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THE IMPACT OF GLOBAL IT OUTSOURCING ON IT PROVIDERS

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ABSTRACT

This article examines the impact of Global IT Outsourcing on Information Technology (IT) firms from the off-shore sourcing perspective. IT Providers are defined in this article as companies that produce IT as opposed to companies that consume IT. To assess the impact of outsourcing on such companies, this article presents an Enterprise Architecture (EA) view of IT and uses it as the framework to determine the impact of outsourcing.

The three dimensions of Enterprise Architecture include people, process and product and/or services. The article argues that if the sourcing decisions are based purely on short term goals such as cost, then the long term viability of the IT firm may be compromised. Lack of an IT development model and lack of IT metrics makes it difficult for IT Providers to truly plan and manage the off-shore resources. This article suggests that shorter development cycles, requirements volatility, and the need for constant developer-user interaction makes off-shore outsourcing more difficult. To address these challenges, organizations should develop metrics and governance practices based on experience.

This article also proposes that the type of product or service is critical in addressing the decision to outsource. The higher the intellectual (or proprietary) content, the higher is the risk when outsourcing. This article presents two simple frameworks, one for assessing the benefits and risk of outsourcing for IT infrastructure services and the other for IT applications. IT Providers are advised to pay particular attention to the life cycle model of off-shoring where early gains give way to a learning and adjustment phase. If the IT firm successfully develops a rich experience base and adjusts the off-shore model, then sustained benefits can be realized.

KEYWORDS: enterprise architecture, global outsourcing, IT Providers, managed development centers, off-shore outsourcing, on-shore outsourcing

I. INTRODUCTION

Outsourcing, particularly Information Technology (IT) outsourcing receives great attention in both the general media and in IT trade journals. A number of the articles in the trade journals (e.g., Computerworld 2003, Computerworld 2004a, Computerworld 2004b, Time Magazine 2004) looked at outsourcing from a socio-economic perspective (e.g., job market, cost savings) or management perspective (e.g., alignment with strategy, governance, and risk). However, the impact of Global Outsourcing on organizations that want to establish an IT delivery capability has not yet been addressed systematically.   Examples of such organizations include IT departments

which service one or more subsidiaries of an enterprise, consulting companies providing IT services, and technology companies where IT is embedded as part of a core product or service. This article examines the impact of Global Outsourcing on such organizations (referred to as IT Providers[1]).

OVERVIEW OF OUTSOURCING

Outsourcing can be defined as the transfer of any business function from one organizational entity to another. Outsourcing is not new and is not restricted to IT. However, its increasing acceptance as an alternative to in-house IT development and the use of IT services propelled IT Outsourcing to be a significant component of an organization's IT strategy. Global IT Outsourcing is just an extension of the same concept to imply outsourcing across political boundaries. From a U.S. perspective, outsourcing to companies located within the same national boundary or near it is often termed "near-shore" outsourcing, and farther distances, typically across the ocean, is labeled "off-shore" outsourcing.   These distinctions are blurred because most "near-shore" outsourcer firms, [2] such as IBM, EDS, and CSC, are not restricted to the U.S. at all. Through subsidiaries and partnerships, these firms have established their presence in countries that specialize in providing IT outsourcing services such as India and China.

Recent articles in trade journals suggest varying degrees of impact of outsourcing on the job market for IT professionals in the U.S.   Outsourcing makes the headlines of popular trade journals such as Computerworld with regularity. Foreign workers performed about 5 percent of information technology services for American companies this year, but by 2007, that share will grow to 23 percent [Information Week, 2003b]. Gartner claims that 5% of corporate IT positions will be lost by 2005 because of outsourcing with only less than 40% of these positions redeployed [Computerworld, 2003b]. According to a November 2002 Forrester Research report [Information Week, 2003a], 3.3 million jobs will be lost over the next 15 years due to outsourcing in the IT and IT-enabled services sectors. But expected job losses in that period will be balanced by openings for several million project managers as U.S. IT positions go up the value chain to avoid extinction. The Forrester report suggests that "there's already a shortage of staff that can manage projects internally, let alone halfway across the globe." [Information Week, 2003a]

Lacity and Willcocks [1998] state that the dominant reason for outsourcing is cost savings. Their assessment was based on a review of 61 outsourcing decisions. Since outsourcing to countries with lower-cost wages allows firms to make significant cost savings, it seems likely that off-shore outsourcing will continue to grow in the coming years.

A few journal articles established frameworks for off-shore outsourcing. For example, a four-stage maturity model is proposed by Carmel and Agarwal [2002] based on interviews with 20 executives from 13 firms. The four stages are:

    1. Bystanders (no off-shore outsourcing);
    2. Pilot/Experimenters;
    3. Cost Focus; and
    4. Strategic Consumers of off-shore capabilities.

Jeff Reid [2003] of Conexant, a company that uses off-shore resources, uses a four phase strategy, shown in Figure 1.

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1 Organizations that deliver IT solutions will be referred to in this article as IT Providers to distinguish them from organizations that consume IT products and services. Many organizations that deliver IT products or services also consume IT (for example, Microsoft employs a CIO and a very large internal IT group), however for the purposes of this article they are classified as IT Providers.

2 This article is written from the perspective of IT Providers located in the United States.
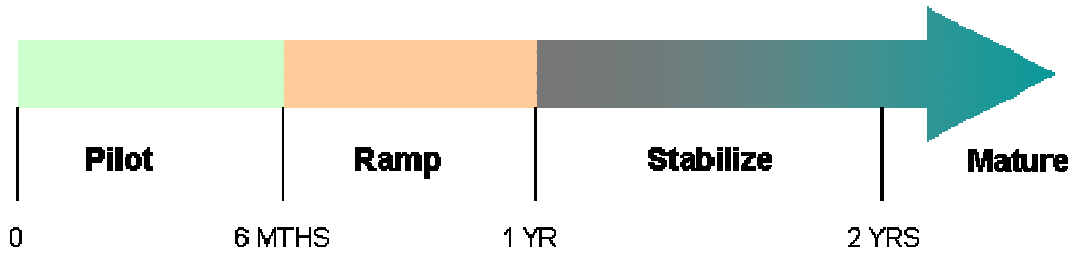
Figure 1. Four Stage Offshore Sourcing Model

The model suggests that in the pilot phase a limited number of projects should be executed to demonstrate viability. In the ramp-up phase, a large number of projects can be moved off-shore, maintaining an on-shore to off-shore resource ratio of 1:4. In the stabilization phase, the ratio of on-shore resources to off-shore resources can be increased to 1:8 to attain maximum cost benefits. The maturity phase is the culmination of the stabilization phase where the use of off-shore resources in projects is seamlessly built into the enterprise's governance model.

TYPES OF IT OUTSOURCING

While the scope of IT functions varies from simple back office systems to fully integrated inter-enterprise systems (in which the firm's IT is fully integrated across supply and customer interface channels), the common functions of IT can be broadly classified under four groups as shown in Figure 2.
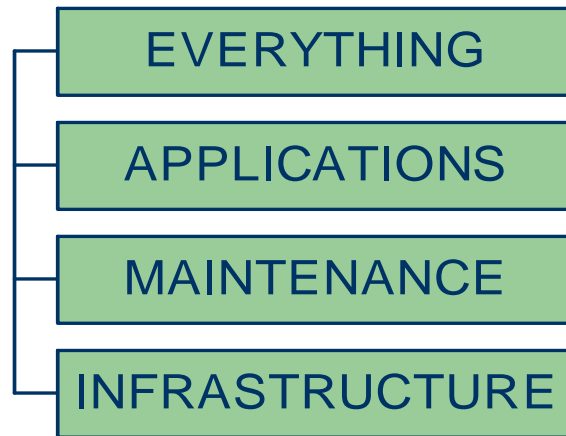

Figure 2. Types of IT Outsourcing

Starting from the bottom of Figure 2:

- **IT Infrastructure** including data centers, end user PCs, core IT services such as E-mail, Internet, portals to manage data and documents, connecting networks (LANs, WANs), information security, helpdesk, data backups, and disaster recovery.
- **Maintenance** of legacy applications.
- **Applications**. Development of IT applications, including packaged commercially available software, customization services, and developing custom applications.
- **Everything**. Complete IT outsourcing including developing and maintaining of proprietary applications/products, customer service centers, and IT infrastructure.

II. A FRAMEWORK FOR ASSESSING GLOBAL IT OUTSOURCING

Assessing the capabilities of organizations that deliver IT services is a subject of significant research. For companies that provide software solutions, the most common cited model is CMM[3]. Despite the popularity of CMM (a process framework) and ISO 9000-3, and other standards that primarily assess product quality, there is no single framework for assessing the delivery capability of IT organizations from a technology/architecture perspective.

This article defines a simple framework for assessing the IT delivery capability of an enterprise and provides an assessment of Global Outsourcing using this framework.   It should be pointed out that this article relies on an Enterprise Architecture view[4] derived from the author's experience with several hundred projects working with over 40 Fortune 1000 clients.   However, this research is anecdotal and has not been subjected to rigorous testing.

A single composite framework for addressing the entire suite of IT capabilities is shown in Figure 3. This framework is *not* a framework for classifying IT Providers. Rather it is a framework for assessing the IT-delivery capability.   The framework anchors on the three fundamental dimensions, or perspectives, on IT service delivery:

- People,
- Process, and
- Products & Services.

The impact of Global Outsourcing on these fundamental dimensions is described in the next section. The framework presented is a simplified view of the real world. However, it provides a pragmatic perspective for organizations that deliver IT solutions to assess the benefits and risks of Global Outsourcing.

III. IMPACT OF GLOBAL OUTSOURCING ON IT PROVIDERS

In this section, the impact of Global Outsourcing is assessed from the three perspectives in Figure 3, namely People, Process, and Products & Services. IT Providers are impacted differently by Global Outsourcing. For example, the recent ban of off-shore outsourcing by organizations using federal project funds significantly impacted IT Providers that cater to the public sector. The risk of losing Intellectual Property is far greater in product companies that develop software and companies that deploy proprietary algorithms. Infrastructure services providers are impacted primarily by low cost call-centers, whereas software consulting and development providers are impacted most by sourcing and process perspectives.

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[3] For more information on CMM refer to Carnegie Mellon's website http://www.sei.cmu.edu/cmm/ cmm.html or Paulk et al. [1997]. CMM is an abbreviation for Capability Maturity Model.

[4] Enterprise Architecture is about understanding all of the different elements that go to make up the enterprise and how those elements interrelate [From the website of Institute for Enterprise Architecture Developments – http://www.enterprise-architecture.info].
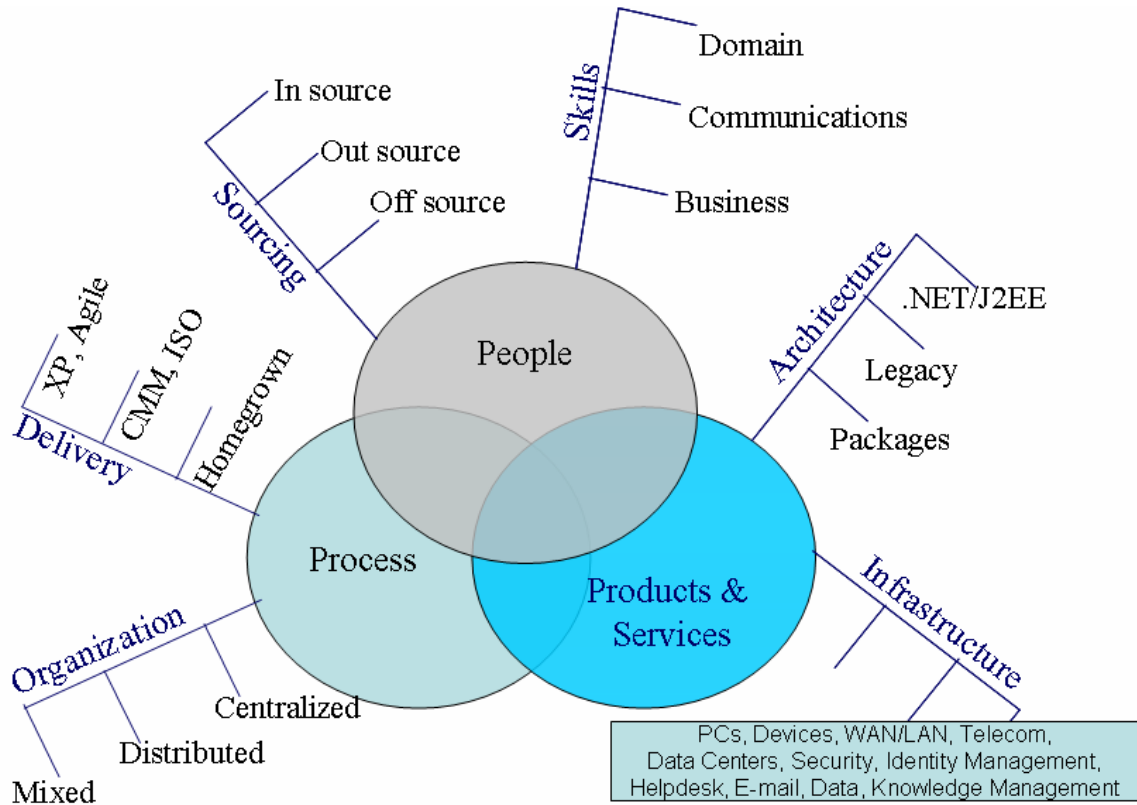
Figure 3. Enterprise Architecture Framework

PEOPLE

It is a cliché that people form the backbone for IT delivery. The major impact of Global Outsourcing has been on people. In-source, out-source or off-source (using off-shore resources) are three options faced by organizations. Traditional benefits of outsourcing from a people perspective include mixing and matching specific technology and domain skills from a larger pool. IT Providers in the U.S. anticipated and planned for the benefits of using off-shore resources to stay competitive with off-shore firms. IT Providers benefited from this pool as evidenced by larger outsourcers (such as IBM and EDS) who can provide significant off-shore sourcing through their wholly owned and partnered off-shore firms.

IT Providers using off-shore resources can be classified into three groups:

- Those who do it themselves (Managed Development Centers),
- Those who contract with off-shore companies (Off-shore Outsourced Vendors), and
- Those firms using off-shore resources on site (On-shore Outsourcing).

An analysis of these three methods is shown in Table 1.

Historically, IT Providers using off-shore resources started with using them on-shore (in the mid 1970s and 1980s), evolved to using project-based models using off-shore vendors or adopting the managed development centers[5] concept.

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[5] Tektronix, Motorola, Hewlett Packard, and City Corp were among the earliest companies to adopt the Managed Development Center models. In the late 1990s with the dot com boom and severe IT resource shortages, these centers became more prevalent.

Table 1. Comparison Between Different Types of Uses For Off-Shore Resources

Characteristic	Managed Development Centers	Off-shore Outsourced Vendors	On-shore Outsourcing[6]
Cost (see Figure 4)	Lowest	In between	Highest (but cheaper than US based outsourcers)
Risk	Highest	Moderate	Lowest
Implementation Time[7]	Longest 9 months to 18 months	Fastest – under 3 Months	Depends on the political situation, Visa availability – up to 6 months
Governance	Special expertise in off-shore culture, regulations, sourcing	Managing off-shore contracts	Traditional vendor management

Costs are the lowest when IT Providers establish their own subsidiaries and manage the resources. These subsidiaries are labeled as Managed Development Centers (MDC) in Figure 4. The total costs per hour for employees of an MDC in India for example varied from $5 per hour to $15 per hour[8]. It costs IT Providers who use off-shore vendors about 25% to 100% more ($6.25 to $30/hour) than the cost of operating MDCs. On-shore outsourcing, which is the most expensive of the three options, costs about 50% to 100% more than outsourcing to off-shore companies (i.e., up to $60/hour).

U.S.-based IT consulting companies who provide IT solutions use the three models shown in Figure 4. In addition, they also use Joint Ventures with established off-shore firms. Examples include Tata-Unisys and HCL-Perot Systems[9].

In deciding upon the outsourcing strategy, IT Providers need to address not only domain skills but also business and communication skills. India far outshone other countries primarily because of their emphasis in communication skills. While Global Outsourcing provides a rich source of technical architects and those who make technology work, these types of people are only a few of those required to deliver IT products or services. Business analysts and business-IT relationship management are skills that are not as readily available through outsourcers, particularly, off-shore outsourcers.

Another area of concern is the erosion of core skills. In the past this risk was mitigated by "importing" off-shore resources (via the H1-Visa program or immigration sponsorship). The recent political climate is not conducive and the future direction is uncertain. Alan Greenspan, the chairman of the Federal Reserve appears to favor outsourcing off-shore [Time Magazine, 2004],

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[6] On-shore Outsourcing refers to utilization of off-shore companies who provide resources at the customer site.

[7] Implementation time refers to the time it would take to initiate the specific type of off-shore outsourcing. It does not refer to project implementation.

[8] These costs were pertinent in 2001 (after the dot-com bubble burst). The costs went up significantly in India. Many off-shore companies in India (for example Infosys) now use software development centers in China. Costs today nearly doubled for entry level and technical resources due to increased demand. Current costs per hour for employees of an MDC in India range between $10 per hour to $20 per hour.

[9] At the time of writing, Perot Systems decided to expand the presence in India and were buying back the Joint Venture from HCL.
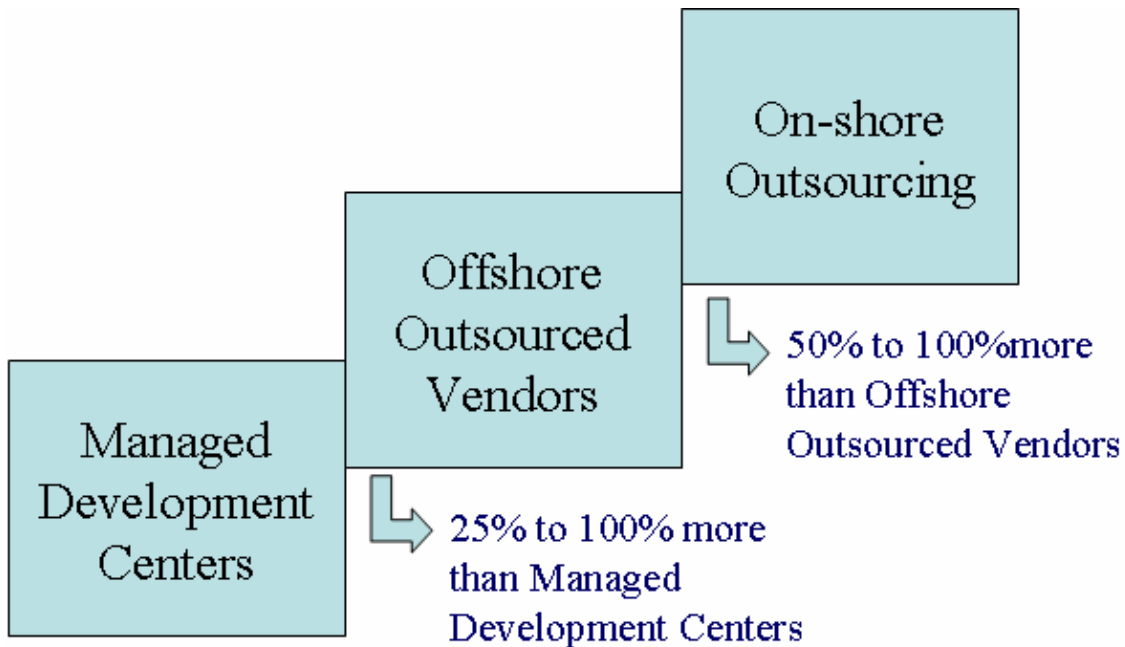
Figure 4. Cost Analysis of Sourcing Options (2001 Costs)

but politicians are and will remain unpredictable. IT Providers clearly need to undertake substantial contingency planning.

A third area of concern is the higher attrition rate faced by off-shore firms. As off-shore outsourcing increases, the demand for IT people increases in the off-shore markets. One of the artifacts of this increased demand is higher attrition, as newer entrants lure away IT specialists from existing firms.

Finally, IT Providers are beginning to recognize that the evolving skill set cannot be monolithic. In the early stages of IT, a person could start and retire with the same skill set (systems programmer on IBM mainframes). As the PCs came into being, the technology cycle became shorter. With the advent of Internet, web services, packaged applications which change frequently, and a constantly changing hardware environment, the technology life cycles became shorter. For example, ABAP, the language of the SAP software and the backbone of thousands of jobs, is on the verge of becoming extinct with Web services. Imagine the impact, if Linux replaces Microsoft and Sun Solaris as the server operating system of choice. Shorter evolution cycles imply the need to develop expertise in multiple domains.   Developing these abilities must be taken into account when developing the Global Outsourcing strategy. Global outsourcing can help IT Providers offload technical work while developing these multiple skill sets. However, if they merely transfer back the cost savings realized to their customers or share-holders without making investments in employee development and developing new technologies, then the long term impact can be detrimental.

PROCESS

IT life cycle addresses the development and management of IT for the enterprise within the framework of the Enterprise's Governance Model. Traditional governance models follow the Anthony Organizational Framework [Anthony, 1965] for identifying and managing projects (Figure 5).
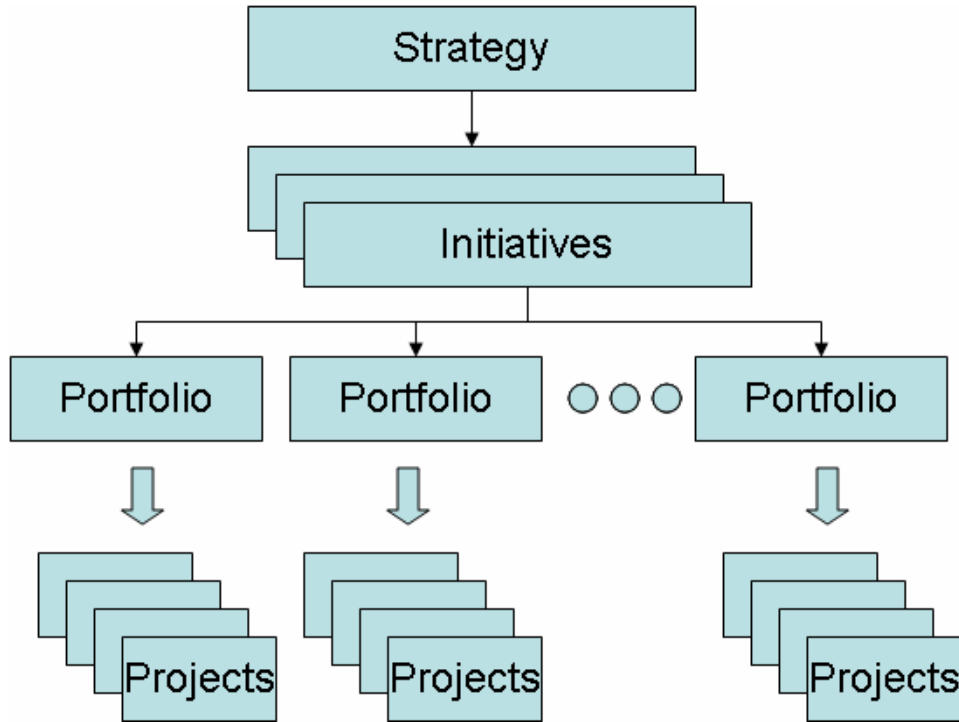
Figure 5. Project Hierarchy

Selective outsourcing is generally more successful than total outsourcing [Lacity and Wilcocks, 2001]. IT Providers typically outsource the applications and support side (call-centers). Seldom do they outsource the IT infrastructure[10]. For IT Providers, the most common form of outsourcing is development and management of IT applications.

Most global outsourcers use CMM as the reference point identifying their process maturity in developing IT applications. CMM, while certainly a model that helps improve software quality, suffers from an intrinsic issue of requiring a clear blue- print of the need – not easily accomplished with off-shore resources because of the lack of constant interaction between developers and users. Requirements volatility is identified as the dominant cause of project delays and cost overruns [Murthy, 1995]. Software life cycle models essentially center around seven phases[11]:

- Requirements (the what)/Project Planning
- Design (the how)/Project Blueprint
- Implementation (Code Development)
- Verification and Validation

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[10] Infrastructure is clearly where IT Providers differ from traditional IT consumers. IT consumers tend to outsource the IT infrastructure more often to gain the benefits of reduced costs, redundancy, high availability, and disaster recovery.

[11] The software life cycle for using commercial software can also use the same seven phase model where the design phase addresses selection of commercial software and the implementation phase includes customization. The life cycle for large systems which include several software applications is considerably more complex than the seven phase model presented here. Traditionally an additional phase for integration across multiple applications is included in the life cycle.

- Deployment
- Maintenance
- Retirement

Traditional waterfall models, prototyping models, and risk reduction techniques such as the spiral model are the popular life cycle methodologies [Boehm, 1988]. These models attempt to reduce the cost of re-work, however, they cannot overcome the two major challenges in implementing software:

- Requirements volatility, and
- Lack of true metrics.

Requirements Volatility

Long development times often led to application obsolescence even before applications were deployed. Prototyping techniques alleviate this problem by bringing users simple mock-ups and obtaining early feedback to ensure that mistakes are corrected at earlier stages in the life cycle. Extreme Programming (XP) also addresses the above concern by making rework a fact of the life cycle [Beck, 2000]. The key elements of XP embrace four concepts:

- Communications (Customer is owner who specifies scope and programmer specifies estimates, open honest communication).
- Quality work (good design, loosely coupled).
- Simplicity (incremental change, simple metrics).
- Feedback (dual teams, test-driven coding for instant feedback, customer-checked functional testing).

XP is characterized by short iterations (few weeks) to a release (few months) with each iteration made up of short tasks. Traditional development models use metrics such as Function Points [Albrecht and Gaffney, 1983], but XP uses a new set of metrics such as "velocity" which is the number of "stories" per iteration. The requirements of dual teams and honest measurement are often barriers in organizations implementing XP; but, nevertheless, it is impossible to follow XP principles if the programming team works off-shore[12].

Lack of True Metrics.

IT process metrics are fractured and no uniform mechanism truly assesses the delivery quality. Metrics play a large role in estimating the true costs or value of IT investments. Since costs play such a major role in off-shoring, assessing true costs is important. Cost estimation techniques when using off-shore resources are no different than traditional estimation techniques when using algorithmic models such as COCOMO [Boehm et al., 2000] or function points [Albrecht and Gaffney, 1983]. Time pressure constrains the estimator's ability to understand the scope of the task. Task characteristics include complexity, volatility, number of functions, size of data, and percentage of reuse. In addition to these costs, off-shore outsourcing entails additional overhead [Computerworld 2004b]. Furthermore, internal resistance and building consensus add additional indirect costs not usually taken into account during the early stages of off-shoring [Computerworld, 2004a].

Five macro-cost factors that affect project estimation when outsourcing are identified in Table 2. These macro factors are grouped into three cost-estimation classes:

- Algorithmic: can be independently estimated using existing cost estimation models or metrics that can be developed specific to the off-shore engagement;

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[12] Use of on-site consultants is an acceptable alternative.

- Fuzzy: estimates can only be obtained using a combination of algorithmic models and historical estimates; and
- Economic: based on market-models (depends on the market conditions). In this case, the best way to arrive at costs is to use RFP-Bids from multiple vendors.

Table 2. Off-Shore Cost Estimation

Cost Factor	Estimation Class	Estimation Technique
Size	Algorithmic	Function Points or Analogical Models [14] developed for each project those are part of the portfolio
Architecture	Fuzzy	Depends on off-shore company skill sets – needs to be developed during early stages of engagement
Duration/Type of Relationship	Economic	Market comparisons with multiple off-shore vendors
Outsourcing Complexity	Algorithmic	IT Provider and Outsourcer "relationship specific metrics" – needs to be developed during early stages of engagement. If the outsourcing includes multiple projects, then metrics for each type of project need to be developed
Governance	Fuzzy	Company specific costs – varies with each engagement and best addressed via a strong Service-Level Agreement (SLA)

Team-based approaches to cost estimation using analogical data produces far better estimates than algorithmic techniques [Murthy, 1995]. This result implies that enterprises venturing into off-shore outsourcing need to develop an experience base (the four stage life cycle model proposed in Reid [2003]).

PRODUCTS & SERVICES

Products & Services can be broadly classified into

- those relating to infrastructure services and
- those relating to application development and maintenance services.

Infrastructure Services

Infrastructure services, in turn, can be classified based on size and scope (Figure 6). Global outsourcing significantly impacts providers of IT Infrastructure and support services. Lower costs coupled with advances in call-center technology reshaped the call-center industry. For example, many airlines, banks and other customer-facing enterprises established their own centers creating a major threat to a once-stable call-center industry. Four broad classes are identified in Figure 6. From simple Helpdesk (quadrant A) to fully managed services (quadrant D), IT Providers take advantage of Global Outsourcing to stay competitive in a price sensitive market.
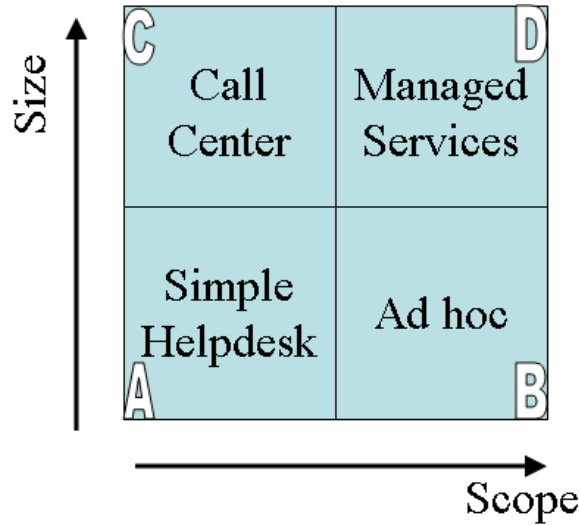
Figure 6. Classification of Infrastructure Services

Applications

Products and Services related to applications fall into application maintenance and application development. These categories can be further classified based on the amount of intellectual property and the extent of customization.

Packaged applications (such as customized ERP, CRM or SCM[13] solutions) are illustrated in quadrant A of Figure 7. When IT Providers add proprietary products on top of packaged solutions (for example, proprietary risk assessment modules used in banks), then protecting the intellectual content becomes a primary driver (quadrant B).   IT Providers of custom application development and maintenance are further classified based on the intellectual content of the applications (quadrants C and D).

It is often stated that application maintenance is best suited for off-shoring whereas new applications development which requires steady user interaction is not amenable for off-shoring. IT Providers must be careful in making these sweeping assumptions. Southern California Edison[14], for example, outsources some of its low-risk new application development, but keeps core application maintenance in-house.

IV. CONCLUSIONS AND RECOMMENDATIONS

This paper presents an overview of the IT services that U.S. organizations that provide IT services can outsource offshore most successfully. The paper argues that increasing use of offshore outsourcing is inevitable and that, as a result, the nature of IT work done by U.S. nationals will move up the value chain to much–needed skills such as project management and business analysis. The core of the paper addresses two questions:

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[13] ERP stands for Enterprise Resource Planning, CRM for Customer Relationship Management and SCM for Supply Chain Management. Simplistic definitions for these applications are:
ERP: Applications that help plan, build and distribute products/services efficiently.
CRM: Applications that help understand and deliver customer centric applications.
SCM: Applications that help manage the sourcing of resources.
[14] I am indebted to Roub Bourland of Southern California Edison for this insight.
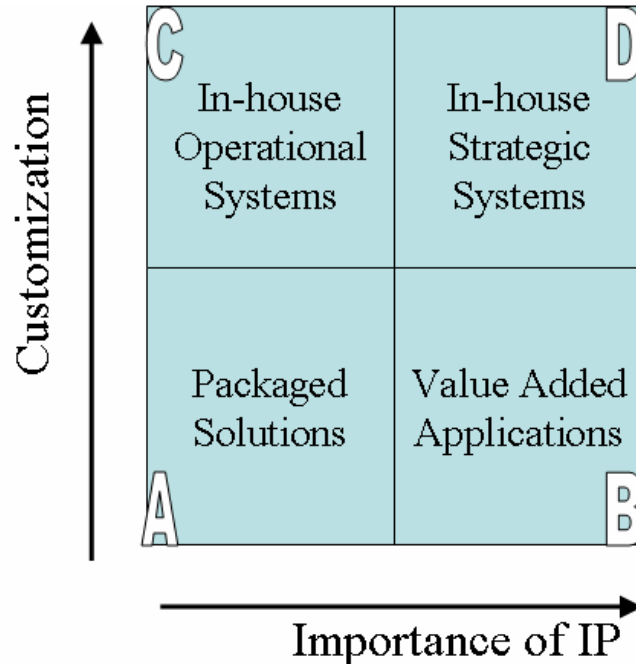
Figure 7. Classification of Applications

1. What IT services can be outsourced offshore most successfully?
2. When can firms realize the benefits of off-shore outsourcing?

With respect to question 1, it is argued that IT services to be outsourced should be considered from three perspectives: People, Process (Projects), and Products & Services.

People: Access to lower-cost people can be managed by creating organization-owned development centers in the foreign country, contracting with off-shore outsourcing vendors, or through use of off-shore-sourced human resources in the U.S. Costs and benefits of each form of governance are considered.

Process: Requirements volatility limits the sorts of projects that can be outsourced offshore effectively. Difficulties in cost estimation mean that outsourcing of development processes offshore should be adopted incrementally, to allow parties to refine project-control processes, rather than as a big-bang move offshore.

Products & Services: Two types of products and services can be outsourced offshore: infrastructure and applications. Infrastructure ranges from the very simple, such as Helpdesks, through call centers, to the very complex,(e.g., full-blown managed services). For applications, the important dimensions to consider are the importance of organization-owned intellectual property and the extent of organizational-specificity of the applications being developed and maintained.

With respect to question 2, it is argued that organizations that provide IT services within the US considering off-shore outsourcing should plan on a two-year transition. By the end of the two-year period it is reasonable to expect that the use of off-shore resources in projects will be seamlessly built into the enterprise's governance model. The reason it takes some years to make

the transition is that it takes time for organizations to develop meaningful governance strategies and metrics for managing the off-shore projects.

It is recommended that IT Providers pay particular attention to the life cycle model of off-shoring where early gains are not easy to sustain (Figure 8). This long term view of costs, coupled with pragmatic risk mitigation strategies, is essential before IT Providers can take advantage of off-shoring.
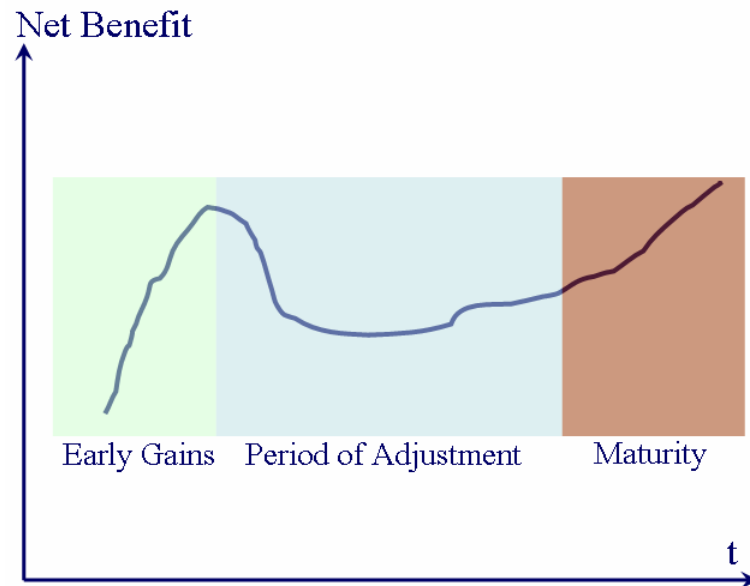
Figure 8. Potential Cost Gains by Outsourcing

The initial honeymoon, is followed by a period of adjustment where reality bites and organizations can develop meaningful governance strategies and metrics for managing the off-shore projects. These two stages last from a year to two years depending on the complexity of the engagement. In the final stage, when the off-shore relationship is mature and the governance model/metrics are in place, IT Providers can gain benefits.

Section III identified different types of products and services and asserted that off-shoring is not suitable for all of them. Specifically, it is recommended that IT Providers pay close attention to applications that carry higher intellectual content and are proprietary to the organizations served by the firm.

V. TOPICS FOR FURTHER RESEARCH

This section lists good topics for further study.

1. Different methods of taking advantage of off-shoring (managed development centers, partnership) were presented at the beginning of Section III. The specific strategy depends on the type of products and services offered by the IT firm.

2. This paper does not specifically address the impact of off-shoring on different market segments (for example, health care, aerospace, semi-conductor, etc.).

3. Outsourcing is, in general, voluntary. However, an organization may be forced to outsource IT functions when it lacks expertise. This form of involuntary outsourcing is common with highly specialized applications such as ERP, Supply Chain, and CRM functions. Rapid changes in technology make it difficult even for IT Providers to offer product and services in all areas; they

are forced to adopt outsourcing involuntarily. Since this article focuses on the benefits and risks of voluntary outsourcing for IT Providers, it does not address involuntary outsourcing. Research on involuntary outsourcing will help in understanding the impact of technology trends on Global Outsourcing.

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REFERENCES

Albrecht A., and J. Gaffney J. (1983) "Software Function Source LOC and Development Effort Prediction A Software Science Validation" *IEEE Transactions on Software Engineering* (9) 6 November

Anthony, R.N.(1965)   "Planning and Control Systems: A Framework for Analysis." Boston: Graduate School of Business Administration, Harvard University.

Beck, K . (2000**)** *Extreme Programming Explained: Embrace Change* 1/e, Boston, MA: Addison Wesley.

Boehm, B. (1988) "A Spiral Model of Software Development and Enhancement" *IEEE Computer*, (21)5 May

Boehm, B. et al. (2000) *Software Cost Estimation with COCOMO II*" Upper Saddle River, NJ: , Prentice-Hall

Carmel, E. and R. Agarwal (2002) "The Maturation of Offshore Sourcing of Information Technology Work": *MIS Quarterly Executive* (1) 2, June.

Computerworld (2004a) "Internal Resistance Can Doom Offshore Projects": January 26

Computerworld (2004b) "Costly Surprises" February 9

Computerworld (2003) "Gartner Says 5% of Corporate IT Jobs Could Go Offshore by 2005", Aug. 4.

Information Week (2003a) "Offshore Outsourcing May Not Cause Flood Of Lost Jobs": Nov. 20.

Information Week (2003b) "Off Shoring Dulls Startups' U.S. Presence": Dec. 15.

Lacity, M.C. and L. P. Willcocks (1998) "An Empirical Investigation of Information Technology Sourcing Practices: Lessons From Experience" *MIS Quarterly* (22)3, September.

Lacity, M.C. and L. P. Willcocks (2001) *"Global Information Technology Outsourcing*": Chichester, U.K: John Wiley & Sons, 2001.

Murthy, S. "(1995) *A Three Stage Process Model For Software Cost Estimation*": Ph.D. Thesis, Claremont Graduate University.

Paulk, M. et al. (1995) *"The Capability Maturity Model: Guidelines for Improving the Software Process*": 1/e. Boston MA: Addison-Wesley

Reid, J (2003) "*Offshore Applications Development and Support*": Informal presentation to Orange County CIO Roundtable November 13.

Time Magazine (2004) "Are Too Many Jobs Going Abroad?" March 1, 2004.

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