providing per-employee normalizations such that firms may be compared and benchmarked with that of other enterprises – and business segments - inside and outside their respective ecosystems.

In the current version of Alphacution's *T-Greeks™ Operational Analytics Framework*, there are 5 analytics. The first of which – T-Spread™ – is the main analytic in the framework, defined as follows:

- T-Spread™ represents the difference between revenue per employee (RPE) and total technology spending (TCO) per employee (TPE) for an entire enterprise or discrete business segment over a specific period of time (which, in the current modeling, is typically a unit of 1 year) and where technology TCO includes hardware, software, data and IT human capital[2].

The primary TCO categories are further defined as follows:

  - Hardware (HW) and other infrastructure includes mainly computer equipment, data center infrastructure, networking and connectivity, and telecommunications;
  - Software (SW) and other data processing functionality includes both internally-generated and purchased (or otherwise acquired) software solutions;
  - IT-related human capital (ITHC) includes both technology and data management personnel; and
  - Third-party data subscriptions.

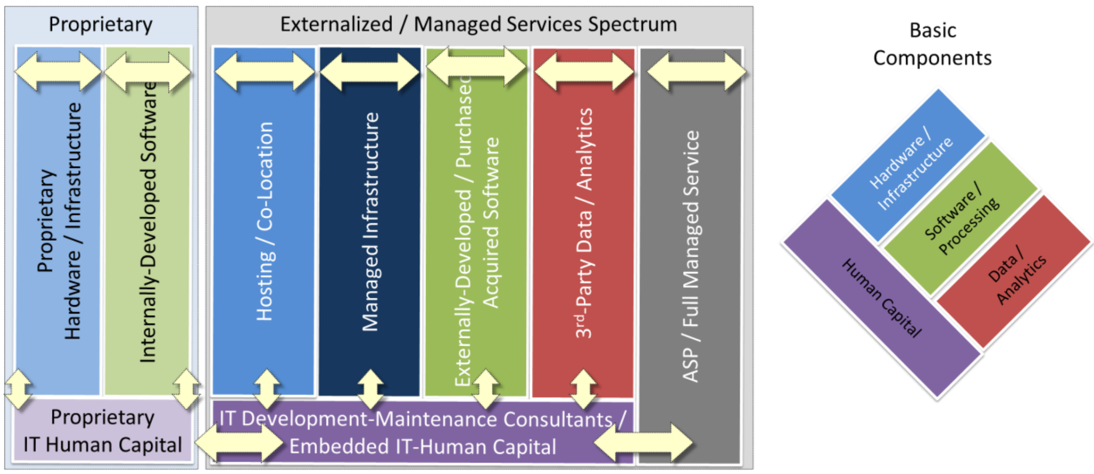
Furthermore, with the exception of third-party data subscriptions (which is always characterized as an external component), each of these categories includes both internal (i.e. - proprietary) and external (i.e. – outsourced, contracted or managed services) counterparts. And, to complicate the longer term modeling and analysis a

[1] T-Greeks™ and other output from Alphacution's operational analytics framework are *pending trademarks* of Alphacution.

[2] Note that for high-level TCO calculations, such as that for a diversified enterprise or business segment, the output needs to be considered as "net enterprise TCO".

little further, managed services, in particular, can be represented by various combinations of all factors (i.e. - hardware, software and/or IT human capital components). For instance, a fully managed services solution – such as market data infrastructure – typically involves all TCO categories, including the embedded IT-human capital component, baked together. Exhibit 1 showcases the variations between the mix of internal and external TCO components and configurations.

Exhibit 1: Proprietary / Externalized Components of Comprehensive Enterprise TCO Framework



Source: Alphacution

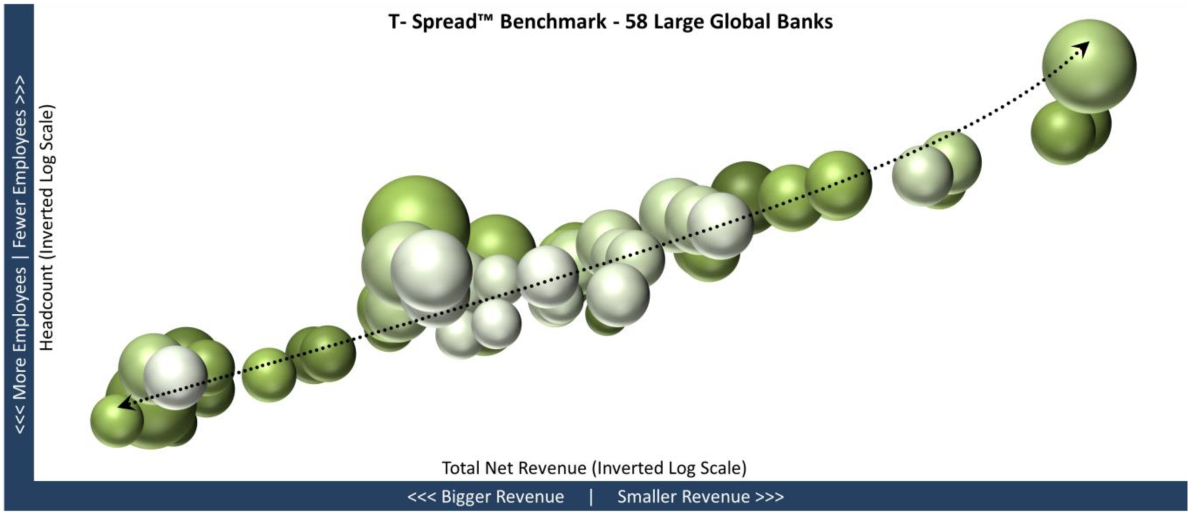
The remaining 4 analytics in the framework are derivations in whole or in part of the T-Spread™. These are defined as follows:

- T-Beta™ is the linear regression equation – much like a "best fit trend line" – used to create a reference benchmark for a collection of T-Spread™ measurements;
- T-Alpha™ represents a condition where the difference between the T-Spread™ (for an Enterprise X) and T-Beta™ (at a point on the benchmark with the same scale as Enterprise X, where scale is defined as total net revenue) is *positive*;
- T-Theta™ also known as "tech debt" represents a condition where the difference between the T-Spread™ (for an Enterprise X) and T-Beta™ (at a point on the benchmark with the same scale as Enterprise X, where scale is defined as total net revenue) is *negative;* and,
- T-VOL™ is the "volatility" – as measured by standard deviation – of total technology spending (TCO) per full-time equivalent (FTE) - otherwise known as TPE – for an entire enterprise or discrete business segment over a range of time that is typically several years or several periods[3].

[3] *Note* that unlike the other T-Greeks™ analytics that are based on or derived in whole from the T-Spread™, we have elected not to directly use the volatility of T-Spreads™ here. The reason for this is that the volatilities of *both* revenue per employee (RPE) and TPE are reflected in the standard deviation of T-Spread™. In order to better *isolate* the volatility of technology spending per employee over time, we only use the TPE component of T-Spread™ as the underlying source for calculating T-VOL™.

If we were to chart the T-Spreads™ for each of 58 large global banks in our Model, that picture would look like Exhibit 2. (Note: we will revisit this illustration and the numbers behind it later in the report.)

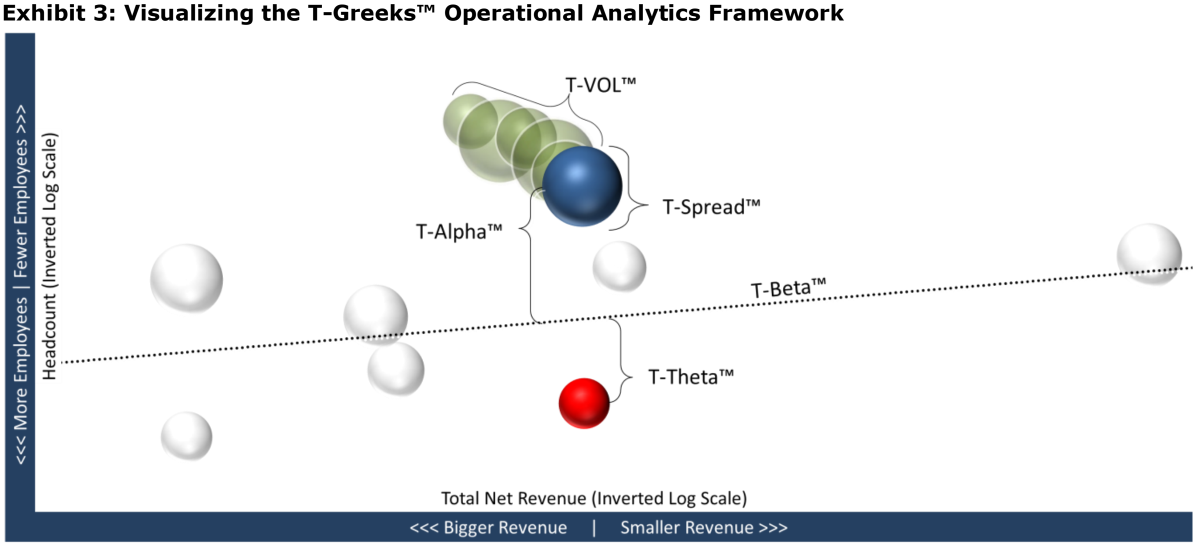
Exhibit 2: Foreshadowing T-Spread™ Benchmarking



Source: Alphacution Research Conservatory

With Exhibit 2 as context, each of the T-Greeks™ framework analytics can be illustrated visually a bit more easily as follows (see Exhibit 3):

Exhibit 3: Visualizing the T-Greeks™ Operational Analytics Framework



Source: Alphacution Research Conservatory

With these definitions and visualization as a backdrop, the subsequent sections will expand the context of the T-Greeks™ framework along these topics:

- Background for calculating T-Spread™;
- Demonstrate how the remaining (4) analytics are derived from T-Spread™;
- Present a selection of practical applications for T-Greeks™; and,
- Provide Alphacution's vision on future developments for its overall modeling as well as T-Greeks™ operational analytics framework.

Standardized Enterprise TCO Framework

The primary goals of this chapter are to showcase Alphacution's methodology, broader modeling efforts and specific data sample that provide the foundation for the T-Greeks™ Operational Analytics Framework.

In this study, Alphacution sets out to identify and measure the enterprise-level and core components of TCO for the largest global banks and then use that output to generate T-Greeks™ operational analytics for the Sample. This section will establish the background for Alphacution's methodology, broader modeling efforts, its total enterprise technology spending (or TCO) framework, and a few key details about the data sample used to generate the current set of analytics.

Methodology

The Alphacution Composite Model (the "Model" or "Sample") is currently focused almost exclusively on the financial services industry (FSI) ecosystem. In this phase of modeling, we harvest financial and operational data from publicly-available sources, such as company annual reports and regulatory filings[4]. This dataset includes primarily annual data from all companies and also selective quarterly data samples from a subset of the same companies. Specifically, most data points are harvested from the income statements, balance sheets, and detailed notes for each of these reports.

Our initial focus has been mainly on the technology spending patterns of the largest global banks, but continues to expand into other firm types, including brokers, asset managers, pension funds, exchanges, post-trade utilities, technology vendors, and others inside and outside of the financial services arena that add value and context to the ongoing analysis. As of the development of this content, the Model currently includes *individual models* – including financial and operational data - from 118 banks, brokers, asset managers, technology vendors, exchanges, and others - most of which over the entire 11-year period ending December 31, 2015[5]. Individual models are then aggregated to form the composite model. Furthermore, this modeling is incredibly diverse, with the companies in the latest version of the Model being headquartered in 24 countries and who report their financials in 19 currencies; all analytics from which have been converted and normalized to US dollars.

Data Sample

For this modeling exercise, we are focusing on 58 of the largest global banking groups for the period 2005 through 2015. This Sample is specifically chosen to include the top 10 banking groups as ranked by Tier 1 capital (2015), all 30 global systematically important banking groups (G-SIBs), and all 22 primary dealers (2014) – among other key attributes (see Exhibit 4, next page). Only 4 of the 58 banks in the Sample do not share any of these attributes. These last 4 banks were chosen to provide additional geographic diversity and/or provide comparative benchmarking for a subset of smaller banks.

[4] Includes, for example, US SEC's Forms 10-K, 10-Q, and 20-F (which must be submitted by all "foreign private issuers" that have listed equity shares on exchanges in the United States).

[5] Subscribers to Alphacution's Premium Content Library receive access to detailed output from individual and composite models.

Exhibit 4: List and Key Attributes of Banking Groups in the Sample

Entity	Country	Currency	50[1]	100	GSIB[2]	Dealer[3]
ABN Amro Group NV	Netherlands	EUR				
Agricultural Bank of China, Ltd.	China	CNY	6		1	
Australia and New Zealand Banking Group, Ltd.	Australia	AUD				
Banco Bilboa Vizcaya Argentaria SA (BBVA)	Spain	EUR				
Banco do Brasil SA	Brazil	BRL				
Banco Santander SA	Spain	EUR			1	
Bank of America Corp	US	USD	5		2	
Bank of China, Ltd.	China	CNY	4		1	
Bank of Montreal	Canada	CAD				
Bank of New York Mellon Corp.	US	USD			1	
Bank of Nova Scotia	Canada	CAD				
Barclays Plc	UK	GBP			3	
BGC Partners	US	USD				Cantor
BNP Paribas SA	France	EUR			3	
Canadian Imperial Bank of Commerce	Canada	CAD				
China Construction Bank Corp.	China	CNY	2		1	
Citigroup, Inc.	US	USD	7		3	
Comerica	US	USD				
Commerzbank AG	Germany	EUR				
Commonwealth Bank of Australia	Australia	AUD				
Credit Agricole Group	France	EUR			1	
Credit Suisse Group AG	Switzerland	CHF			2	
Daiwa Securities Group Inc.	Japan	JPY				
Danske Bank A/S	Denmark	DKK				
Deutsche Bank AG	Germany	EUR			3	
Development Bank of Singapore	Singapore	SGD				
Fifth Third	US	USD				
Goldman Sachs Group, Inc.	US	USD			2	
Groupe BPCE	France	EUR			1	
HSBC Holdings Plc	UK	USD	9		4	
Industrial and Commercial Bank of China, Ltd.	China	CNY	1		1	
ING Bank NV	Netherlands	EUR			1	
Intesa Sanpaolo SpA	Italy	EUR				
Itau Unibanco Holding SA	Brazil	BRL				
Jefferies LLC	US	USD				
JP Morgan Chase & Co.	US	USD	3		4	
Key Bank	US	USD				
Lloyds Banking Group Plc	UK	GBP				
Mitsubishi UFJ Financial Group Inc.	Japan	JPY	10		2	
Mizuho Financial Group Inc.	Japan	JPY			1	
Morgan Stanley	US	USD			2	
National Australia Bank, Ltd.	Australia	AUD				
Nomura Holdings Inc	Japan	JPY				
Nordea Bank AB	Sweden	EUR			1	
Northern Trust	US	USD				
PNC Financial Services Group Inc.	US	USD				
Rabobank Group	Netherlands	EUR				
Royal Bank of Canada	Canada	CAD				
Royal Bank of Scotland Group Plc	UK	GBP			1	
Société Générale	France	EUR			1	
Standard Chartered Pls	UK	USD			1	
State Street	US	USD			1	
Sumitomo Mitsui Financial Group Inc.	Japan	JPY			1	
Toronto-Dominion Bank	Canada	CAD				
UBS AG	Switzerland	CHF			1	
Unicredit Group SpA	Italy	EUR			1	
US Bancorp	US	USD				
Wells Fargo & Co.	US	USD	8		1	

Notes: 1) Numbers indicate Tier 1 Capital ranking 2015; 2) Numbers indicate global systematically important bank (G-SIB) loss absorbancy bucket; 3) Primary dealer list 2014

Source: Alphacution, The Banker, Financial Stability Board, NY Federal Reserve

Additional highlights are as follows: 23 banking groups headquartered in North and South America (the "Americas"), 22 banking groups headquartered in Europe, Middle East or Africa (EMEA), and 13 banking groups headquartered in the Asia Pacific region (APAC). This Sample is further broken down into the number of banking groups headquartered in various countries (see Exhibit 5).

Exhibit 5: Countries Represented in the Data Sample[6]

Region	Country	Banks
Americas (23)	Brazil	2
	Canada	5
	US	16

Region	Country	Banks
APAC (13)	Australia	3
	China	4
	Japan	5
	Singapore	1

Region	Country	Banks
EMEA (22)	Denmark	1
	France	4
	Germany	2
	Italy	2
	Netherlands	3
	Spain	2
	Sweden	1
	Switzerland	2
	UK	5

Source: Alphacution

In total, this Sample is headquartered in 16 countries and reporting financials in 11 currencies. It also employed total aggregate 6.0 million people, generating US$1.7 trillion in total net revenue, spending a total aggregate $525.6 billion on compensation and benefits, and also representing an aggregate technology TCO of $168.8 billion (including hardware, software and IT related human capital) in 2015 (see Exhibit 6).

Exhibit 6: Key Sample Metrics[7]

Key Sample Metrics	2015	11-Year Average	5-Year CAGR (%)	10-Year CAGR (%)
Total Net Revenues[1]	1,715.6	1,566.3	-0.1%	6.0%
Full-Time Equivalent (FTE) Employees	6,046,430	5,909,640	-0.4%	2.1%
Total Compensation[1]	525.6	468.8	1.1%	5.2%
Average Annual Compensation per FTE	117.8	118.1	-0.1%	1.6%
Total Cost of Ownership (TCO)[1]	168.8	154.0	0.8%	4.7%
Total Software Spend[1]	48.6	35.6	5.8%	8.1%
Total Hardware Spend[1]	60.3	61.4	-1.7%	7.6%
Total IT Human Capital (HC) Spend[1,2]	59.9	57.1	0.1%	3.4%

1) US$ billions, 2) estimates based, in part, on weighted-average annual compensation per FTE

Source: Alphacution, Company Data

Also, incredibly important for this analysis are the 5- and 10-year CAGR rates for software, hardware and IT human capital spending. It is worth noting here at the outset that hardware spending – which has heretofore been the largest component of TCO since the beginning of our dataset in 2005 – is gradually losing that leadership position. And, on the back of new managed service and other Infrastructure-as-a-Service (IaaS) offerings, Alphacution is predicting that software spending will take over the top spot in the next 3 years (by the end of 2018).

[6] Region, country and other grouping labels are typically followed by a number in parentheses, "EMEA (22)" or "Brazil (2)" or "Global Markets (8)". These figures represent the number of banks within that grouping.

[7] All averages presented in this report are weighted averages, unless otherwise noted.

Key Points

- The Alphacution Composite Model is an aggregate of individual models, currently totaling 118 diverse financial service companies headquartered in 24 countries and reporting their financials in 19 currencies.
- Data for this model is currently harvested from publicly-available documents, including annual reports and regulatory filings.
- This study focuses on data from 58 of the largest banking groups in the world which are headquartered in 16 countries and reporting financial data in 11 currencies.
- All financial data in the Model is converted and normalized to US dollars.
- The banking groups in this report are comprised of all 2015 G-SIBs (33), all primary dealers as of 2014 (22), all top 10 global banks for 2015 (as measured by Tier I capital), and 50 of the top 100 banking groups for 2015 (as measured by assets).
- In 2015, these 58 banks generated $1.7 trillion in revenue, employed slightly more than 6 million people, and spent US$169 billion on technology including US$71.7 billion on hardware, US$59.9 billion on IT human capital, and US$37.2 billion on software.
- Alphacution predicts that software spending will surpass hardware spending as the largest component of TCO within 3 years (or by the end of 2018).

T-Spread™ Construction

The primary goal of this chapter is to present step-by-step details for the process of estimating total hardware, software and IT human capital components of TCO which then leads to an estimate for global enterprise TCO for banks.

With our methodology, framework, data sample n place, the next step on the road to calculating the first of the T-Greeks analytics is to estimate the value of the TCO component categories, namely hardware, software and IT-related human capital[8]. Alphacution believes that the easiest part of establishing this analytical foundation – if there is one – is to find the value of the combination of hardware and software first. The reason for this initial step is that it is the closest to how banks and others disclose their information technology costs.

Estimating NHC Technology Spending

With very few exceptions, banks do not disclose technology spending in much detail. More specifically – if they do disclose any detail at all – most banks disclose a bundled "information technology" expense line or something similar in the income statement[9]. There are a few exceptions that disclose technology spending in great detail, delineating between categories of hardware, software, development and maintenance expenses – or, who break out detailed software values between internally-generated and purchased software sub-categories. On the other end of the spectrum, there also banks who disclose no additional detail beyond very broad operating expense categories in the income statement and/or very broad asset values in the balance sheet. Many US banks – including many G-SIBs – are notorious for providing very little transparency on their technology spending patterns.

This brings us to two key points: First, due to the variance in the quality, accuracy and detail of individual banking models, Alphacution grades each of them; a semi-objective score based on levels of detail in the income statement, balance sheet, and the notes to each (including financial and operational data for business segmentation). With this method, we can be sensitive to where we rely on strong models vs. reliance on weak models.

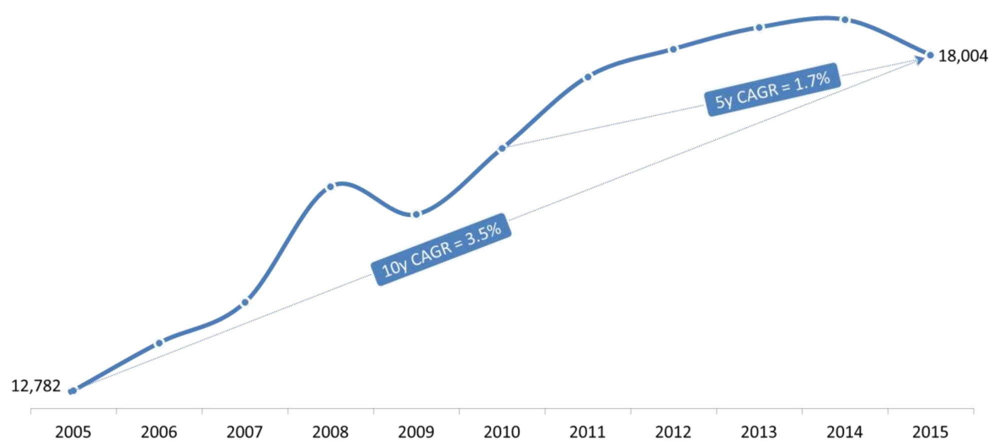
The second point is about context – and a discussion that is likely beyond the scope of this report: At the base of this exercise is the realization that the numbers we seek are unknowable. There is no omniscient arbiter of exact technology spending data for a global consortium of complex banking groups. So – like a massive and increasingly complex Sudoku puzzle – we must seek the best and most credible context available in order to properly estimate the values that cannot be directly observed. In short, stronger models will add incremental improvement in context for supporting certain figures and estimates in weaker models – particularly as we seek to look beyond bulky spending categories. Exhibit 7 is our first illustration for how the analysis in each

[8] Recall that the value of third-party data subscriptions is not yet estimated separately – and is currently assumed to be embedded with hardware spending estimates.

[9] Additional transparency on technology spending sometimes can also be found in the notes to the income statement under detailed operating expenses, general and administrative expenses, or non-personnel operating expenses.

individual model is normalized and aggregated to generate "per employee" metrics. In this example, we demonstrate that the weighted average spend on hardware and software – otherwise known as non-human capital (NHC) technology spending – *per employee* in 2015 was US$18,004. Further, this figure represents a 10-year CAGR (from 2005) of 3.5% and a much slower 5-year CAGR (from 2010) of 1.7%.

Exhibit 7: Hardware + Software Tech Spending per Employee (2005-2015, USD)



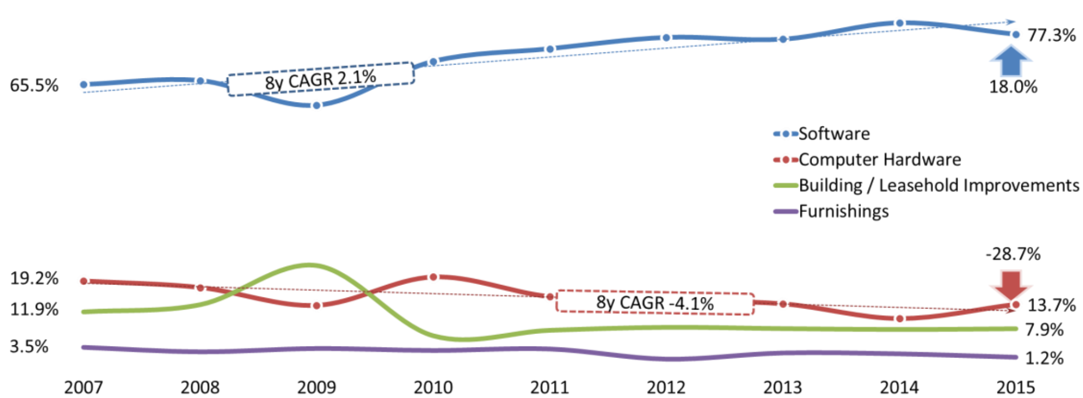
Source: Alphacution, Company Data

The next step in the process is the question of how to split the broader NHC technology spending category into its primary categories, hardware and software. For now, we assume that if one of these can be determined with credibility, the other is determined by default.

Estimating Software Spending

It turns out that some our individual bank models hold clues breakdown spending that we can use to estimate certain figures for the entire group. Exhibit 8 is a perfect example of this: A US-based bank discloses its breakdown for capital expenditures (or "capex") for an 8-year period commencing in 2007.

Exhibit 8: Software v. Hardware Spend (US Bank–Capex Breakdown, 2007-2015)

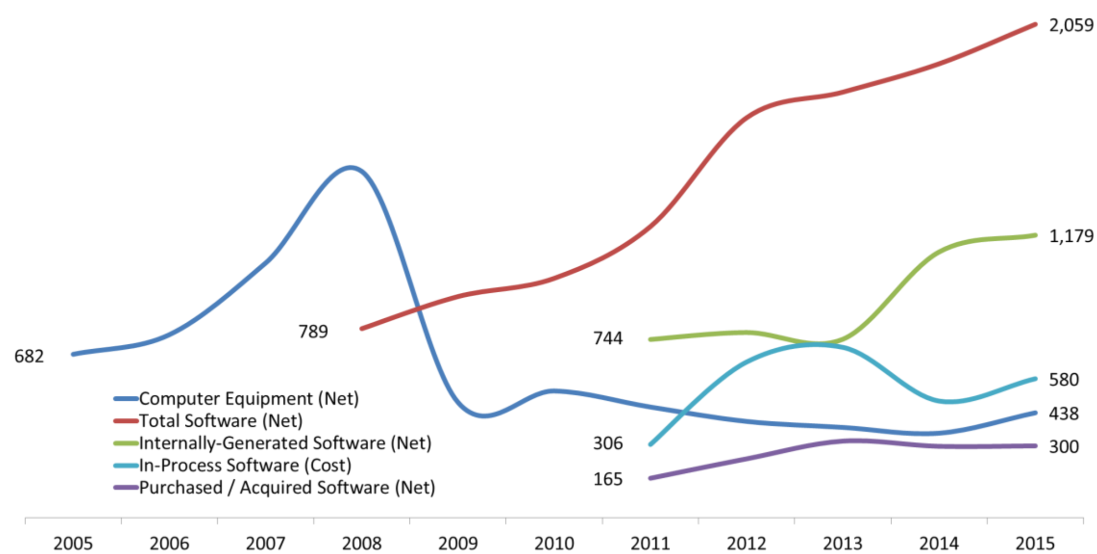


Source: Alphacution, Company Data

Beware that this chart is a bit of an illusion. It shows both hardware and software spending increasing on a dollar basis – 8 year CAGR of 2.1% for hardware vs. 9.3% for software. This is because the overall capex budget is growing at an 8 year CAGR of 7.1%. However, as a portion of capex – and since software is growing so much faster than hardware – software continues to demonstrate a "crowding out" effect on hardware and other capex spending. Another way to measure this relationship: Software capex represents a multiple of 3.4 vs. hardware (at the minimum) and 7.8 (at the maximum, in 2014). Yes, these are a lot of numbers to absorb. Yet, this is an extremely important point because it may explain a new driver behind increasing adoption of more cost-efficient managed services or other Infrastructure-as-a-Service (IaaS) offerings due to regulation-induced software development needs.

Another great example of spending clues can be found below in Exhibit 9: A Canadian bank provides increasing balance sheet transparency on computer equipment and software asset values over the 11-year modeling period beginning in 2005. These disclosures clearly illustrate shifting resource allocation patterns between and among the primary TCO categories, with further transparency on the relative shifts in internally-generated, purchased, and in-process software, beginning in 2011.

Exhibit 9: Software v. Hardware Spend (Canadian Bank Analysis, 2005-2015, USD millions)

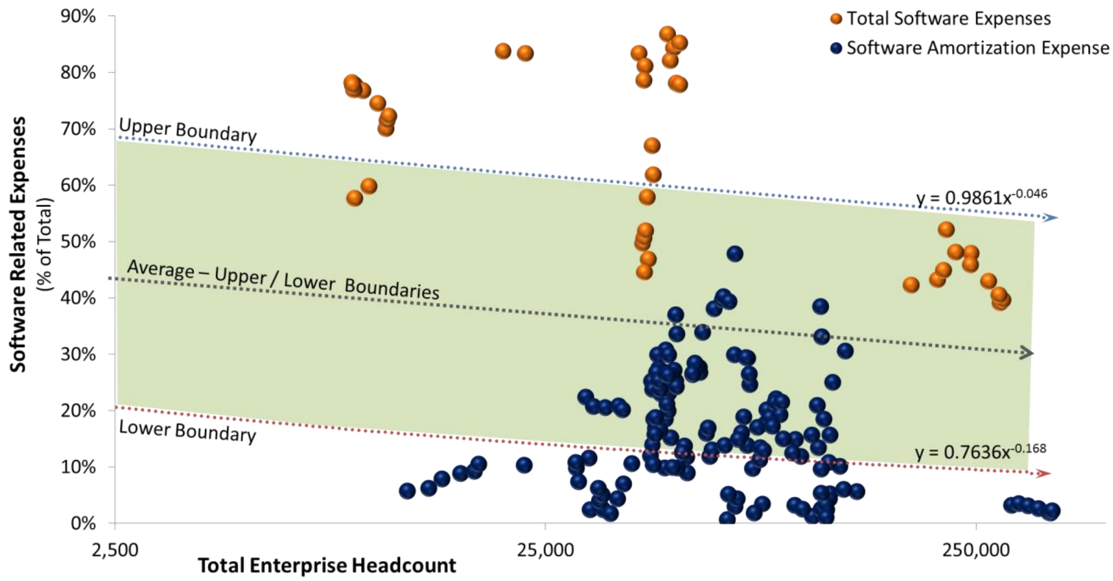


Source: Alphacution, Company Data

When we take these two examples – along with many others - this modeling can begin to offer a credible framework for estimating software spending patterns for the Sample (and the global banking sector, as a whole). Based on observations from 24 banking groups representing 13 countries over 11 years (218 total data points), we can develop a scatterplot chart from which to generate best-fit trend lines for the entire Sample (see Exhibit 10, next page).

In this example, observations (where n=157) of *software amortization expenses* form a lower boundary and observations (where n = 61) of *total software expenses* form an upper boundary. The average of the equations of these upper and lower trend lines form the basis for estimation of software expenses as a portion of NHC technology spending and also based on enterprise scale (or total headcount.) Notice that software expenses are skewed based on total headcount, where economies of scale become more prevalent with more employees.

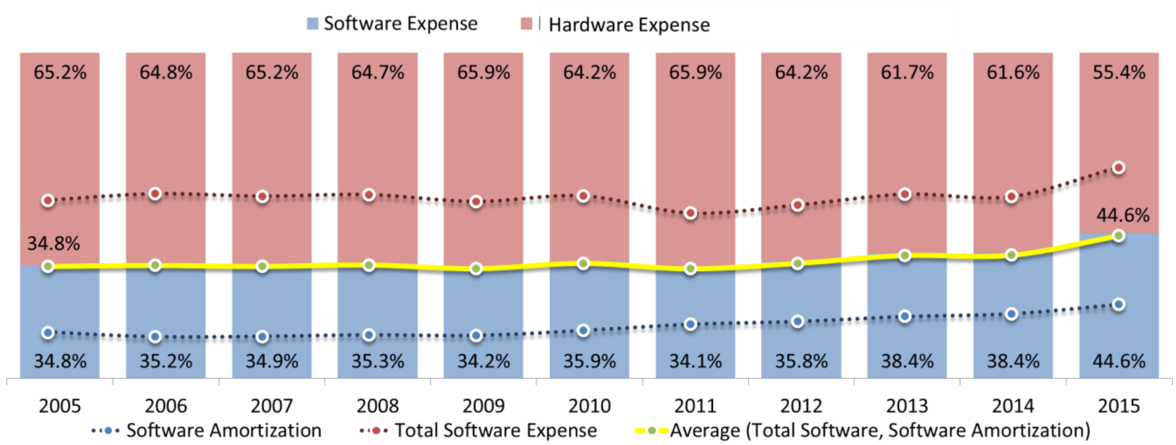
Exhibit 10: Estimating Software Expense Allocation (2005-2015 Average)



Source: Alphacution, Company Data

One drawback of the presentation format of Exhibit 13 is that it does not reflect changes in spending patterns over time – which are significant. So, if we were to delineate our 218 software expense-related observations by year, we would arrive at Exhibit 11. In this case, average software expenses (independent of enterprise scale) increases from 34.8% of NHC technology spending in 2005 to 44.6% in 2015. These results imply that hardware spending over the same period declines significantly from 65.2% of NHC technology spending in 2005 to 55.4% in 2015 and thereby providing more weight behind the aforementioned hypothesis about how dramatic increases in software spending may be crowding out on hardware spending.

Exhibit 11: Average Software / Implied Hardware Spending (% of Total NHC-TCO)



Source: Alphacution, Company Data

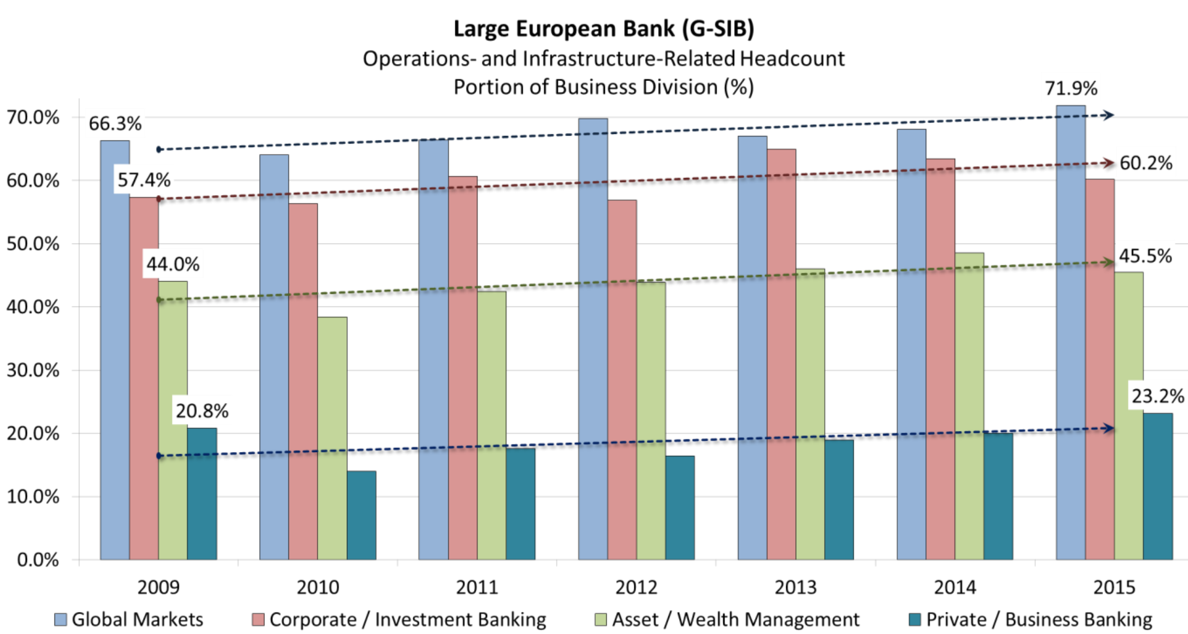
Estimating IT Human Capital Spending

The last piece of this phase of the puzzle is in estimating the IT-related human capital (ITHC) component of TCO. The process is similar to the previously illustrated software expense estimation, but arguably a notch more fascinating because of the growing evidence for how global banks have modified their organizational structures to address the cost of technical redundancies and fragmentation in the post-GFC era – and at the same time take a meaningful step towards achieving greater operational agility. Alphacution also believes that these new organizational structures indirectly address "cultural fragmentation" which is a major intangible impediment to achieving agility.

Specifically, a growing number yet still minority of banks (11/58 in the Sample) have been setting up new organizational segments labeled "corporate center" or some other related business unit that represents the "horizontal", enterprise-wide functions that support all "vertical" segments. This "platform" or infrastructure-oriented organizational structure is roughly defined as including mostly enterprise functions – which is a very broad spectrum. These include the likes of corporate communications, audit, strategy, research, finance, tax, risk, regulatory and compliance, public affairs, human resources and – most notably for our purposes here – technology, operations and digital transformation initiatives responsible for support of the chief information and chief data offices.

In Exhibit 12, we use evidence from one European bank to illustrate the proportion of operations- and infrastructure- related headcount for each of four common and core business segments – as well as the change in those proportions since the re-org was implemented in 2009.

Exhibit 12: Estimating IT Human Capital Allocations (European Bank / G-SIB, 2009-15)

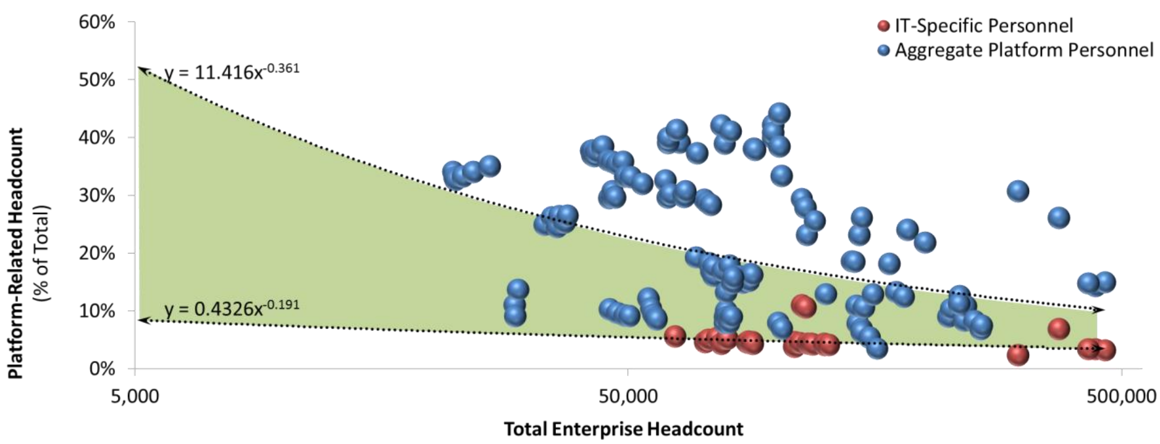


Source: Alphacution, Company Data

Note that not only has – in all cases – the proportion of "platform" headcount grown as a percentage of total headcount for each business division since 2009, but the variance in the percentage of platform headcount by the *nature* of each business division is fascinating, as well. These are incredibly valuable clues for how a diversified financial organization fits together, and the relative proportion of IT-related personnel that are necessary given the activities in different types of financial businesses. Alphacution believes that a simple axiom emerges from this evidence that proves useful in determining each business segment's "technology signature"*: Higher-touch businesses have lower automation, and therefore, lower IT human capital allocations; lower-touch businesses have higher automation, and therefore, higher IT human capital allocations.*

All that said, we used the aforementioned evidence along with disclosures from other banking groups[10] to estimate the ITHC allocation for the Sample TCO (see Exhibit 13).

Exhibit 13: Estimating IT Human Capital Expense Allocation for TCO (2005-2015 Average)



Source: Alphacution, Company Data

As with the software spending estimation process, each subset of observations (for IT-specific personnel and aggregate "group center" personnel) yields two best fit lines, which gives us an upper and lower boundary for estimation. Then, we take the average of the equations from the scatterplot to estimate ITHC allocations for each bank in the Model. Recall that these estimates are scale dependent, much like Exhibit 10 illustrates a skew of platform headcount where smaller firms need more platform personnel and larger banks need fewer platform personnel. Lastly, in order to complete the estimate of ITHC for our TCO modeling, we combine bank-specific IT personnel estimates with average annual compensation per banking group to arrive at the ITHC expense estimate.

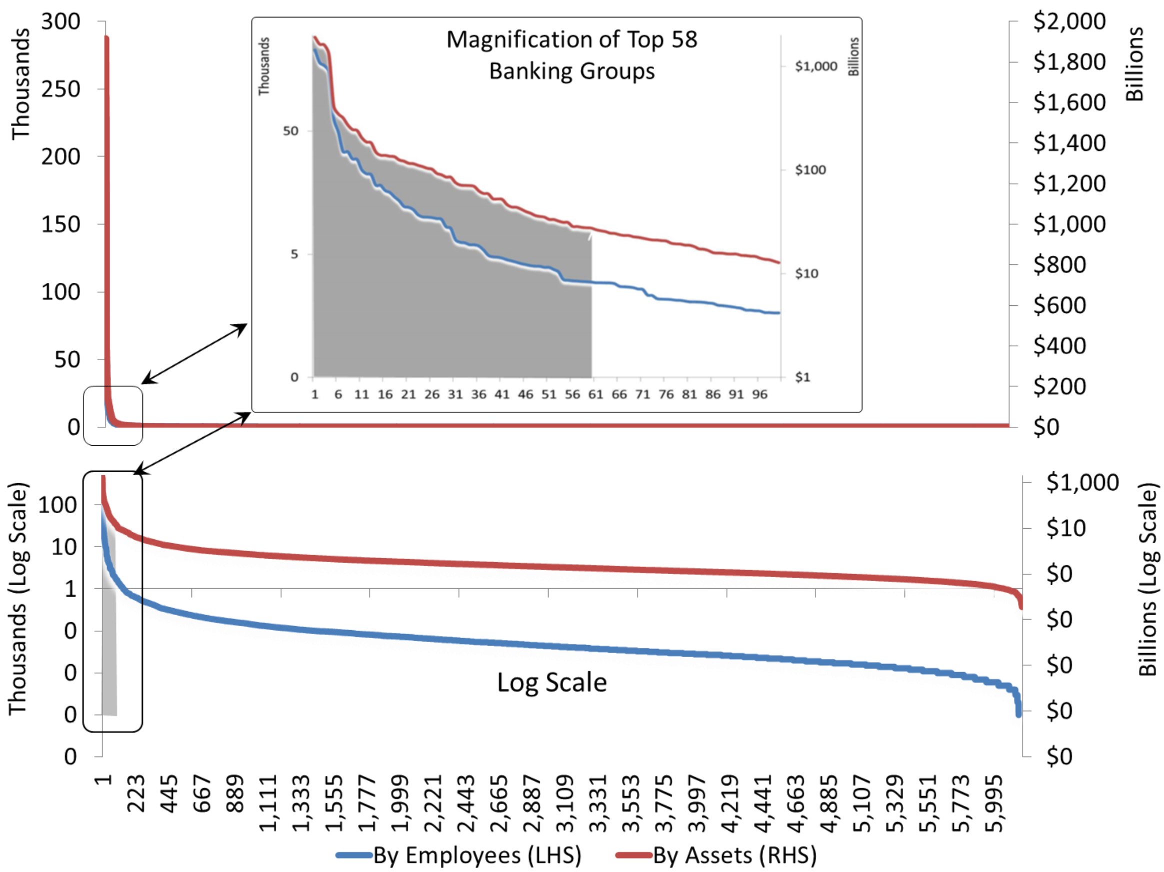
Now, while imagining a not-so-faint drumroll in the background, we now combine the estimates described above for each of the core spending categories - software, hardware (implied), and IT human capital costs - we arrive at figures that get us one step closer to estimating global enterprise TCO for banks:

[10] 22 banks in total, headquartered in 11 countries, representing 162 unique observations over 11 years

Estimating Global Enterprise TCO

The global banking sector is incredibly concentrated – and this kind of concentration has a very unique "shape". For instance, based on data from USBankLocation.com, 52% - or US$ 8.3 trillion - of banking assets (and 47% of banking employees) are represented by the top 10 US banks. It turns out that the shape of this concentration is also quite useful for estimation for lots of economic phenomena, like TCO. In other words, with so much of the banking activity and employment concentrated literally within the top 1% of the total market, concentration makes the estimation of totals much easier to calculate (see Exhibit 14).

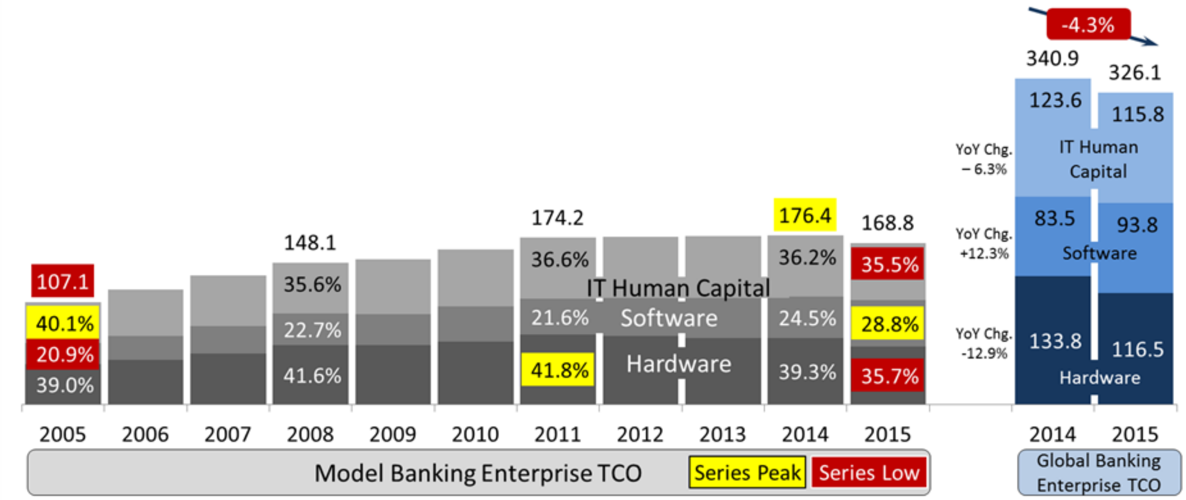
Exhibit 14: Shape of US Banking Concentration for Global TCO Estimation



Source: Alphacution, USBankLocations.com

From here, all we need to estimate is how much of the total banking sector is represented by the Sample. We arrive at this estimation by calculating that the US segment of our Sample banks represents 51.8% of US banking headcount (for 2015). Assuming for the time being that this relationship holds up globally – an assumption worth debating further - we can estimate global banking headcount (11.7 million) and from there we can use our Model estimates for software, hardware and IT human capital *per employee* to finally arrive at a global TCO estimate (see Exhibit 15, next page).

Exhibit 15: Sample, Global Bank TCO by Framework Components (2005-2015, USD billions)



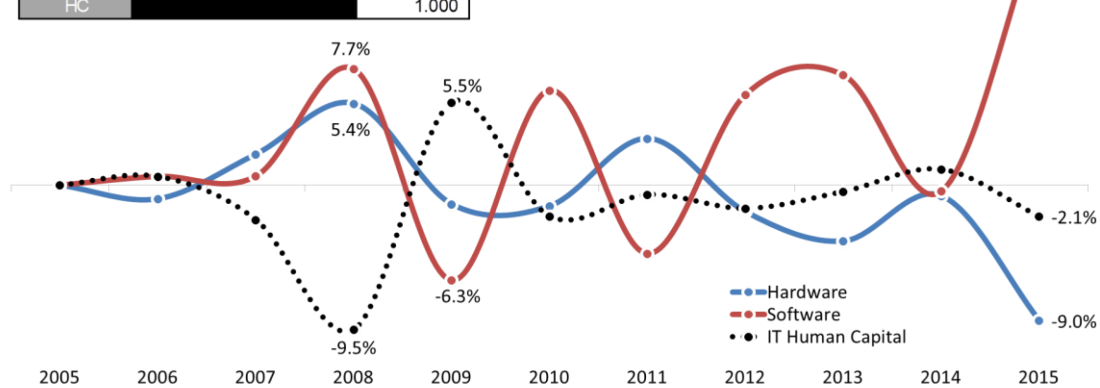
Source: Alphacution, Company Data

$240 billion is Alphacution's current estimate for total global enterprise TCO for banks in 2015, where hardware and IT human capital are nearly equivalent at US$85 billion each and software spending is estimated to be US$69 billion. Digging a level deeper, software spending is at an 11-year high of 28.8% for 2015 (as a percentage of TCO) – coming at the expense of both hardware and IT human capital, which currently stand at 35.5% and 35.7% of TCO for the period, respectively - both 11-year lows.

The cause of these extremes fall into a few buckets – namely, new pricing levels, shifting demands, new solution offerings, and combinations of each of these. For instance, new solution offerings – mostly notably managed services or IaaS - typically have the effect of moving the IT human capital expense from a proprietary to an embedded cost of a service or solution. So, for 2015, an 11-year low in IT human capital spending could be explained, at least in some part, by ongoing elimination of proprietary IT-human capital. Exhibits 16 and 17 (next page) illustrate just how dramatic the shifts in component allocations have been, and only since 2011.

Exhibit 16: Annual Change in TCO Component Allocations (2005-2015, % of TCO)

Correlation	HW	SW	HC
HW	1.000	(0.566)	(0.369)
SW		1.000	(0.555)
HC			1.000



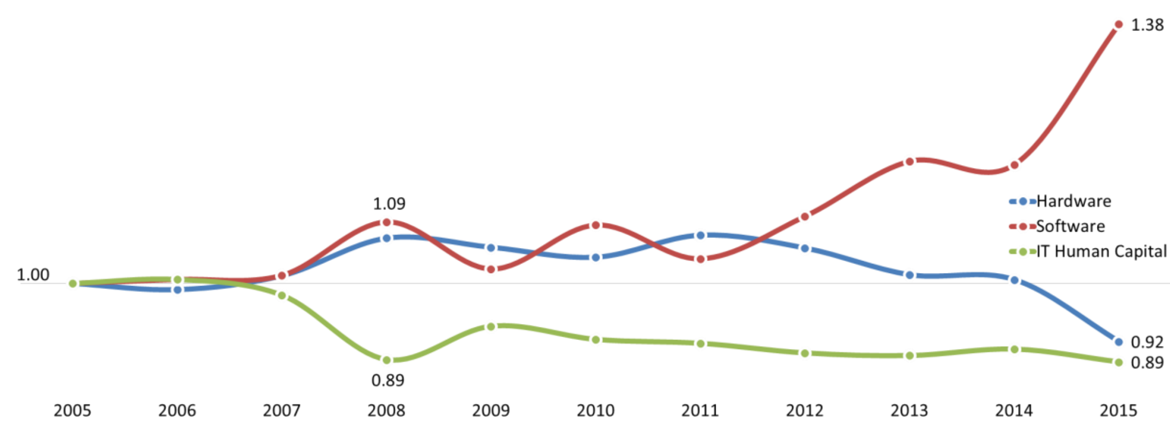
Source: Alphacution, Company Data

All three core TCO components exhibit high correlations through the GFC until around 2010-2011. It is almost as if - operationally and structurally - large banks generally experienced a lag of 2 years before any meaningful reaction to the events of the GFC. Arguably, it took at least this long for new regulations to achieve enough clarity on risk reporting, new clearing and collateral rules, and other regulatory transparency initiatives. For instance, the G-20 Commitments on OTC Derivatives Reform began in Pittsburgh USA in September 2009. It wasn't until at least a year later that early preparations for these new rules began.

Since 2010-2011, persistent shifts occurred in all core TCO components: Growth in software spending is the most dramatic. Without 3rd party, off-the-shelf software solutions to manage new enterprise-scale governance, risk and compliance (GRC) mandates, banks poured considerable new money into custom, internally-generated software development projects. Along with this, increasing needs to respond to "digital disruption" from areas like mobile banking and improved user experience (UX) as well as the expensive, agility-preventing effects of redundant and fragmented technologies also boosted demands for software investments. Alphacution does not believe that any embracing of open source solutions, like Hadoop, has impacted software spending trends.

In parallel, and to make room in already tight and inelastic tech budgets (where new software spending essentially began to crowd out hardware investments), banks engaged in two strategies to contain hardware spending: First, they have stretched the life of legacy infrastructure wherever possible – which is the same as lengthening hardware refresh cycles. The second strategy is clued in by the gradual decline in IT-human capital allocations: Banks have been gradually eliminating proprietary management of technical infrastructure in favor of a spectrum of managed service and IaaS offerings that allow them to reduce proprietary headcount and either eliminate or embed those costs in the more outsourced offerings.

Exhibit 17: Cumulative Change in TCO Component Allocations (2005-2015, % of TCO)



Source: Alphacution, Company Data

Key Points

- There are no standards for disclosing technology-related spending, and therefore, there is wide variance in reporting conventions and details. Banks rarely report technology spending broken down between hardware, software and IT human capital.
- Alphacution estimates that weighted average spending on hardware and software per employee by global banks in 2015 was US$18,004 – representing a 10-year CAGR of 3.5% since 2005 and a 5-year CAGR of 1.7% since 2010.
- Since 2011, increased software spending drivers have created a "crowding out" effect on hardware and IT personnel spending; this has caused both extension of legacy hardware lifecycles and a tipping point for accelerated adoption of managed services, cloud and other IaaS offerings.
- High demands for custom, internally-generated software has also caused purchases of 3rd party software to be flat to down; another crowding out effect.
- A minority of banks shifts in organizational structure to include "corporate center" or other "platform" segments – for enterprise technology, risk and other horizontal functions – is evidence for movements towards more agile operating strategies.
- Detailed bank segment analysis yields evidence that each type of business segment has a unique "technology signature"; generally this means: Higher-touch businesses have lower automation, and therefore, lower IT human capital allocations; lower-touch businesses have higher automation, and therefore, higher IT human capital allocations.
- This analysis confirms that the estimates for IT human capital are scale dependent; smaller firms need more platform personnel and larger firms need fewer platform personnel on a proportional basis.
- The global banking sector is incredibly concentrated; the "shape" of this concentration allows Alphacution to leverage estimates from 58 large banks into an estimate for Global Bank TCO.
- In 2015, the Sample TCO was $169 billion; software spending achieved an 11-year peak of 28.8% of TCO; both hardware and IT human capital delivered 11-year lows of 35.7% and 35.5% of TCO, respectively; and Global Bank TCO was US$240 billion.
- The cause of TCO component spending extremes in 2015 is due to the recent convergence of primary drivers: regulatory, digital innovation, and economic uncertainty.

T-Greeks™ Practical Application

The primary goals of this chapter are to demonstrate possible use cases for broader TCO modeling as well as specific applications for T-Spread™ and the other analytics from Alphacution's T-Greeks™ operational analytics framework.

It may seem strange to declare at this stage of the presentation – after laying down so many numbers and elevating the virtues of adopting new "more-for-less" solutions – but in the final analysis Alphacution believes that it really doesn't matter what your firm spends on technology. What actually matters most is what your firm *receives* for its investment in technology. In turn, "technical leverage" is dependent on your firms mix of people (What is the skills mix?), processing (Are your workflows robust, efficient and agile), and technology (Does your mix of tools and infrastructure collectively represent a competitive advantage?) for harvesting actionable intelligence from raw and derived data. In other words, is your firm receiving a "tech dividend" or paying a "tech debt"? This is where the practical application of Alphacution's T-Greeks framework begins to come into play along our journey to better quantify enterprise and ecosystem transformation.

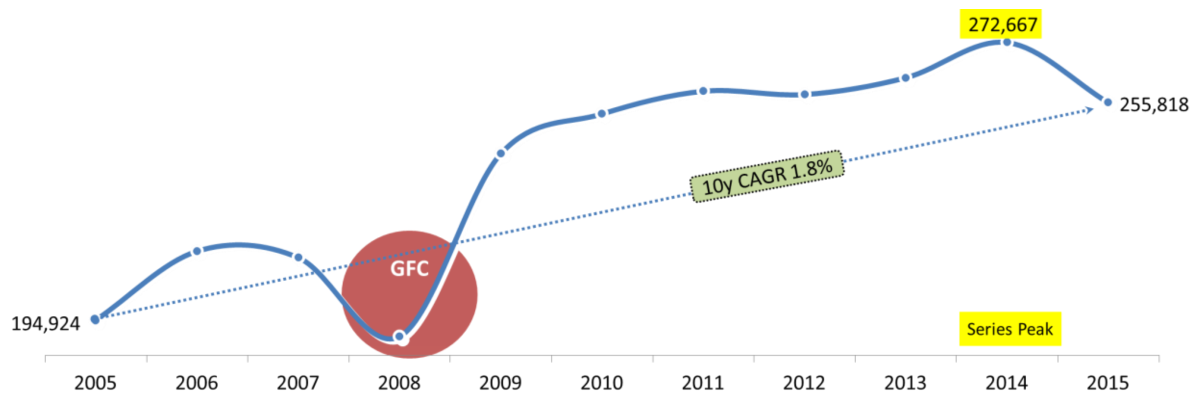
Return on Technology and the T-Spread™ Time Series

It turns out that this so-called "return on technology" concept is *quantifiable* by normalizing and benchmarking the difference between performance (or, total net revenue) and the component cost of that performance (or, total technology spending). The foundational ingredients for this conclusion have been laid out throughout this report. Furthermore, since technology spending patterns are quantifiable, Alphacution believes that this new intelligence can then be used to monitor and *navigate* the ongoing process of transformation from a strategic perspective. Moreover, these analytics and benchmarks can be used for more tactical transformation, as well; ultimately providing more detailed visibility for solution selection and workflow re-engineering and replacement.

This is where we return to Alphacution's T-Spread™ calculation. This analytic is designed to convert the concept of return on technology into actionable intelligence. Recall that it is calculated simply by taking the difference between revenue per employee (RPE) and TCO per employee (TPE). Understanding the value of the T-Spread™ is straight-forward, as well: A higher T-Spread™ for one entity (relative to the T-Spread™ for another entity) represents higher return on technology. A lower T-Spread™ represents the opposite.

Beyond that, we typically use a series of T-Spreads™ over a range of time in order to diffuse the impact of business cycles, as is illustrated from the 2008-2009 period of the GFC (see Exhibit 18, next page). Furthermore, with a 10-year CAGR of 1.8% we might consider that such a pace of growth in T-Spread™ is a reasonable proxy for the pace of the implementation and practical application of innovation among global banks – and the broader FSI ecosystem. Certainly, we believe this declaration is fruit for much more vigorous debate.

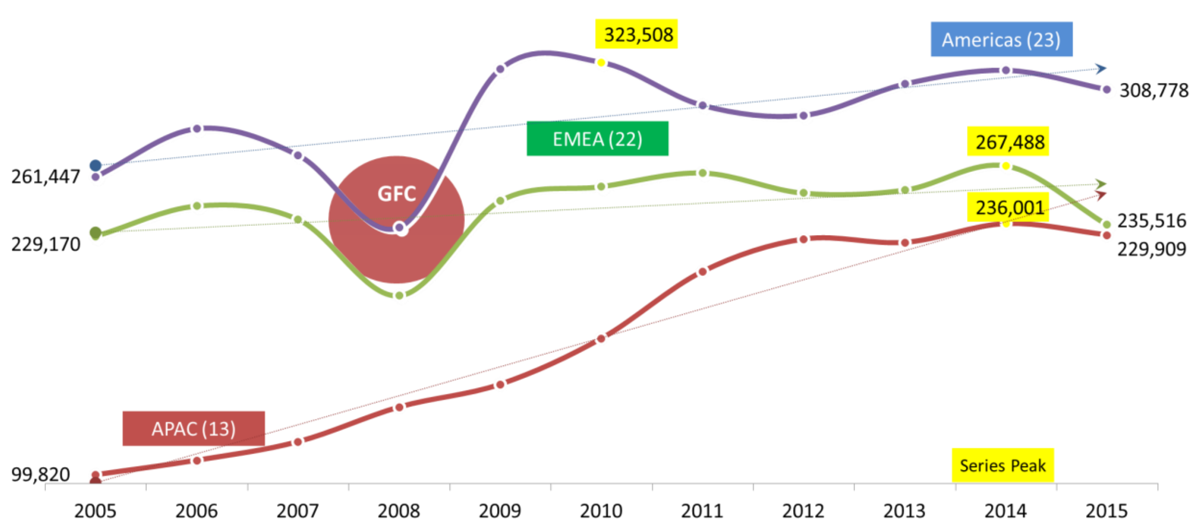
Exhibit 18: Weighted Average T-Spread™ for Sample Banks (2005-2015, USD)



Source: Alphacution, Company Data

From this high level, we can begin to filter the results into further detailed views. For instance, T-Spread™ by region showcases how the Americas region – with a heavy concentration of 16 US-headquartered banks – has consistently led the other regions in harvesting more net output per FTE than the other regions with a leading T-Spread™ of US$308,778 for 2015. Also, APAC – largely due to evolution of Chinese banks – has nearly caught up with long-term T-Spread™ levels for EMEA, and to a lesser extent, the Americas. And finally, we wonder if the uncharacteristic decline of 12% in the EMEA T-Spread™ from 2014 to 2015 is a harbinger of upcoming global trends – or perhaps even a return to GFC-like trends - given that EMEA has typically been a leading indicator of declines in revenue, headcount, and tech spending since the beginning of the post-GFC period (see Exhibit 19).

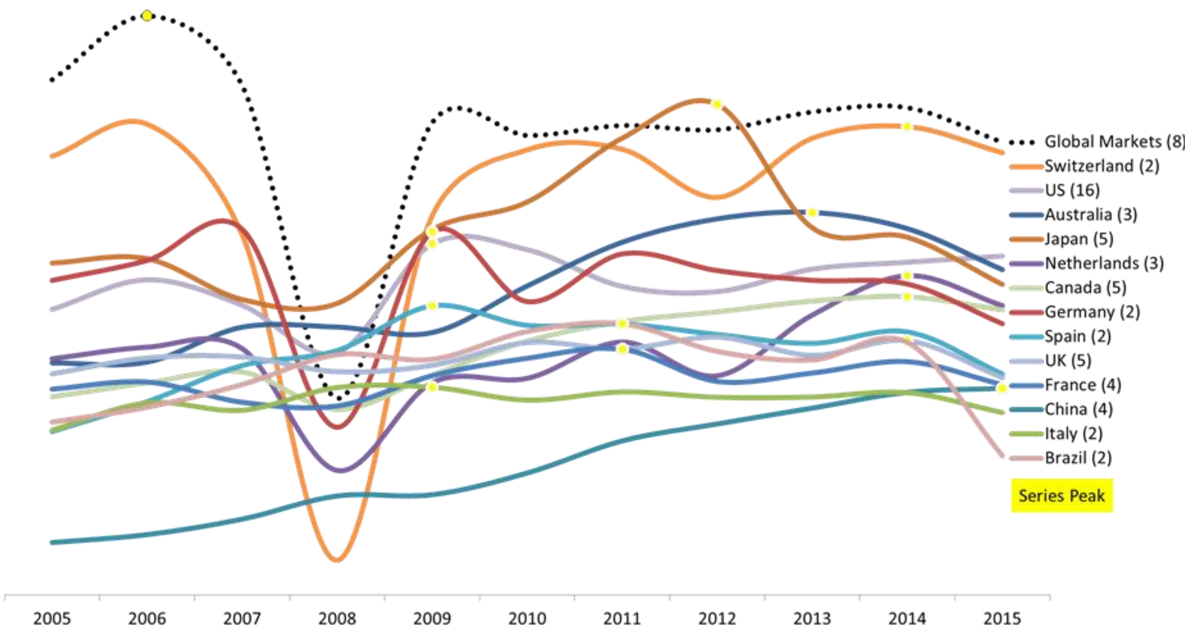
Exhibit 19: Weighted Average T-Spread™ for Sample Banks by Region (2005-2015, USD)



Source: Alphacution, Company Data

Taking this exploration a step further, T-Spread™ by country provides additional highlights: First, it showcases a small subset of countries where the GFC originally made "landfall" in 2008. This subset corresponds directly to banks with heavy global markets exposure. It also showcases how most country's banks T-Spreads™ are down in the past year or more with the notable exception of Chinese banks which have consistently harvested more performance from increasing tech spend (see Exhibit 20).

Exhibit 20: Weighted Average T-Spread™ for Sample Banks by Country (2005-2015)



Source: Alphacution, Company Data

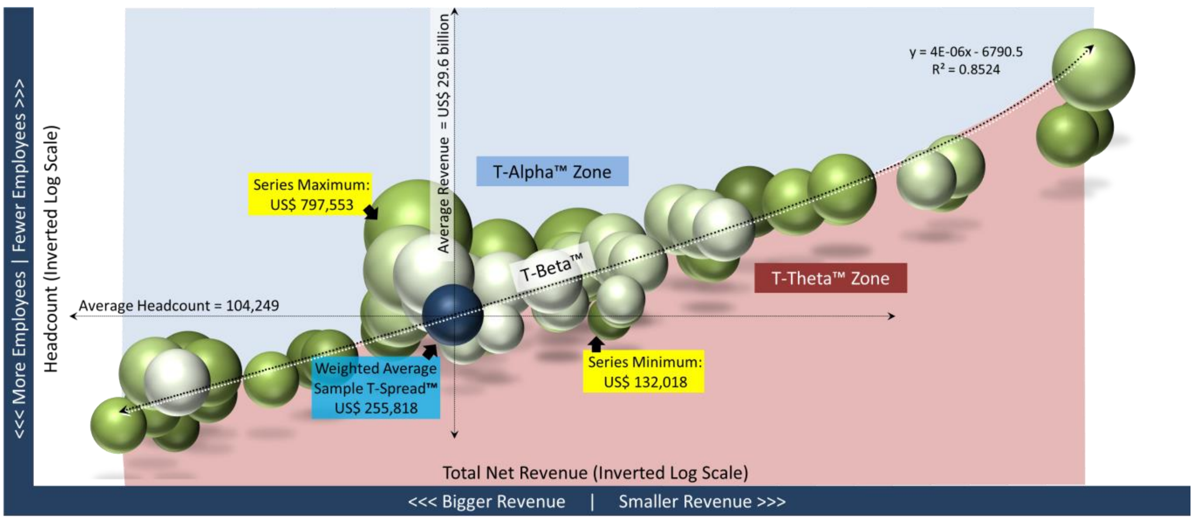
We use the Global Markets (8) basket of banking groups with high concentration to trading and investment banking segments to further showcase who was and who was not at "ground zero" for the GFC – and perhaps more importantly – how this special group responded (in terms of return on technology) in its aftermath. Alphacution's reading of the post-2009 *variance* of T-Spreads™ for global markets-concentrated banking groups is eerily low – and begs the question of how they might respond to an upcoming or future period of volatility given how much work has already been done to upgrade technology footprints over the past 5-6 years.

Expanding T-Spread™ for Benchmarking

Underneath all of these numbers and wiggly lines are the "technical signatures" of individual companies and the various business segments within them. For this report, we have focused almost exclusively on the largest and most complex banking groups in the world – and isolating our exploration to enterprise-level output for this presentation. As we will demonstrate shortly herein (and in subsequent publishing), the T-Greeks framework – and the broader Alphacution composite modeling, as well - is relevant to a 360° view of profiles inside and outside the FSI ecosystem. More importantly, for practitioners who are navigating and managing transformative efforts at business unit or solution-specific levels, this framework has a "fractal" quality to it. Meaning: T-Greeks are scale-independent at enterprise-, segment-, and solution-specific levels alike, and therefore, useful for benchmarking at both macro and micro perspectives.

Exhibit 21 displays T-Spread™ for each of 58 banking groups. Moreover, having the entire Sample in this view allows us to take the first step into T-Spread™ benchmarking. As alluded to in the Introduction section, a linear regression of individual enterprise T-Spreads™ (with equitation y=4E-06x – 6790.5 and where R^2=0.8524) represents the T-Beta™ threshold. Recall that this is the Sample reference benchmark for each "scale point", where scale is synonymous with total net revenue (the x-axis). According to the T-Greeks™ Framework, firms with T-Spreads™ greater than T-Beta™ are in the T-Alpha™ zone and those with T-Spreads™ less than T-Beta™ are in the T-Theta™ zone.

Exhibit 21: T-Spread™ Benchmark 2015 – 58 Large Global Banks

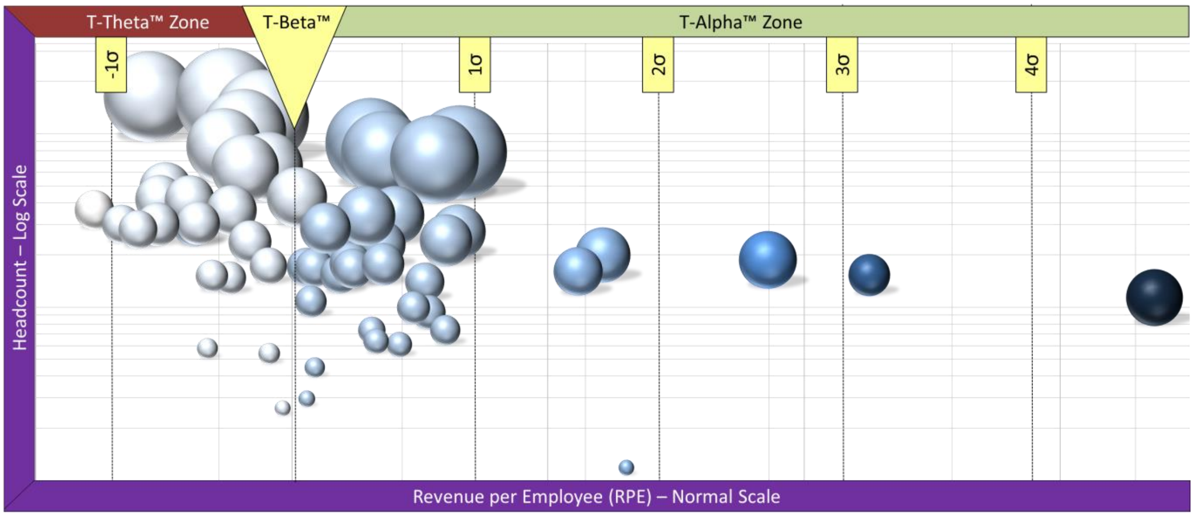


Source: Alphacution, Company Data

Note that the weighted-average T-Spread™ for the Sample is US$255,818 for 2015. This figure translates into a fictional reference entity with 104,249 FTEs and total net revenue of US$26.9 billion for 2015. For the entire Sample, the series maximum and minimum T-Spreads™ are US$707,553 and US$132,018, respectively – which translate into the series maximum T-Alpha (US$541,735) and minimum T-Theta (-123,800).

To enhance the intuition around how this framework can be visualized, we can demonstrate an alternative view with the axes rearranged (see Exhibit 22, next page). Setting the numbers aside for the time being to focus in on the illustration, this view keeps headcount on the Y-axis (with no inversion) and then swaps revenue for RPE (again, without inversion), where revenue is now depicted in the size of the bubbles and RPE is on the X-axis. In this illustration, scale starts small on the bottom and increases to the top; by the same token RPE grows from left to right. With this setup, anything to the right of the weighted-average T-Beta line is in the T-Alpha zone; to the left of T-Beta is the T-Theta zone.

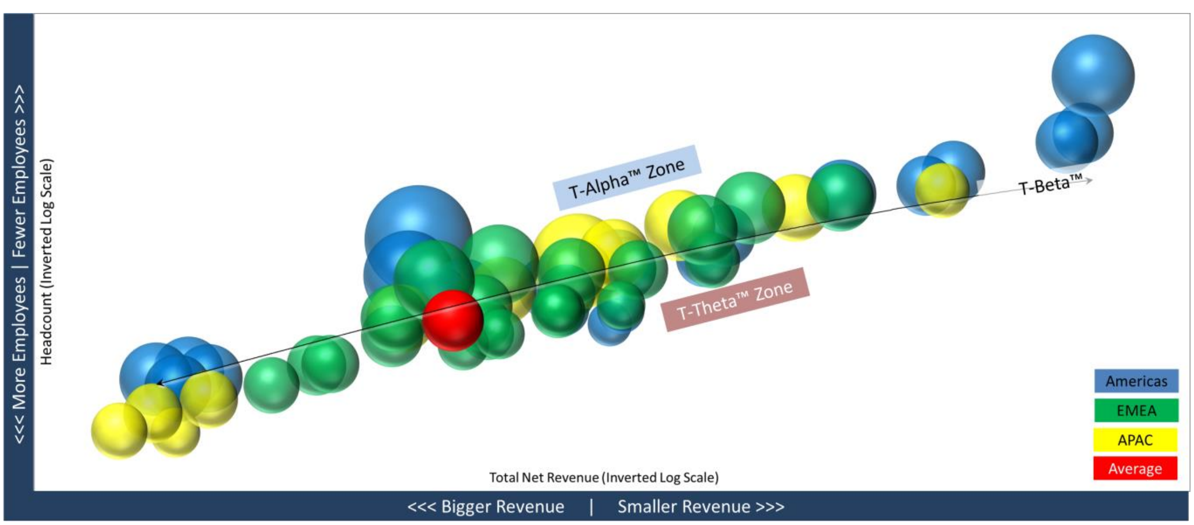
Exhibit 22: Alternative View T-Spread™ Benchmark 2015 – 58 Large Global Banks



Source: Alphacution, Company Data

The utility of this information is broad, particularly for individual banking groups to understand where they fit into the ecosystem and how they are moving relative to the peers. Solution providers and investors are also likely to find this analysis useful in terms of designing more prescriptive sales strategies (for the former) and to assess the investment potential of target and/or peer group enterprises. Further detailed analysis makes this point even more potent: Similar to examples from Exhibits 19 and 20, T-Greeks™ can also showcase comparisons at higher "magnification". For example, we can reconfigure this view by region and distinguish several sub-groupings, such as the largest Chinese banks at the far left joined closely by the largest US-headquartered banks, a few high T-Spread standouts from the Americas who belong to the "global markets 8" as well as a group of smaller US-headquartered banks at the far right (see Exhibit 23). There are numerous other observations, such as how EMEA banks take up most of the middle of the Sample.

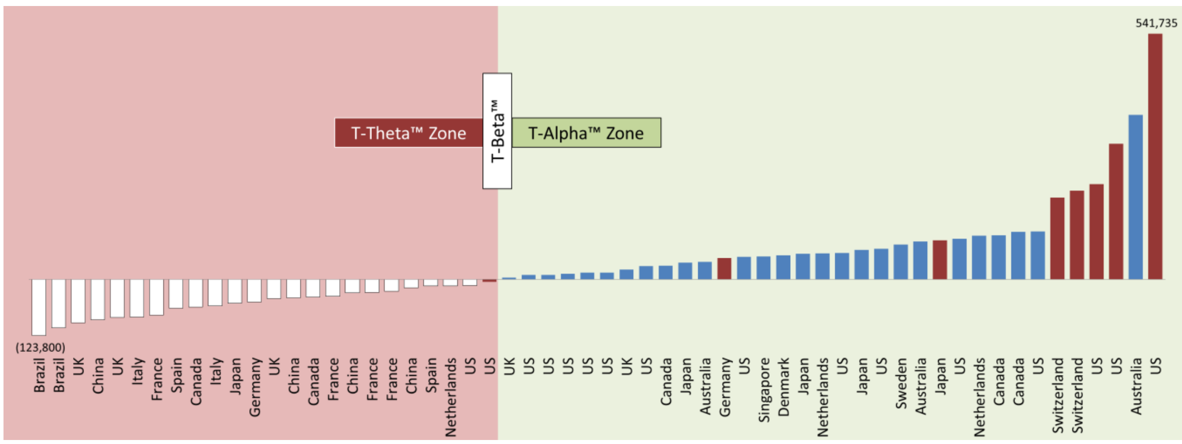
Exhibit 23: T-Spread™ Benchmark 2015 – 58 Large Global Banks by Region



Source: Alphacution, Company Data

Another way to look at this sample is to rank T-Alpha / T-Theta (high to low) by country – in this case, with extra emphasis on the "global markets 8" in red (see Exhibit 24). There are numerous fascinating observations here as well: On the negative side, both Brazilian banks are in the worst T-Theta position. And, all the banks in the sample from China (4), France (4), Spain (2), Italy (2) and most from UK (3/5) are also in a negative T-Theta position. Why? We know that the Chinese banks are the least automated (and with highest headcount) and therefore have low technical leverage. On the others, we can speculate that it is due to similar factors: high concentration to retail banking or low technical leverage businesses.

Exhibit 24: T-Spread™ Benchmark 2015 – 58 Large Global Banks Ranking by Country



Source: Alphacution, Company Data

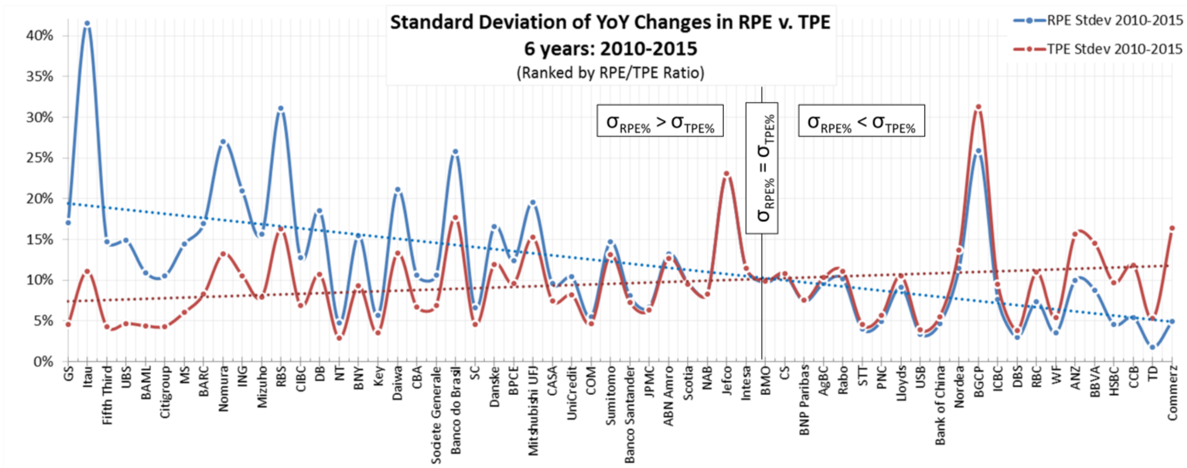
On the T-Alpha™ side, banks with high exposure to global markets stand out, including both of the banks in our sample that are headquartered in Switzerland. (And clearly we have missed something special about one of the 3 banks from Australia, given its second-highest T-Alpha™ ranking.) We can also point out that 14 of 16 US banks reside on the T-Alpha™ side for 2015, as well.

Focus on T-VOL™

Now, we finally get to T-VOL™, which is unique among the T-Greeks™ analytics, and therefore, requires a little extra attention. In the case of T-VOL™, only one side of the T-Spread™ analytic – namely, technology spending per employee (TPE) – is used. The short reason for this is that the volatility of the T-Spread™ is influenced by both revenue per employee (RPE) and TPE. And, since we can calculate that the average standard deviation of RPE is at least 50% greater than that of TPE, we know that the volatility of RPE over-influences T-Spread™ volatility. Hence, we stick with the standard deviation of TPE only as the basis for the T-VOL™ calculation which is intended to allow observers to rank the dispersion of tech spending among a group of companies.

Exhibit 25 (next page) is a pre-cursor to this analysis; illustrating a high-low ranking of the standard deviation of the ratio of the percentage change in RPE relative to the percentage change in TPE over the same period (which in this case are the 6 post-GFC years 2010-2015). That's a lot of confusing words. Translation: This exhibit answers the question, which banks have the highest or lowest volatility of RPE as compared to that of TPE. This analysis helps us answer numerous questions beyond this one. For instance, as a potential sign of agility - what is the relative elasticity (as in fixed vs. variable costs and opex vs. capex) of tech spending among banks, given comparative volatility in revenue? Regional, country, and business mix questions logically follow from there, among many others – and represent ample fruit for long term analysis.

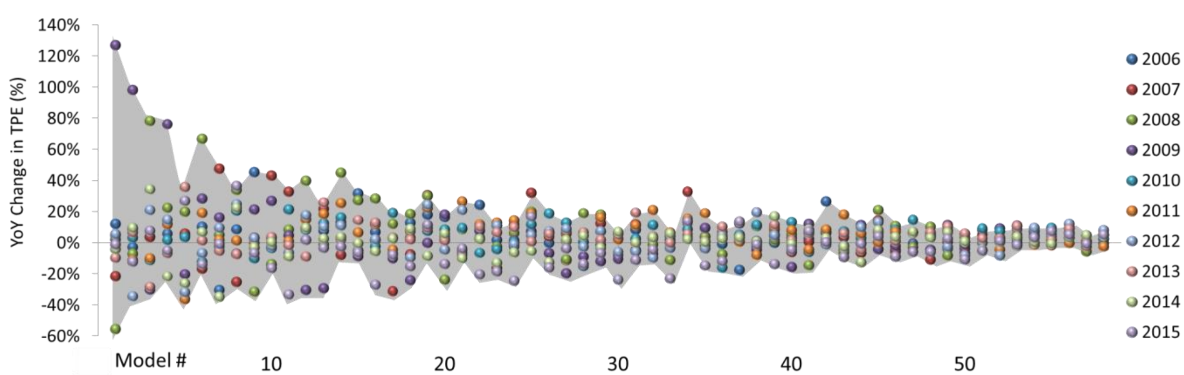
Exhibit 25: Preparation for T-Vol – Comparing Changes in RPE% and TPE%



Source: Alphacution, Company Data

Lastly, we turn to the T-VOL™ dispersion analysis that ranks – high to low – the isolated annual change in TPEs over the 10-year period 2006-2015 (see Exhibit 26). The banking group with the highest dispersion is represented at the far left of the exhibit, the lowest dispersion to the far right.

Exhibit 26: T-VOL™ Dispersion Ranking Analysis (2006-2015)



Source: Alphacution, Company Data

Alphacution believes that the T-VOL analytic is a measure of management effectiveness an even cultural cohesion. Arguably, firms with more wildly changing technology spending patterns are going to be more brittle than firms who maintain disciplined allocations to its technical investments even in the face of market undulations. Certainly, it could also be argued that business mix and business transactions (as in, mergers and acquisitions) play a role in the volatility of technology spending since difference types of business segments require different "technical signatures" as we have mentioned before. In some business segments, the "refresh frequency" or level of change due to innovation and competitive needs is going to be higher, requiring more frequent shifts in technical strategy. However, all that said, when comparing T-VOL™ analytics across an increasingly broad and diverse sample of enterprises, we believe that more reliable conclusions can be drawn about individual players in the ecosystem.

Key Points

- It really doesn't matter what your firm spends on technology; what your firm *receives* for its investment in technology – or its "return on technology" (RoT)- matters most.
- Return on technology is dependent on your firm's skills mix, processing efficiency and agility, and mix of tools and technologies for harvesting actionable intelligence from raw and derived data. In other words: Is your firm receiving a tech dividend or paying a tech debt?
- Alphacution's T-Spread™ benchmark analytic is useful for quantifying enterprise return on technology - calculated as the spread between performance and cost of performance – and therefore, converts this concept into actionable intelligence to assist in ongoing navigation towards more operational agility.
- T-Spread™ = Revenue per Employee (RPE) – TCO per Employee (TPE), where a higher T-Spread™ (relative to another T-Spread™) represents higher "return on technology" and a lower T-Spread™ represents the opposite.
- T-Spread™ is a member of Alphacution's T-Greeks™ operational analytics framework for quantifying and navigating organizational transformation, which also includes T-Beta™, T-Alpha™, T-Theta™, and T-VOL™.
- T-Beta™ is the linear regression equation used to create a reference benchmark for a collection of T-Spread™ measurements; and it provides a method by which to compare the level of "return on technology" for a group of companies.
- T-Alpha™, like receiving a "tech dividend" represents the extent to which a company's T-Spread™ is greater than T-Beta™; T-Theta™, like paying a "tech debt", represents the extent to which a company's T-Spread™ is less than T-Beta™.
- T-VOL™ measures the "volatility" of total technology spending (TCO) per full-time equivalent (FTE) - otherwise known as TPE – for an entire enterprise or discrete business segment over a range of time; and is believed to provide intelligence for management strength / weakness and cultural cohesion, among others.
- Alphacution believes that operational analytics, like T-Spread™ and the broader T-Greeks™ Operational Analytics Framework, are useful for all ecosystem stakeholders – including buyers, sellers, investors, and other observers - of technology, tools and solutions for quantifying and managing organizational and business transformation.

Conclusion

The primary goals of this chapter are to lay out a vision for further development of the T-Greeks™ operational analytics framework and Alphacution's broader ecosystem modeling.

It is no accident that these new analytics – and this new "language" – emits a strong aroma of trading culture, especially derivatives trading culture. It turns out that this is due to Alphacution's core background from proprietary derivatives trading, and it plays a huge role in informing our overall vision and the specifics behind the T-Greeks™ framework.

Operational Portfolio Management

We believe that complex and diversified enterprise management over time is very similar to portfolio management, and particularly portfolios that include non-linear opportunity sets, like options – which is basically true of *all* real-world business opportunities. These days, there would be no way to manage a complex, multi-asset, multi-regional and multi-temporal portfolio of financial products without looking at risk and exposures on a highly automated and high update frequency "nine ways for Sunday" basis. As a result, the appetite for risk data and risk analytics for navigation of modern markets is unprecedented. Why should the largest banking groups in the world (and many many others) be any different for "operational portfolio management"? The answer is that it shouldn't be any different (in theory).

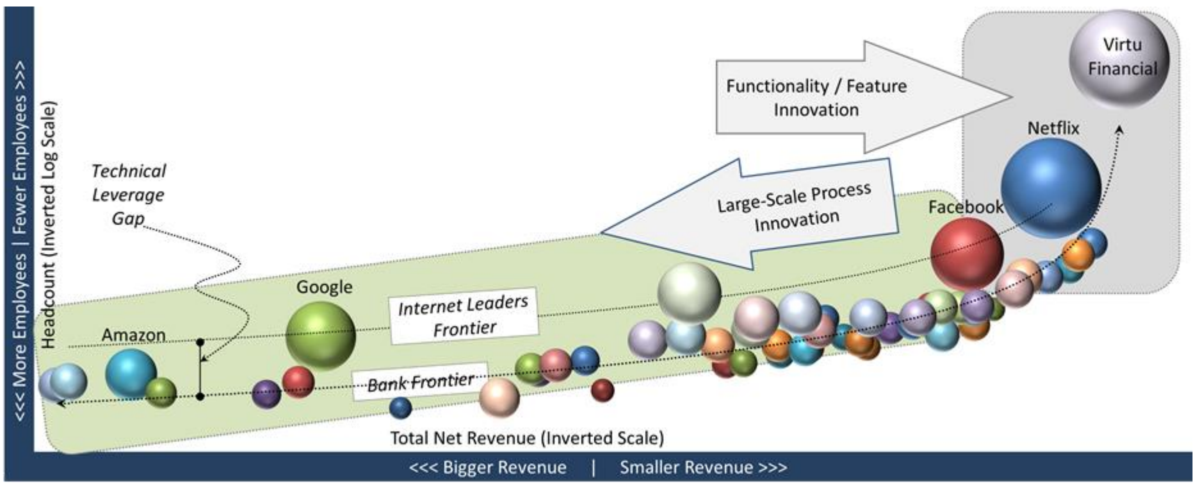
So, we start with the following hypothesis: What if we could approach the management of such a complex and diversified business like a basket of trades? Quickly, we run into a processing challenge: The data for such an analysis – for operational risk analytics that drive operational transformation – is not neatly and cleanly flowing out of the end of a "hose" – which has a lot to do with why the practice is only emerging now. To the contrary, this type of data is at least temporarily entombed in documents, which fortunately today are at least digital documents, but documents nonetheless. In short, for now the data needs to be harvested by hand. The good news here is that the more we harvest this hard-to-aggregate data, the more valuable the asset, analysis and analytics become. In parallel with our vision for the value of the modeling is our vision for the automation – or, at least, semi-automation – of this largely manual process; hopefully a riveting story for another day.

Anyway, this is exactly the point where we step off with the T-Greeks™ framework. Certainly, Alphacution's specific and composite modeling of the FSI ecosystem will shed new light and clarity on numerous fascinating narratives in the space and incrementally support improved navigational intelligence for its consumers. But, a standardized suite of analytics like the T-Greeks™ is something more; something that will provide more prescriptive navigational impact entirely. Moreover, Alphacution believes that we are just in the emerging stages of a new chapter for operational analytics. Beyond this, we believe that this type of framework has a "fractal" quality to it. This means that operational tracking concepts can move "north to south" (in terms of moving from enterprise level to business segment level down to specific workflow, project and solution levels) and "east to west" (in terms of using output from a group of companies in one industry to expand the contextual understanding for the analytical output of another industry, like banking). In other words, if designed properly, this type of operational analytics framework can exhibit some – if not, a lot – of scale independence and domain elasticity. Over time, expansion of this this modeling will confirm this fractal hypothesis.

Contextual Expansion

Along these lines, we were curious in late 2015 to begin testing the domain elasticity hypothesis. One angle was to look at the RPEs of internet leaders like Facebook, Amazon, Netflix and Google- known to some as the "FANGs" – and their comparison to our expanding banking sample. Exhibit 27 provides exactly this kind of contextual expansion.

Exhibit 27: Contextual Expansion (RPE- Global Banks, 2005-14; FANGs, 2014)



Source: Alphacution, Company Data

There are several points that we are looking to make here: First, as we might expect, the FANGs demonstrate a "technical leverage gap" with our banking group sample that is worth roughly US$610,920 per FTE as measured by RPE as of the end of 2014[11]. This is illustrated by the linear regression of the FANG RPEs relative to that of our banking group sample[12] where the technical leverage gap translates to a factor of 3.2 to 1. This outcome makes sense given that the FANGs were "born" in the digital era while the banks hail from what is more commonly becoming known as the analog era. In some ways, these digital leaders should represent the outer limits for what is possible in terms of technical leverage.

Our second primary observation relates to scale and how the challenges at smaller scale tend to relate to *functionality* or *feature innovation* while the challenges at larger

[11] The RPE of the FANGS for 2014 is US$885,992 and the RPE for the banking group sample (an average for the period 2005-2014) is US$275,072 for a difference of US$610,920.

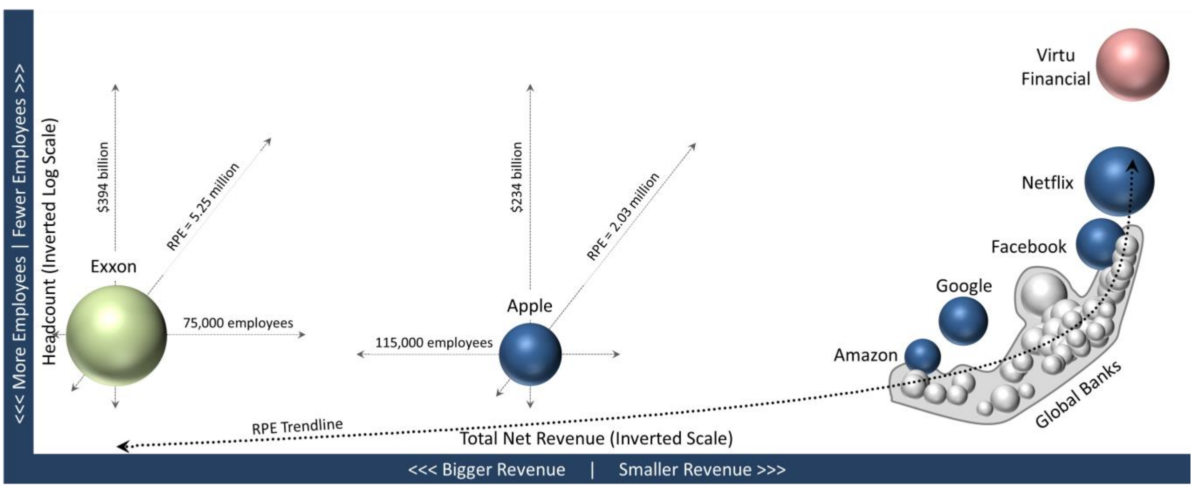
[12] At the time of this analysis in late 2015, the Sample was represented by 51 large and global banking groups.

scale tend to relate to *process innovation*. With very few exceptions, the larger the scale the greater the complexity and diversification of the enterprise is likely to be. Therefore, at larger scales, the competitive advantage is about executing on process leadership (because there are numerous processes in a large and diversified organization) as opposed to single-process product or feature innovation that is typically found at smaller scales and in smaller enterprises.

The third and final observation from Exhibit 26 relates to the fact that only a single member of the banking group sample (and not including Virtu Financial) is performing at a level of RPE that is more similar to the FANGs than it is to the banking group (at more than 3x the average RPE of banks). We will not get into the specifics of this company here, but simply want to point out how this "anomaly" begs the questions: How is this standout performance possible? And, is it replicable - a condition for more than one large player?

Yet, like traveling beyond our own "galaxy" to find what we cannot easily see, there is always greater context to be won. Exhibit 28 embodies this sentiment with the additions of Apple and Exxon to the previous analysis. In the case of Apple in 2014, for a firm with 115,000 employees to be generating an RPE of over US$2 million is unprecedented relative to the firms in Exhibit 26 – and clearly puts the banking group in a whole different light. That is until we add Exxon – with an RPE of US$5.25 million across 75,000 employees for 2014 – where the context shifts dramatically, yet again.

Exhibit 28: Contextual Expansion (RPE- Global Banks, 2005-14; FANGs/Apple/Exxon, 2014)



Source: Alphacution, Company Data

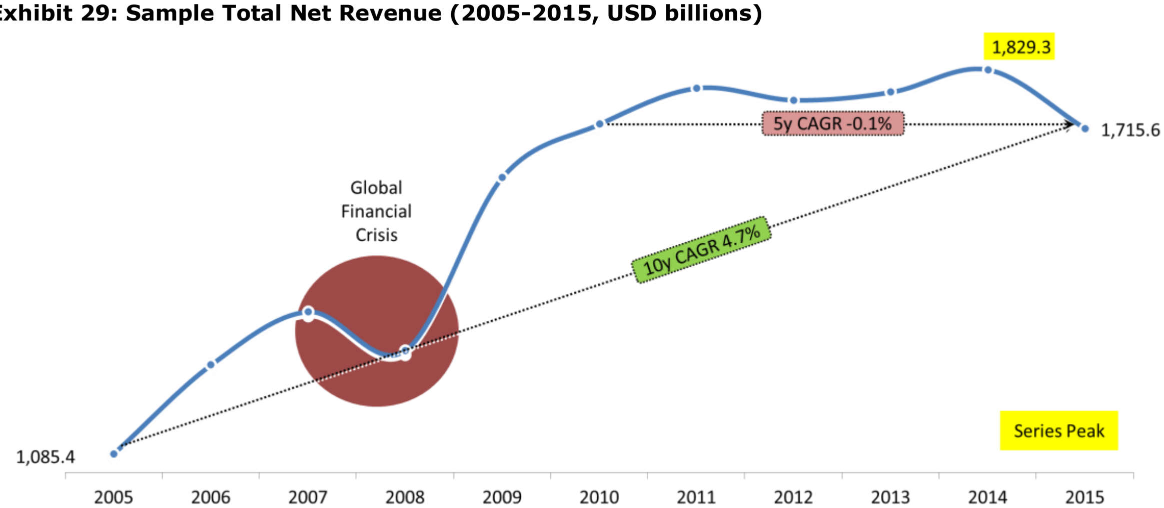
Certainly different ecosystems come with different economic paradigms. Adding a global consumer products powerhouse like Apple and a global energy powerhouse like Exxon suggests that there is more economic leverage *per employee* in tangible goods than there are in services, even including our digital darlings. We are as fascinated as anyone to continue to use this modeling and its various framework analytics to discover new patterns and relationships between and possibilities among the ingredients of people, process and technology.

State of Urgency

Our final point here has to do with *timing*. Largely unnoticed, there is a phenomenon that is gradually pervading the FSI ecosystem – and, in some ways, the daily lives of people all over the globe: Scarcity. With an expectation for scarcity – and particularly for those who expect scarcity and yet do not have a plan to deal with it – desperation can set in – which, in turn, leads to a wave of bizarre personal and institutional behavior. We see this in our neighborhoods, our politics, and in our international diplomacy – to name just a few.

They say to make hay while the sun shines. This bromide is fitting for those who have already woken up to the need for a more "digital" form of operational transformation. For those have yet to spring into action around transformative efforts, we send our condolences and the following message: In 2015, twice as many banks in our sample (41) reported declining revenue than in 2008 (20) at the height of the GFC. The aggregate decline in revenue in US dollar terms was US$113.7 billion, a 52% increase over the US$74.9 billion decline in 2008 (see Exhibit 29).

Exhibit 29: Sample Total Net Revenue (2005-2015, USD billions)

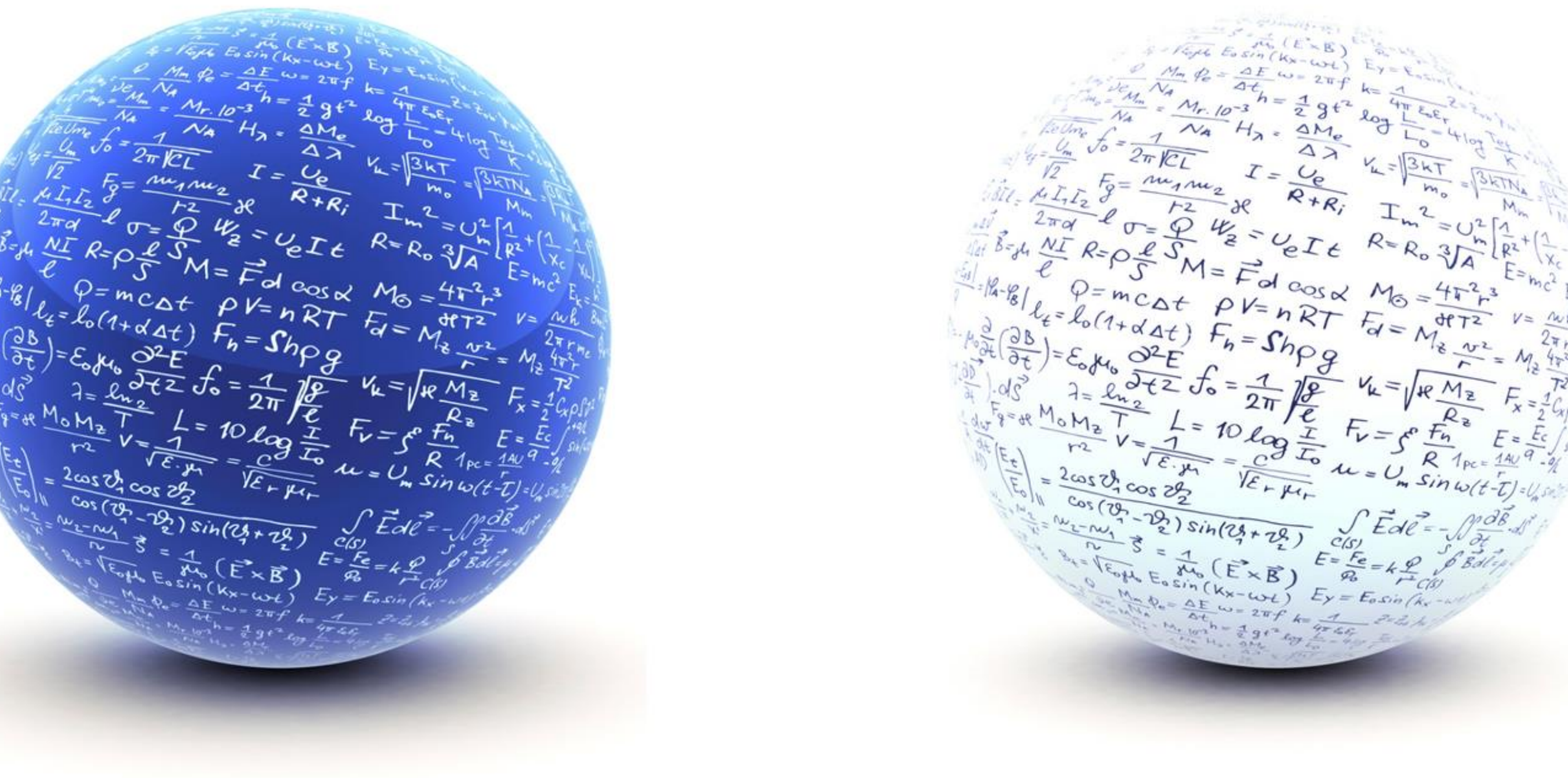


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Revs – YoY Change	172.4	103.0	(74.9)	335.2	102.8	69.7	(23.1)	15.3	43.5	(113.7)	
Revs up (# banks)	51	43	38	43	40	44	30	28	36	17	
Revs down (# banks)	7	15	20	15	18	14	28	30	22	41	

Source: Alphacution, Company Data

It doesn't feel like 2008-2009 right now, but by the clunking sound of 1st quarter 2016 earnings announcements among key banking groups, the state of urgency seems to be growing quickly. Large incumbents must now identify tools to reconcile the gap between incremental change and *radical, digital-age agility*; a seemingly Gordian hurdle that is gathering more and more attention from all corners of the ecosystem.

Alphacution believes that new tools – a framework of operational analytics - are required to help bridge the gap between the current and prior eras; a framework that helps quantify all phases of ongoing transformation, from measurement to management to monitoring. These tools need to be useful in the decision-making process for both tactical and strategic technology migrations. Lastly, we believe that such a framework is useful to demonstrate how the industry's level of urgency for engaging in transformation needs to be stoked. If the concept and urgency of "unprecedented transformation" has been lost on you or your firm, Alphacution's latest round of industry modeling might just cue the clue that our collective hair is in fact on fire. The state of post-GFC complacency has now tipped to an outright state of urgency.



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