e-Services: Problems, Opportunities, and Digital Platforms

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Abstract

Services that are delivered over the Internet—e-services—pose unique problems yet offer unprecedented opportunities. In this paper, we classify e-services along the dimensions of their level of digitization and the nature of their target markets (business-to-business, business-to-consumer, consumer-to-consumer). Using the case of application services, we analyze how they differ from traditional software procurement and development. Next, we extend the concept of modular platforms to this domain and identify how knowledge management can be used to assemble rapidly new application services. We also discuss how such traceabilty-based knowledge management can facilitate e-service evolution and version-based market segmentation.

1. Introduction

In 1959, Edith Penrose [1] suggested that it is not the resources that a firm has, but the services that those resources render that are of value. Arguments for conceptualizing software as more than just a product have also been voiced in recent software engineering literature [2]. In practice, the metamorphosis of the software industry into a service industry is becoming increasingly apparent. Oracle's service related revenues, for example, accounted for two thirds of its 1999 sales with a rate of growth that outstripped its software licenses (16% versus 9%). Conceptualization and delivery of the "product" as a fuzzy meld of service and tangible components is not just limited to software; it has been extensively reported in recent interdisciplinary research as well [3]. The impact of Web-based delivery of traditional services is being felt in finance, government (e.g. eTrade), healthcare (WebMD), B2B retail (RosettaNet), communications (MCI), and transportation industries [4], among others.

While the hallmark of software companies has always been their products, their growing complexity and scale has led businesses to seek alternatives [5] that continue to provide new features, higher levels of performance, or better value [6] without the associated maintenance overhead. Treating production and delivery of software as a "value delivery process" both questions some of our assumptions about developing it, yet brings unprecedented new opportunities for research and development [3].

This paper examines such software-based services that are delivered over the Internet, develops a taxonomy for them, and taking a specific case of application services, identifies the linkages between their design, workflow, and delivery with knowledge management.

In this paper, we first define e-services and discuss their importance. A taxonomy of e-services is provided with examples to highlight the mix of physical, digital pure services that are delivered by it. Then, we discuss application service providers (ASPs) as an examplar and discuss factors influencing their successful adoption. Then, we discuss the role of knowledge management in the creation of e-services platform. We present traceability as a mechanism to facilitate the creation of such platforms.

2. E-Services

As brick-and-mortar and e-businesses focus on their core competencies [7, 8], e-services offer the opportunity to electronically outsource non-core IT functions without the traditional lock-ins and coordination overhead involved in outsourcing systems and electronic services.

If the transformation of software into service is indeed occurring, information systems development approaches must resemble the processes used by service firms more than product firms. In service industries, "customers don't buy products or services. They buy results [9]." The quality of the processes for delivering those results is of critical import in sustaining their competitiveness their and eventual success.

2.1. Defining E-services

In this paper, we view e-services as Internet-based applications that fulfill service needs by seamlessly bringing together distributed, specialized resources to enable complex, (often real-time) transactions [10]. Examples of e-services include supply chain management, customer relationship management (CRM), accounting, order processing, resource management, and other services that are electronically delivered through the Internet.

E-services typically involve a series of parallel-executed transactions performed by e-service providers as they locate, negotiate, and handle requests from each other. As such, these services are self contained and modular in ways that facilitate their brokering and auctioning. Further, some of these services can be unbundled and partly farmed out, thereby permitting real-time switching by clients (owing to lower switching and negligible sunk costs) to optimize efficiencies on the fly.

2.2. Why E-Services?

Whatever a firm's e-business strategy is, the need for software tools and technologies as well as services to support core business processes such as supply chain management, coordination, inventory management, purchasing, call center management, distribution, work flow management, and order fulfillment functions is clear. E-services attempt to offer these capabilities with flexibility, adaptability, and cost-effectiveness. They also support linkages across multitudinous stakeholders (suppliers, vendors, retailers) within the firm's business web [11] without the traditional lock-ins that are associated with large investments in specialized, custom developed information systems.

The non-monolithic and modular nature of e-services facilitates alliance formation, transactional switching, and delivery of adaptable, flexible, and scalable, end-to-end technology architectures for client businesses [10]. Such services will fuel the rise of new types of brokers and mediators who will serve as anchors for locating, aggregating, and mediating various types of transactions. Such aggregation could be around specific industries (insurance, banking, IS, travel), specific customer types (medical specialists, attorneys, writers, contractors, purchasing managers), specific issues (order taking), specific processes (procurement, stock brokering), or specific transaction chains (new product development, end-to-end marketing, supply chain management).

2.3. A Taxonomy of E-services

E-services can be classified along using the taxonomy illustrated in Figure 1. The nature of business activity that is supported, and the nature of participants can be classified as business-to-consumer (B2C), business-to-business (B2B), and consumer-to-consumer (C2C) (Y-axis). Similarly, the type of *end product* that the e-service primarily supports is mapped along the X-axis of the taxonomy matrix. This dimension can be decomposed intro three broad, non-exclusive categories.

Physical: The primary product-process supported by the e-service is a physical good, and the service itself is concerned with its assembly, design, aggregation, or delivery. For example, FedEx's package tracking services (B2C) focus on package delivery and tracking, Dell's supply chain management services focus on aggregating parts and components from across its suppliers on the back end (B2B) and managing their delivery to customers on the front end (B2C), and eBay's auction service manages transactions of physical goods (and occasionally purely digital goods) among buyers and sellers (C2C).

Digital: The primary end product *delivered* by the e-service is a digital information product [12]. Such products are *assembled* digital goods that exist primarily in electronic form. Examples of such services include Beyond.com's aggregation of purchasable and electronically delivered software published by hundreds of different software publishers (B2C), MP3.com and E-music.com's service that delivers digitized tracks from a vast array of music albums (B2C), ACM's digital library (www.acm.org/dl/) that electronically delivers journal papers in PDF format, services such as Employease that help businesses build payroll records for their employees (B2B), and services such as Napster and Gnutella.com that facilitate consumer-to-consumer trade of digitized information products.

Pure Service: The end product for some services is neither a packaged information product nor a physical artifact. These are pure services in the true sense of the word. E*Trade, and Amazon.com's customer interest profiler, RebateCentral's rebate tracker are examples of such e-services in the B2C arena. In the B2B arena, application service providers and Web-delivered ERP services exemplify these services; likewise, Microsoft's MSN Messenger and America Online's instant messenger that allow consumers to chat in real time while they are bombarded with advertising, and Thirdvoice.com's C2C distributed real-time discussion system exemplify these in the C2C context.

These distinctions are not always very clear. In many cases an input might be digital but the output might be physical. A case in point is OfficeMax's NowDocs e-service that allows customers to upload digital documents that the company prints, binds, and ships according to the options selected by the customer. Similarly, some of these e-services might be simultaneously classified in more than one category.

A complementary way of classifying such services is the mapping them in a three-dimensional space according to the relative proportion of physical and electronic components in them. This way, the physical-digital characteristic can be treated as a continuum rather than a collection of discrete states. Once such services are mapped accordingly, clusters of similar services can help determine their design, fulfillment, and delivery similarities. Because no classification mechanisms are available in existing literature, such mappings are illustrated in Figure 2 with examples of e-services rather than their characteristics.

	Pure Service	Digital	Physical
B2C	@Backup.com E*Trade.com RebateCentral.com Amazon Profiler	Flooz.com E-music.com Beyond.com eStamp.com ACM Digital Library WebMD.com MP3.com MyDesktop.com Elsevier ContentsDirect	WebVan.com Outpost.com tracker my.FedEx.com Ofoto.com
B2B	Credit Processing Application Service Providers	Employease	TradeOut.com Supply chain management (e.g., Cisco Dell Apple) Chemdex.com
C2C	MSN Messenger Thirdvoice.com	Napster.com Gnutella.com	eBay.com FirstAuction.com Half.com Swapit.com

Figure 1. A taxonomy of e-services

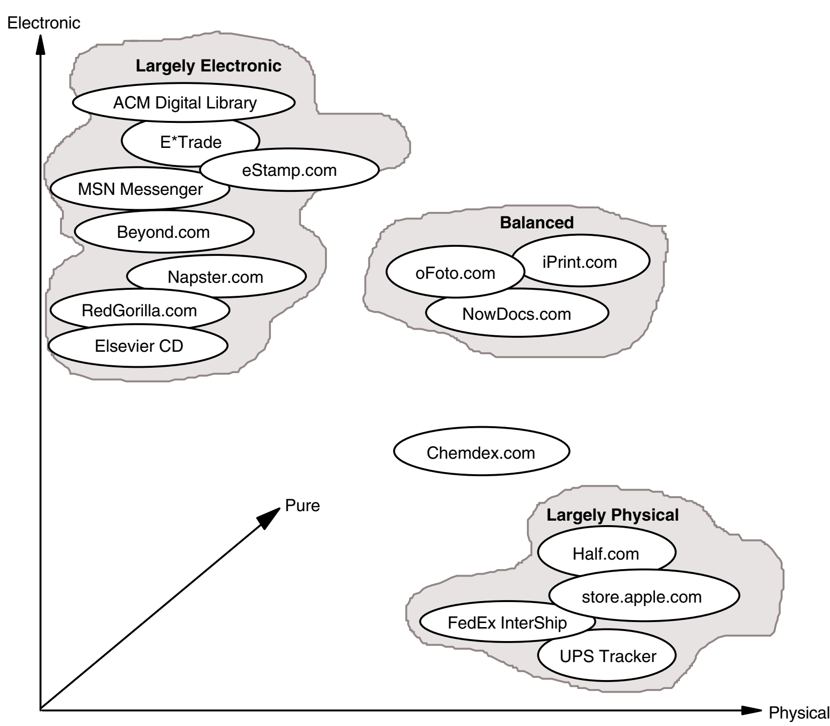

Figure 2. Mapping e-services across their digital, physical and pure service dimensions

As shown in Figure 2, some e-services are largely focused on delivering physical end products, some digital products, while others are truly intangible services. Irrespective of what the end product is, the service package itself might consist of both physical and digital components. Based on this composition, they can be placed at different points along the three dimensional space in Figure 2.

Table 1: Application Services Market Players

Market Players/ Competing Firms	Strengths	Characteristics and Relationships
Telecommunications firms	Network service infrastructure	Manage data centers
Pure play ASPs	Legacy free	Subcontract infrastructure from other firms
Professional services firms	Offer specialized services while further outsourcing components; broad experience base	Variable pricing; covers customization & implementation
Hardware manufacturers	Fewer integration challenges	Equipment and integration services
Software developers	Application ownership	Head start with existing applications

In all cases, different types of inputs are needed for creating, designing, delivering, and maintaining these services. An increasingly significant input is knowledge involved in "assembling" e-services from various components such that customized service offerings produced rapidly [13].

3. Application Services

In the following sections, we focus on one type of e-service: application services that fall along the borders of intangible and digital ends focused services in the B2B category, as illustrated in Figure 1. Application services are provided by application service providers in the same way as Internet service providers provide Internet access, albeit more complexly. Application service providers (ASPs) are IS service firms that sell software and information systems as a rental service rather than a software product or license of ownership. These service providers provide contractual service offerings that collectively deploy, host, manage, and rent access to an application from a centrally managed facility; they are–directly or indirectly–responsible for providing all the relevant expertise and supporting specific activities targeted at managing this application set [14]. An ASP provides these software services to customers over a network, typically the Internet [15], based on a contract between a service purchaser and provider that is structured around levels of service. Rather than having to choose technologies, customers get to choose *outcomes* such as acceptable performance levels, downtimes, transaction processing time bounds, response times, etc.

Accordingly, the market is being penetrated (see Table 1) by a variety of firms, and in effect, changing the very face of outsourcing contracts [16].

We focus on application services for four reasons. First, they represent a category of online services that is growing at a phenomenal rate of 55% annually with a market value of $12.2 billion in early 2000 [17]. Second, they represent a new business model for outsourcing information systems, and services in general. IDC estimates that outsourcing spending will grow from the current figure of $100 Billion to $151 Billion by 2003, the fastest growing area within which will be application services [18]. A 90% compounded growth rate for application service providers will create a $4.5 billion market by 2003 [19]. Fourth, ASPs might make IT investments more competitive in a business environment where up to 40% of enterprise IS costs can be tied up in maintaining applications [18] by shifting the maintenance burden away from the client side.

Two predominant ASP firm models exist: (1) the application outsourcer and (2) the managed application provider [20]. While both types provide template-configured versions of software through remote hosting of applications, the latter type represents a majority market share, essentially distinguished by three factors: (1) wrapping a suit of services around outsourced applications, (2) offering higher degrees of application customization to fit each client's needs, and (3) employment of variable-pricing schemes that significantly differ from the fixed monthly fee structures used by application outsourcers. The second model has a striking degree of semblance to IT service providers who deliver third-party applications such as ERP systems as part of a suite that includes implementation, consulting, integration, maintenance, and ongoing management.

3.1. Business Models of Real-time Web-based Services Outsourcing

E-services represent a new model of real-time outsourcing over IP networks. Application services—the specific context in which e-services are examined here—exhibit several characteristic differences and are contrasted to various other modes of IS outsourcing in Table 2.

Table 2: Application services versus traditional outsourcing

Service Characteristic	ASP	Data Centers	ISD Outsourcing	Custom Programming	IS Consulting	IT Outsourcing	Web hosting
Application centricity	✓		✓	✓	✓		
Centralized management	✓	✓				✓	✓

One-to-many	✓	✓				✓	✓
Mass Customizatio n	✓	✓				✓	
Packaged applications	✓				✓		
Performance contracts	✓	✓				✓	✓

An e-service may be delivered in one of many forms: (1) As a Web-site embedded service, (2) as a Web application back-end, (3) as a packaged solution comprising multiple outsourced e-services, or (4) as a portfolio of related services delivered on a metered basis [10]. Six characteristics of application services distinguish them from traditional IT services and information systems development outsourcing. They are:

1. *Application centricity*: The core service provided is the software application/system itself. This is different from IS consulting (where focus is on design of a custom solution), or outsourced custom programming, or IT outsourcing (infrastructural services).
2. *Contractual nature of performance and reliability*: The ASP bears the responsibility for service level agreements (SLAs) and performance of the application services provided to each customer, irrespective of whose software is deployed on the supply end.
3. *Centralized management:* Applications, much like IT services, are centrally managed (at an “application center” or “data center”) rather than at each customer’s site; access is provided through the Internet.
4. *“Application access” is sold:* Customers gain access to new applications without making any other upfront investments in software licenses, hardware, and additional IT staff that would typically be required for in-house developed IS or packaged applications, such as upfront investments. The ASP adds value to their service through contractual arrangements with software vendors or through ownership of the application [14].
5. *One-to-many*: An ASP provides a customized set of applications from a common set of modules/subsystems to a number of different customers. Unlike custom ISD and consulting which are one-to-one, it implies selling modified versions of the same IS service set to multiple clients.
6. *Mass Customization*: Due to their one-to-many nature (much like IT outsourcing and telecommunications services), there might be a certain level of customization for individual customers (subscribers). Principles of mass customization [21] can be, and a codification strategy [22] for knowledge management might be relevant in this context.

In the following section, we focus on the last two characteristics to argue that the development of e-services platforms is an effective way to deliver e-services that can be mass customized to service different customer segments.

4. From Product Platforms to E-service Platforms

Application services rely on coordination of processes and integration of expertise from a variety of participants that might span the range of software, network, hardware, delivery, and branding components that that are assembled into a coherent whole to deliver an application service. Product platforms are defined as “A common set of design rules and implemented subsystems and subsystem interfaces that form a common structure from which a stream of derivative products/services can be efficiently developed and produced [6].” Because e-services are often built by integrating software, hardware, and network components rather than systems, different ways of integrating these components will invariably lead to different services. New product development research has recognized the viability of product platforms in manufacturing [23, 24] as well as in traditional services [6]. Product platforms consist of individual subsystems and subsystem interfaces which themselves become the key focus of both investments and innovation. Platforms help firms customize their offerings for specific market segments and their associated needs. While this has been explicitly recognized in manufacturing literature, this recognition, if even existent, is somewhat subtle in IS. Focusing on developing families of e-services rather than one service at a time can help design and deliver multiple versions of the same service in parallel and incremental versions of those in rapid succession.

However, effective platform renewal and product family management is necessary to rapidly deliver successive generations of market-driven offerings [25]. Meyer and DeTore note, “integration of markets, products, and embodied technologies is arguably the most difficult yet important challenge facing firms seeking continued growth.” This is because new components cause unpredictable interactions with other components, and lacking knowledge of what these might be, integrating these components can be challenging. The complexity of e-business related software development [26] and the needs to seamlessly link across the possibly different systems used across the business web (suppliers, buyers, partners, vendors) exacerbate the problem even further. Emergence of these problems should be unsurprising because the need for effectively negotiating with suppliers, efficient supply management, reduction of non value-added activities, and transaction time minimization are well recognized in services procurement research (e.g., [27]). Such coordination also spans internal business units; viewpoints, expertise, and knowledge across a variety of functional areas such as IS, marketing, engineering, logistics, and manufacturing must be integrated and applied [28].

5. The Role of Knowledge in E-service Platforms

Knowledge enters e-services from various perspectives. Conceptualizing an e-service requires market knowledge, its design depends on component knowledge [29], its development requires design process knowledge integration from across an array of stakeholders [30-32].

- *Integration of external Knowledge:* External Knowledge among suppliers, partners, and developers of subsystem-level components is as important as internal organizational competencies. In e-service applications, such back- and front office services are being increasingly Web-sourced to minimize ramp up time and to facilitate rapid, cost-effective deployment [33]. Knowledge-based service platforms can facilitate rapid, real-time "assembly" of customized e-services while applying experience gained from the preceding customer set for designing the service offered to the next customer.
- *Component subsystem selection and architectural mass customization:* Selection of service specific architectural components to provide requisite client functionality needs a multi-disciplinary, cross-organizational team focused on customer-centric service quality metrics [6]. This selection process is intensively knowledge-based, and given *very* short time frames within which such decisions must be made, process efficacy spells the difference between a "good" and "bad" service design decision. Furthermore, as customization *primarily* occurs at the time of delivery [6], how exactly this customization must be done can be guided by knowledge of past customization processes (for earlier customers), their differentiating attributes, and commonalities [34].
- *Design and integration of subsystem-level service components:* A platform-focused e-service approach can not only use KM for tracking the differentiating attributes and commonality points [35] among derivative e-services but also to set the bar at which standardized services and processes end and customization begins.
- *Integration and design of governance and maintenance mechanisms:* Many business-to-business providers design the service first, and build mechanisms for governance later [6]. Experiential knowledge can help devise maintenance mechanisms (and SLAs) simultaneously with the service. As variants of customized service packages are developed, emergent learning occurs and over the course of several projects, a repository of design process knowledge begins to accumulate .

5.1. Traceability Enabled Development of E-service Platforms

E-services do not enjoy the lock-ins of traditional systems because of lower up-front and open standards. Therefore, the flow of knowledge must necessarily be two way, and must include and incorporate post-adoption feedback from the service's customers [17, 36]. More importantly, an e-service provider must build mechanisms to facilitate such feedback and knowledge integration that most packaged software developers lack. Quality satisfaction research in services marketing suggests that satisfaction is an extremely important determinant of long-term service loyalty [37]. Perceptions of poor service quality and dissatisfaction often trigger discontinuance behavior, and in electronically delivered services this is further motivated by low initial investment and low switching costs [17, 37].

5.2. Role of Traceability

The process of developing e-service platform is a iterative process involving the modification, elaboration and refinement of various versions of e-services. Operational scenarios, requirements and assumptions underlying the usage of these services differ across various customer segments necessitating formulation of different solutions that satisfy them. However, this process can be error prone and involve a lot of rework, unless the organizational memory on the many critical decisions and trade-offs that are made during model development and maintenance is available. Therefore, it is essential to capture process knowledge about the development and maintenance of e-services to facilitate their understanding and proper use. We propose that the capture and management of traceability to process knowledge as critical to the successful development of e-service platforms. Using such an approach the delivered services are clearly linked to their sources (backwards traceability) as well as to their use (forward traceability) (Ramesh and Jarke, 2000). Such traceability not only provides a means for rapidly integrating various components to deliver a service, but also facilitates effective understanding, validation and use by providing a history or trace of the process of their development, use and evolution. In dynamic situations such as e-service development, where tightly integrated decision processes can not be easily developed and implemented, process knowledge traceability provides a "loose coupling" between relevant decision situations that can greatly enhance the understanding and coordination across functional boundaries. It can be very valuable in a variety of activities such as establishing compliance with user requirements, maintaining rationale behind the creation of a specific version of a service, and establishing change control and maintenance mechanisms.

6. Our Approach

Many successful service providers develop a set of components that can be mixed and matched at the point of delivery [28]. Such mixing-and-matching has also been reported in online information delivered by electronic publishers (e.g. [38]) and in traditional services such as insurance [6]. A similar approach is viable in e-services if they are built with such reconfigurability in mind. This requires that: (1) the e-service components be modular by design [39] and (2) knowledge of interactions and integration among various components be used to evaluate component-service combinations. E-services can then be assembled using existing components in a given product platform, and can be integrated with new components to rapidly address new market opportunities while reducing the time cycle for new product introductions [6].

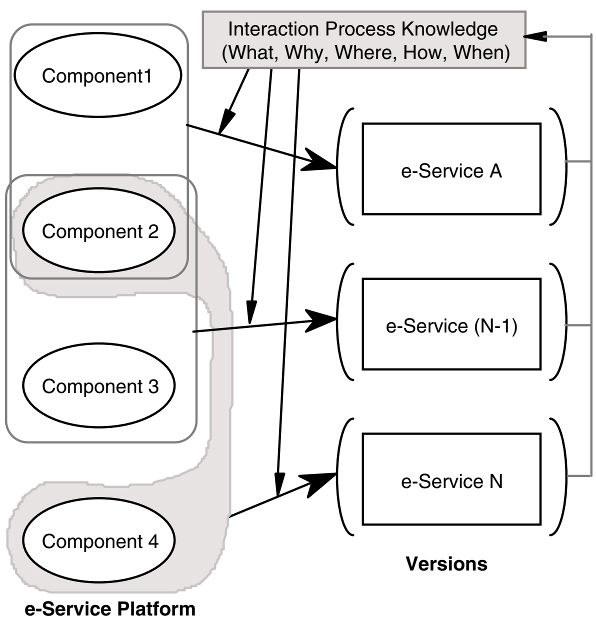

Figure 3. A conceptual model of an e-service platform

This is conceptually illustrated in Figure 3. For simplicity's sake, consider a platform with four components that can be combined in many possible ways. Component knowledge is associated with each such component [40]. This component knowledge must be integrated into architectural knowledge or systemic knowledge [41] that describes how the service components fit together. A credit card billing module and an order processing system are examples of a component and a service respectively. Every time a new service is assembled, knowledge of *What, Why, Where, How,* and *When* regarding the choice and integration process of these components can be captured. After the service is delivered, feedback (either initiated or usage pattern based) can be incorporated into this set. As this base of knowledge grows, it can be used as a logical knowledge-based platform to guide design of future versions of the e-service as well as facilitate frequent future releases. Our approach is based on our studies on the use of traceability to support systems development activities [42, 43]. Applying the concept of traceability, process knowledge about how, when, why, where, and by whom these service design decisions are made, accumulated process knowledge can be used to: (1) guide new e-service development decision making processes, (2) create the next version of the e-service platform, and (3) transfer knowledge across platform generations.

7. Discussion

A broad set of competitive, strategic and technological factors affect the successful adoption of e-services. Our analysis of nearly fifty trade press accounts on e-services adoption (in *CIO, The New York Times, The Wall Street Journal,* and *The Industry Standard)* suggests that the following technological factors are critical for successful deployment:

- Integrating integrate diverse, distributed systems
- Integrating fragmented and specialized applications
- Coping with changing technology and customer needs, and
- High levels of customization [20]

The approach proposed here seeks to support the above objectives by leveraging process knowledge gained during the development of e-services so that e-service platform can be created to support the needs of various customer segments. Though our approach is derived from empirical studies of systems development practices, its generalizability to the development of e-service platforms is a subject of ongoing research. Using case studies in organizations developing e-service platforms, we are currently investigating how process knowledge is acquired and used with both formal and informal means.

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