

Intelligent Document Gateway - A Service System Analysis

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Abstract

In today's fast paced world, it is necessary to process business documents expediently, accurately, and diligently. In other words, processing has to be fast, errors must be prevented (or caught and corrected quickly), and documents cannot be lost or misplaced. The failure to meet these criteria, depending on the type and purpose of the documents, can have serious business, legal, or safety consequences. In this paper, we evaluated a B2B order placement service system that allows clients to place orders for products and services over a network. We describe the order placement service before and after deploying the Intelligent Document Gateway (IDG), a document-centric business process automation technology from IBM Research. Using service science perspective and service systems frameworks, we provide an analysis of how IDG improved the value proposition for both the service providers and service clients.

1. Introduction

'With the new technologies now available almost anything is possible from an operational standpoint-the limits lie solely in our consolidated habits, our mind sets and our culture' - Alfredo Ambrosetti

To succeed in a global economy, enterprises need to exploit their own competencies and to develop strong relationships with suppliers, customers and external business service providers to co-create value they could not produce on their own. Recent economic reports and studies [10] [11] indicate that the global economy is actually a "large *service system* in need of innovation to grow [5]." A service system comprises service providers and clients working together in complex networks or chains to co-create value for all stakeholders, with value creation being realized by the transformation of something owned or controlled by the client [8]. Additionally, complex service system compositions include people (e.g., individuals, teams, organizations), technology (e.g., information processing, communication, self-service), and business management processes all interconnected by value and information networks, resulting in observable dimensions or characteristics.

Richard Norman refers to a "new" global economy in which an "elevated level of value creation" is made possible by new technological breakthroughs associated with the ability to effectively reconfigure resources inside, and especially outside, the corporate boundaries [6]. Value is then created as a result of better use and deployment of resources. The Intelligent Document Gateway (IDG) is a breakthrough information technology for document-centric business process automation based on key concepts from the emerging field of "document engineering" [2] that offers corporations the opportunity to reconfigure its resources in ways that were not possible before.

In this paper we provide an analysis in terms of service systems of a recent successful IDG engagement with IBM's B2B order placement service hosted by e2Open gateway [3]. The B2B order placement service allows business clients, procurement analysts or approved employees to place orders over the internet using a web-based or installed application user interface. The order typically includes information such as product or service selections, part numbers, payment information, contract numbers, billing address, shipping address, and shipping preferences. Orders are submitted and routed to the appropriate fulfillment system. However, because orders often contain invalid part numbers, special handling requirements, or custom requests, a large percentage of the orders required manual processing by a Customer Service Representative (CSR). The CSRs are located globally in 35 countries, including Brazil, China, and India. They report into Customer Service Organizations (CSOs), where due to competitive job markets, management struggles with high turn-over rates.

In fall of 2004 researchers in Almaden Services Research met with leaders in IBM.COM worldwide sales and distribution to discuss issues they were facing with the existing B2B order placement service. IBM.COM described their problem in terms of lost orders, ones submitted by IBM clients that were not completed or acted upon by Customer Service Representatives (CSRs). IBM Research proposed an approach based on IDG for intelligent routing of orders that they believed could both completely eliminate lost orders as well as route them more efficiently. The engagement began with several meetings to discuss the proposed solution, gathering of requirements, refinements of the requirements, followed by a six month period of active research and

development. Following the development phase, IBM Research and IBM.COM engaged on a six month deployment activity. Deployment involved Customer Support Organizations (CSOs) around the world, technical support teams, process owners, and content management experts in addition to the researchers.

In the remainder of this paper, we describe the original order placement service *before* IDG, followed by a high-level description of the IDG framework architecture, and then a description of the new B2B service system *after* IDG. We then provide an analysis of the order placement service in terms of a service system, followed by a summarization in the conclusions.

2. B2B Order Placement Service before IDG

In the original order placement system, business rules for routing orders to the appropriate CSR were implemented using Notes agents. The agents routed the orders by sending them to the CSRs as an email. Business process owners updated the routing rules daily using a basic text entry interface. A Lotus system administrator would shut down the order placement system, load the new rules, and then restart the system for them to take effect (see Figure 1).

This approach had a number of drawbacks:

- **Incorrectly routed orders.** In many cases the orders were sent to the wrong CSRs, who didn't know what action to take. Thus, orders would be left open indefinitely.
- **Lost orders.** Since orders were stored in a Notes email folder, the organization and tracking was idiosyncratic to each individual CSR. When a CSR resigned, there was no easy way to ascertain the number and state of the orders they owned. Relatedly, because there was no central repository for orders, CSO managers were unable to track orders or generate reports. Finding and transferring incomplete orders to another CSR took a long time, or in some cases, they were never recovered. These accountability problems affected 8-10% of the manually processed orders.
- **Routing rules update.** The text based rule entry was time consuming and error prone. Because there were no rules checking capabilities, semantic and syntactic errors were sometimes not discovered until the Notes servers were restarted.
- **System availability.** When the Notes servers were restarted to activate the updated routing rules, order placement service was interrupted. If there were errors in the updated rules, service may be degraded until the errors could be corrected.

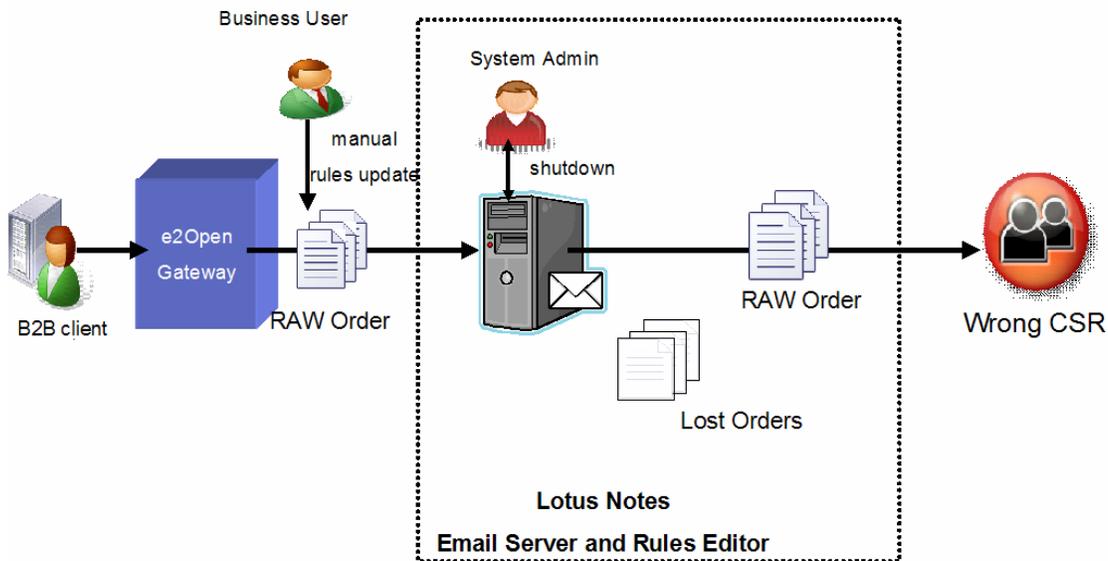


Figure 1. B2B placement service before IDG

3. B2B Order Placement Service after IDG

This section describes the generic IDG framework architecture and provides a graphic of the order placement service after deploying IDG.

3.1. IDG Framework

The core of the IDG framework (see Figure 2) consists of a Document Gateway component that automatically parses the incoming purchase order, extracts metadata, classifies, and converts the orders depending upon each order type. The data either provided by a business user or automatically extracted by the gateway is sent to a Business Rules Engine component that determines the action to be taken for the order. An example of such action could be notifying via email the appropriate CSR for handling the order.

The following example illustrates a rule in the IBM.com order placement business scenario in which the raw purchase orders must be routed to the appropriate CSR in multiple countries:

If customer name contains the string "AA1" and the country code is in the set {UK, FR} then notify by email the following CRS as follows:

To: john.doe@uk.ibm.com
Cc: aa@fr.ibm.com
Bcc: customer_support@ibmc1.pe.e2open.net

Rules are expressed in MS Excel spreadsheets enabling business users to author and update them using an easy and familiar paradigm. The IDG framework provides business users with a Document Gateway Authoring (DGA) tool. This is an intuitive user interface that allows business users to edit and create new business rules along with on-the-fly configuration of the runtime system. All rule updates are automatically and securely delivered to the document gateway component while still in service, ensuring zero system downtime. This is done with on-the-fly syntactic and semantic error checking. If any new rules or updated ones contain anomalies, IDG notifies the business users that authored the rule via email alerts with a suggestion for an appropriate fix. An optional User Verification application is also provided for human verification of the processing output of the system.

3.2. B2B Order Placement Service Reconfigured

The proposed infrastructure (see Figure 3) replaced the Lotus Notes agents with the Intelligent Document Gateway (IDG) framework for automating and streamlining document-centric business processes [3].

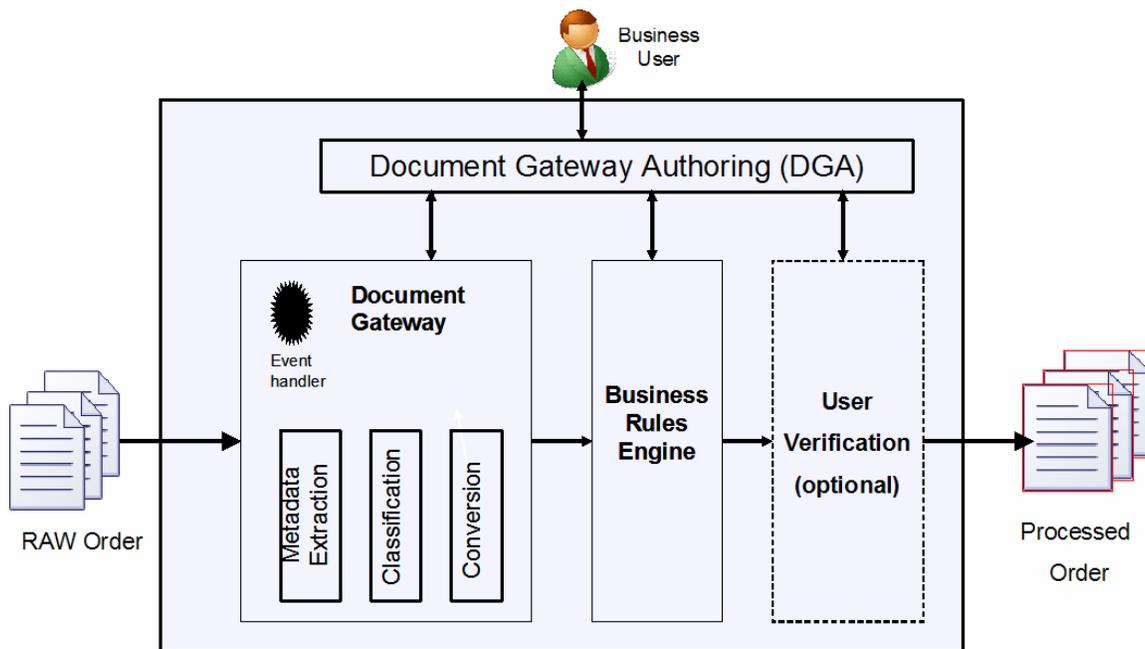


Figure 2. IDG architecture

As illustrated in Figure 3, the original (i.e. raw) purchase orders were picked up from the e2Open B2B gateway and processed in real-time by the IDG. The new processed order is then stored into the central Content Management repository after ensuring that each order is persisted until a subsequent sub-component of IDG takes ownership of the order. The Content Management system was deployed as part of the IBM WebSphere™ Application Server and provided the backend layer to a web based workflow application that allowed CSRs to get detailed views of the pending orders.

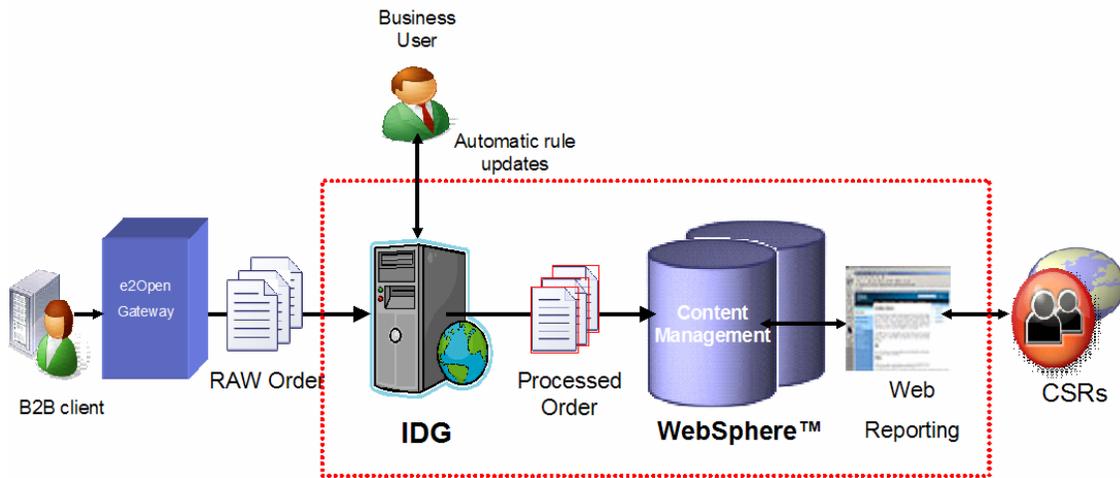


Figure 3. B2B placement service after IDG

4. Analysis

A typical B2B order placement service comprises a service provider, service client, and a service target that is being transformed as a result of the service (see Figure 4). These elements and relationships are one useful way to describe a service system [1]. However, there are several alternatives which are not described in this document, including service blueprint [9], a framework for services marketing strategy [4], and the Unified Services Theory model [7]. Additionally, there are a number of dimensions or characteristics along which a service system can be evaluated. This analysis is not intended to provide an exhaustive review, rather to introduce some prominent dimensions and illustrate how they can be applied in an analysis.

Using an adaptation of Gadrey’s model [1], the service provider is IBM, the service clients are IBM B2B clients located in 26 countries, and the target being transformed is the clients order information. When the clients enter their order information into the ordering application and submit it, the order service acts upon that information,

resulting in the transfer of goods or services from the provider to the client. Thus, information is transformed into a completed transaction.

When using this model, the service system boundaries can be drawn at different places. We approached this mapping by using tangible, easily observed and measured constructs. For example, we determined that what was being transformed was the order information supplied by the B2B client. However, you might imagine that what is actually being transformed is something less obvious, such as ability to compete in a certain marketplace.

This example is much more difficult to study because it is further away from the actual transaction, just one determinate factor of many, and thus more difficult to assess or measure. The approach that we took in drawing the boundaries might be considered first order, since we were driven mostly by the desire to understand the tangible and immediate effects of deploying a new technology. Our choice should not be considered the best approach, nor should choosing less obvious boundaries be dismissed. Indeed, less obvious boundaries may lead to the most unexpected and valuable insights. However, given the more immediate, tangible impacts of IDG, the analysis boundaries that we selected have provided actionable insights.

Next, we’ve evaluated several distinguishing attributes of service systems, considering both before and after deployment of the IDG technology.

4.1. Service systems should satisfy all stakeholders

In the simplest interpretation of a service system, there are two stakeholders – a single service provider and a service client. It is one person doing something of value

for another person. In a complex service system there are many different stakeholders, each with different expectations, arising from their relative needs and goals. Complex service systems are often nested and recursive, with each instance of sub-service systems serving both internal and external stakeholders. Thus, a challenge in analyzing complex service systems is to evaluate them from the perspective of all service stakeholders. In this paper, we chose to simplify the assumptions by not overly emphasizing the service sub-system of IBM research providing a service to IBM.COM, a different IBM business unit, even though in reality there are significant implications to this arrangement. The stakeholder's interests are summarized in Table 1.

effective, utilizing feedback from within and outside the system to guide adaptations [8]. The ability to update the rules that check the order forms and determine routing for manually processed forms can be considered a kind of adaptability. In the original system, updating rules was slow, cumbersome, and potentially risky. After IDG was deployed, updating rules without a restart and built-in semantic and syntactic checking were major advances in the ease with which the system could adapt to changing business and demand characteristics. These changes allowed the business process owners to more easily make error free changes to rules, and activation of rule updates did not affect service by reboots.

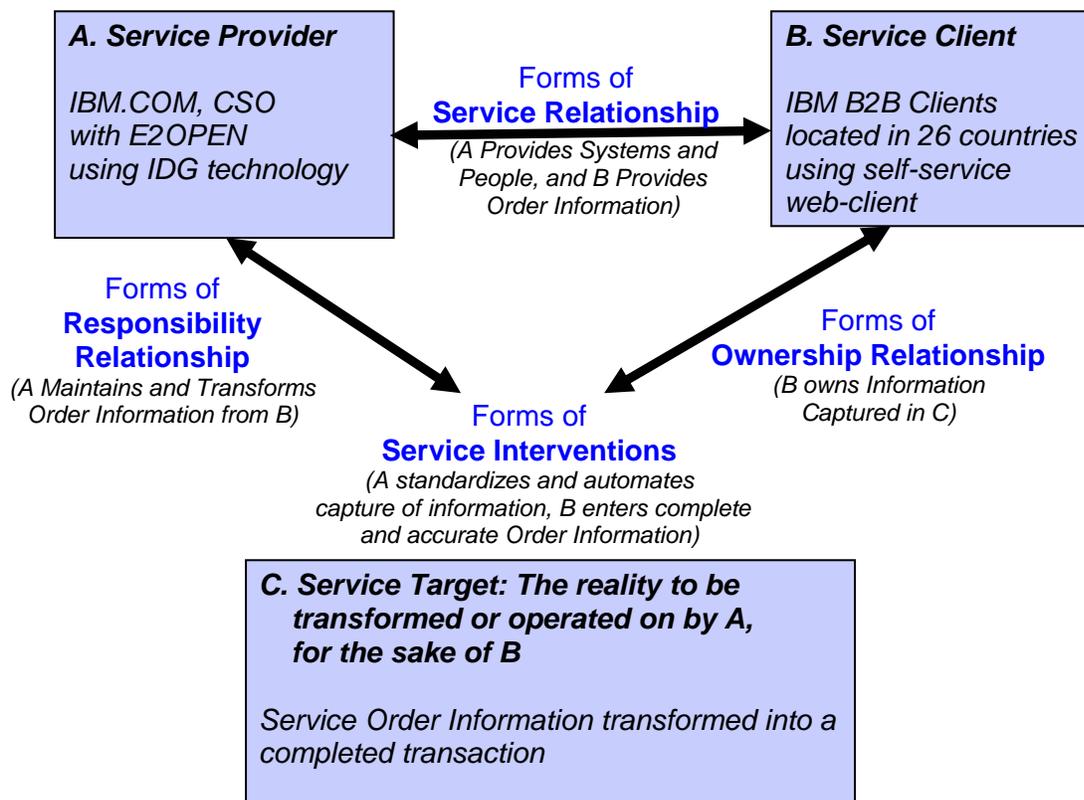


Figure 4. Order placement service system

4.2. Service systems should adapt

Service systems can be adaptive in the short term, adapting to fluctuations in demand or usage patterns. This kind of adaptability is similar to the ideas of resiliency and agility. Service systems should also be adaptive over the long term, becoming more efficient and

4.3. Service systems should account for people and technology related costs from a provider and client perspective

In this analysis, we've considered the cost of the IDG intervention not only in terms of the hardware and labor required to deploy and maintain IDG, but also in the terms of training service providers and clients.

Table 1. Stakeholders before and after IDG

System Stakeholders	Challenges (before IDG)	Benefits (after IDG)
IBM.com	<ul style="list-style-type: none"> • 8-10% order loss • Service interruption 	<ul style="list-style-type: none"> • Significant additional revenue /year • Improved reliability • Improved Customer Sat • Increased customer loyalty, and potentially increased demand
IDG	<ul style="list-style-type: none"> • Understand business and technical requirements • Provide the technical solution and expertise 	<ul style="list-style-type: none"> • Increased credibility in its value proposition to prospective clients • Great platform for further IDG based innovation and transformation of the ibm.com business
Business User (a.k.a. Process Owners)	<ul style="list-style-type: none"> • Manual rule updates 	<ul style="list-style-type: none"> • Improved productivity as they benefit of easier rule updates • Reduced errors in rules due to syntax an semantic checking • Reduced update cycle time due to eliminating requirement to reboot
CSO Mangers	<ul style="list-style-type: none"> • No way to easily track orders • Turn-over problems amplified by poor order accountability 	<ul style="list-style-type: none"> • More productive in their jobs as they no longer have to track unfulfilled orders from CSRs emails
CSRs	<ul style="list-style-type: none"> • No order management and accountability 	<ul style="list-style-type: none"> • Increased productivity • Lower turnover rate: likely to stay longer due to more user/worker-friendly toolset
Customers	<ul style="list-style-type: none"> • Poor service • Misrepresentation 	<ul style="list-style-type: none"> • Orders always processed in short time • No false indicators of order being processed • Eliminate time and frustration in tracking down orders

On the service provider side, CSR’s had to learn the new web-based client for managing their orders, business rules architects had to learn to how to change rules using the MS Excel spreadsheet, a content management specialist and support personnel had to be trained and staffed. CSO managers also had to be trained to use the new content management capabilities. On the client side, there were no changes imposed by IDG. The procurement analysts that place orders using the network-based ordering applications did not have to change anything or learn anything new.

In service systems, the value is co-produced by the service provider and service client during production of the service. The work to improve the IBM order placement service took place on the service provider side of the equation, with the IBM client not being required to learn anything new or change the way they were submitting their orders. Thus, the nature of the co-

production relationship in terms of inputs into the system was not changed from the clients’ perspective. Because there is a cost to the service client in changing, and any changes that become cumbersome or increase work might result in the client defecting to another provider, the ability to improve service by changing the provider side of the service system is extremely valuable. In this case, the client sees only that the order placement system is more responsive and reliable; likely improving their satisfaction and potentially increasing the number of orders they place (effectively growing demand).

4.4. Service systems should become more efficient by standardizing client inputs

The unified services theory states that a service involves a provider and client working together to transform the clients inputs during performance of the

service [7]. Service efficiencies can be realized by standardizing client inputs. The network-based ordering application is a way of standardizing how B2B clients provide their order information to the service provider. The introduction of IDG did not change anything in what the client was required to do, rather it added an extra layer of standardization (orders are analyzed, formatted, saved and routed better) after the clients have completed their part of the co-production relationship.

4.5. Service systems should employ self-service and automation technologies to lower cost and improve service

Self-service and automation, used appropriately, can decrease cost to both the service provider and client, while simultaneously improving service for the client. The use of ATM machines is one example of successfully combining self-service and automation to improve availability and speed of conducting simple banking transactions. In the case of IDG, the original service system was already a self-service system, which mitigated traditional constraints on order placement such as business hours or salesperson availability, but IDG added an extra layer of automation on the backend. The automation lowered costs by eliminating the need to restart the systems during routine updates to order routing rules, and it resulted in better routing and persistence of the orders. Also, orders were no longer lost, thus eliminating provider work in manually tracking, transferring, and reprocessing them.

4.6. Service systems should scale to greater service capacity at declining costs to the service provider

Service systems that require equal increases in labor to achieve equivalent growth in service capacity do not yield increasing profits. In this case, it is difficult to determine whether IDG will also contribute towards lowering costs while increasing capacity. Will it require less CSR's per order placed by service client? It is too early to tell, but it is logical to assume that it will have some positive effect. However, larger impacts on this metric might require a different kind of focus, such as interventions that reduce the large number of orders requiring manual processing. Building real-time auto-correction mechanisms for invalid orders is a future direction for IDG.

4.6. Service systems should appear to be customized to the client to the degree that it is equivalent to cost

A service client will reasonably expect to pay more for a customized service. In this case, IDG did not change the perception or reality of how customized the order service appeared to the client. However, since this is a globally deployed order placement system, it is reasonable to expect that there is some opportunity to customize the order forms or processes to better accommodate local practices or conventions.

4.7. Service systems should provide evidence to the client that a service has or is being performed

While the service itself is often evidence enough, service satisfaction usually benefits from multiple forms of evidence. The evidence informs and reinforces to the client that a service has been or is being performed. Evidence can also convey a sense of value. When orders were lost in the original placement service, the clients would eventually notice a lack of evidence that their order was being processed. By insuring that all orders are processed, IDG insures that clients receive evidence via CSR phone calls or email. Furthermore, in the original system, a confirmation email sent to the B2B client confirming that the order was received would be misleading in the event that their order was lost. This unfortunate combination would predictably result in service clients wasting time trying to track down orders that they submitted, causing frustration and potentially impacting their business. Eliminating lost orders corrects the problem of misleading evidence.

4.8. Service systems should support transparency to the degree that it enhances value for the service client and preserves value for the service provider

Transparency is a way for service providers to share production information with the service client. It might also be considered a kind of evidence that the service is being performed. An example of transparency is the UPS or FedEx package tracking capabilities. When a client ships a package, they receive a shipping number, and then can track the package using a web-based service. This allows them to see the progress of the service as it happens. Transparency that divulges competitive trade secrets or submits the client to useless or damaging internal workings should obviously be avoided. Transparency is also bidirectional. Services often require transparency into the service client. Note that IDG did little to change transparency between the provider and client. However, it did significantly change an internal transparency factor between the CSO manager and the CSRs work on orders. This improved effectiveness of the CSO managers.

5. Conclusions

We have described an order placement service system, the problems, and interventions used to address the problems. We then analyzed the system in terms of a service system framework.

The results of this internal service engagement, Almaden Services Research providing technology and expertise to IBM.COM, has exceeded expectations. IBM clients in 26 countries now enjoy an order placement service that is more reliable and responsive, while IBM enjoys a substantial increase in order generated revenue.

In summary, the research and IBM.COM teams that developed and deployed the IDG solution achieved the above results by:

- 1) Virtually eliminating the 8-10% loss of manually processed orders
- 2) Eliminating the need to restart routing systems for routine business rule updates
- 3) Improving syntactic and semantic checking of order routing business rules
- 4) Providing superior order retention, tracking, and reporting capabilities

Additional benefits, less direct but arguably most important, include potentially improving client satisfaction, increasing demand, and lowering client defection rates. Additional interventions as described in the analysis, such as decreasing the percentage of orders requiring manual interventions and customizing the ordering experience, should result in even better overall service system performance.

The IBM.COM order placement document-centric service system was dramatically improved by IDG. However, this is just one example of where IDG has provided value, other document-based domains that could potentially benefit from IDG include immigration, healthcare, finance, and import/export, and global expense reimbursement.

7. Acknowledgements

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