Cloud Computing and its Role in Business

Carlos Barnett

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Benefit of Cloud Computing

There is a lot of benefit for the business looking for the service from the cloud service provider. Apart from the bundle of suits they have to offer, it focus all an escape from huge investment into IT infrastructure and operating cost.

REDUCE RUNTIME AND RESPONSE TIME

For applications that use the cloud essentially for running batch jobs, cloud computing makes it straightforward to use 1000 servers to accomplish a task in 1/1000 the time that a single server would require.

The New York Times example cited previously is the perfect example of what is essentially a batch job whose run time was shortened considerably using the cloud.

For applications that need to offer good response time to their customers, refactoring applications so that any CPU-

intensive tasks are farmed out to 'worker' virtual machines can help to optimize response time while scaling on demand to meet customer demands.

The Animoto application cited previously is a good example of how the cloud can be used to scale applications and maintain quality of service levels.

MINIMISE INFRASTRUCTURE RISK

IT organizations can use the cloud to reduce the risk inherent in purchasing physical servers. Will a new application be successful? If so, how many servers are needed and can they be deployed as quickly as the workload increases?

If not, will a large investment in servers go to waste? If the application's success is short-lived, will the IT organization invest in a large amount of infrastructure that is idle most of the time? When pushing an application out to the cloud, scalability and the risk of purchasing too much or too little infrastructure becomes the cloud provider's issue.

In a growing number of cases, the cloud provider has such a massive amount of infrastructure that it can absorb the growth and workload spikes of individual customers, reducing the financial risk they face.

Another way in which cloud computing minimizes infrastructure risk is by enabling surge computing, where an enterprise data centre (perhaps one that implements a private cloud) augments its ability to handle workload spikes by a design that allows it to send overflow work to a public

cloud. Application lifecycle management can be handled better in an environment where resources are no longer scarce, and where resources can be better matched to immediate needs, and at lower cost.

LOWER COST OF ENTRY

Since the infrastructure is rented, not purchased, the cost is controlled, and the capital investment can be zero. In addition to the lower costs of purchasing compute cycles and storage "by the sip," the massive scale of cloud providers helps to minimize cost, helping to further reduce the cost of entry. Applications are developed more by assembly than programming. This rapid application development is the norm, helping to reduce the time to market, potentially giving organizations deploying applications in a cloud environment a head start against the competition.

INCREASED PACE OF MODERNISM

Cloud computing can help to increase the pace of innovation. The low cost of entry to new markets helps to level the playing field, allowing start-up companies to deploy new products quickly and at low cost. This allows small companies to compete more effectively with traditional organizations whose deployment process in enterprise data centres can be significantly longer. Increased competition helps to increase the pace of innovation — and with many innovations being realized through the use of open source software, the entire industry serves to benefit from the increased pace of innovation that cloud computing promotes.

FREE FROM SOFTWARE LICENSING/UP GRADATION/PRESERVATION

Cloud computing frees up user from any further licensing of the software or from up gradation and maintenance. All the services are provided by the service providers. No longer having to worry about constant server updates and other computing issues, government organizations will be free to concentrate on innovation.

A MOBILE OUTLINE

Since all is accessible through internet, it will be accessible globally. It will be too much beneficial for a small and medium sized enterprise that is not willing to invest a lot in network setup and wish to free from maintenance.

AN INTERIM EVALUATION FOR THE COMMERCE

In cloud computing models, customers do not own the infrastructure they are using; they basically rent it, or pay as they use it. The loss of control is seen as a negative, but it is generally out-weighed by several positives. One of the major selling points of cloud computing is lower costs. Companies will have lower technology-based capital expenditures, which should enable companies to focus their money on delivering the goods and services that they specialize in. Still there are key features for consideration before one talk for the need of the business. Since entire gamut of services is available in the market one has to be very choosey and do lots of self evaluation before drawing a final plan for the business.

- In which stage of your business life cycle you are planning to scale for the service of cloud computing?
- What business line you need to support and how much is the requirement os for your business.
- How much cost effective it can be when you rent the services?
- Which type of service is going to be beneficial for you?
- What is the organization preferred technology, development platform and business that require for this type of service?
- Is your organization having the capabilities to handle these services, as these services needs lot of competency to handle it as there are lots of mechanism with different layers of service present in them.
- How much risk is associated with the data dependency when it is a kept in others infrastructure?
- How much performance and bandwidth is required to use this type of service with comparison to the current business needs? Is the company able to cope it up with the existing bandwidth to its business needs?

There is no limit for the evaluation, and consideration should be made with respect to the current business in one is, with respect to the multiple factors with responsiveness

towards stake holders and business needs, financial goals, investment capabilities, profitability, future planning, industrial growth, service providers offerings etc.

One can only earn the advantage through the new technology only if they are able to do a correct feasibility study to mitigate the business need.

DISADVANTAGE TECHNOLOGY

As any technology is a boon for an evaluation as the history is evidence, there are disadvantages too which cannot be ignored. Despite a fact cloud computing has so many features which can be awaiting a new horizon there are also key factors which cannot be ignored. Few have been summed up below:

- Lack of connectivity causes 100 per cent downtime, whereas with traditional applications, lack of connectivity allows for some local function to continue until connectivity is restored.
- The lack of industry-wide standards means that a usage surge can easily overwhelm capacity without the ability to push that usage to another provider.
- Companies providing computing services will over-sell these services similar to how bandwidth is over-sold based on average or "peak" usage, instead of "maximum" usage. ISP's typically operate at multiples of 5 to 1, where they sell.
- 5 times more than they have in capacity, assuming users will not use more than 20 per cent of their

allotted resources. This works, until there is a popular YouTube video that everyone wants to see at the same time.... resulting in outages. Cloud computing is even more vulnerable to the peak-usage problem than internet bandwidth.

- "Denial of service" attacks, currently common, become easier. What's more they become harder to trace, as compromised "cloud resources" can be leveraged to launch the attacks, rather than compromised "individual pc's". Cloud computing is vulnerable to massive security exploits. Currently, when a system is broken into, only the resources of that system are compromised. With cloud computing, the damages caused by a security breach are multiplied exponentially.
- By "centralising" services, cloud computing increases the likelihood that a systems failure becomes "catastrophic", rather than "isolated".
- No political approach has been made till date to control the uncontrolled factors to bring the service under the boundary lines of trust and owner ship, as these services are beyond country lines.

OVERVIEW

COMPARISONS

Cloud computing can be confused with:

1. Grid computing — "a form of distributed computing, whereby a 'super and virtual computer' is composed of a cluster of networked, loosely coupled computers acting in concert to perform very large tasks"

2. Utility computing — the "packaging of computing resources, such as computation and storage, as a metered service similar to a traditional public utility, such as electricity";
3. Autonomic computing — "computer systems capable of self-management".

Indeed, many cloud computing deployments depend on grids, have autonomic characteristics, and bill like utilities, but cloud computing tends to expand what is provided by grids and utilities. Some successful cloud architectures have little or no centralized infrastructure or billing systems whatsoever, including peer-to-peer networks such as BitTorrent and Skype, and volunteer computing such as SETI@home.

CHARACTERISTICS

In general, cloud computing customers do not own the physical infrastructure, instead avoiding capital expenditure by renting usage from a third-party provider. They consume resources as a service and pay only for resources that they use. Many cloud-computing offerings employ the utility computing model, which is analogous to how traditional utility services (such as electricity) are consumed, whereas others bill on a subscription basis.

Sharing "perishable and intangible" computing power among multiple tenants can improve utilization rates, as servers are not unnecessarily left idle (which can reduce costs significantly while increasing the speed of application development). A side-effect of this approach is that overall

computer usage rises dramatically, as customers do not have to engineer for peak load limits. In addition, "increased high-speed bandwidth" makes it possible to receive the same response times from centralized infrastructure at other sites.

ECONOMICS

Diagram showing economics of cloud computing versus traditional IT, including capital expenditure (CapEx) and operational expenditure (OpEx)

Cloud computing users can avoid capital expenditure (CapEx) on hardware, software, and services when they pay a provider only for what they use. Consumption is usually billed on a utility (e.g., resources consumed, like electricity) or subscription (e.g., time-based, like a newspaper) basis with little or no upfront cost. A few cloud providers are now beginning to offer the service for a flat monthly fee as opposed to on a utility billing basis. Other benefits of this time sharing-style approach are low barriers to entry, shared infrastructure and costs, low management overhead, and immediate access to a broad range of applications. In general, users can terminate the contract at any time (thereby avoiding return on investment risk and uncertainty), and the services are often covered by service level agreements (SLAs) with financial penalties.

According to Nicholas Carr, the strategic importance of information technology is diminishing as it becomes standardized and less expensive. He argues that the cloud

computing paradigm shift is similar to the displacement of electricity generators by electricity grids early in the 20th century.

Although companies might be able to save on upfront capital expenditures, they might not save much and might actually pay more for operating expenses. In situations where the capital expense would be relatively small, or where the organization has more flexibility in their capital budget than their operating budget, the cloud model might not make great fiscal sense. Other factors impacting the scale of any potential cost savings include the efficiency of a company's data centre as compared to the cloud vendor's, the company's existing operating costs, the level of adoption of cloud computing, and the type of functionality being hosted in the cloud.

ARCHITECTURE

The majority of cloud computing infrastructure, as of 2009, consists of reliable services delivered through data centres and built on servers with different levels of virtualization technologies. The services are accessible anywhere that provides access to networking infrastructure. Clouds often appear as single points of access for all consumers' computing needs. Commercial offerings are generally expected to meet quality of service (QoS) requirements of customers and typically offer SLAs. Open standards are critical to the growth of cloud computing, and open source software has provided the foundation for many cloud computing implementations.

HISTORY

The Cloud is a term that borrows from telephony. Up to the 1990s, data circuits (including those that carried Internet traffic) were hard-wired between destinations. Then, long-haul telephone companies began offering Virtual Private Network (VPN) service for data communications. Telephone companies were able to offer VPN-based services with the same guaranteed bandwidth as fixed circuits at a lower cost because they could switch traffic to balance utilization as they saw fit, thus utilizing their overall network bandwidth more effectively. As a result of this arrangement, it was impossible to determine in advance precisely which paths the traffic would be routed over. The term "telecom cloud" was used to describe this type of networking, and cloud computing is in concept somewhat similar.

The underlying concept of cloud computing dates back to 1960, when John McCarthy opined that "computation may someday be organized as a public utility"; indeed it shares characteristics with service bureaus that date back to the 1960s. In 1997, the first academic definition was provided by Ramnath K. Chellappa who called it a computing paradigm where the boundaries of computing will be determined by economic rationale rather than technical limits. The term cloud had already come into commercial use in the early 1990s to refer to large Asynchronous Transfer Mode (ATM) networks.

Loudcloud, founded in 1999 by Marc Andreessen, was one of the first to attempt to commercialize cloud computing

with an Infrastructure as a Service model. By the turn of the 21st century, the term "cloud computing" began to appear more widely, although most of the focus at that time was limited to SaaS, called "ASP's" or Application Service Providers, under the terminology of the day. In the early 2000s, Microsoft extended the concept of SaaS through the development of web services. IBM detailed these concepts in 2001 in the Autonomic Computing Manifesto, which described advanced automation techniques such as self-monitoring, self-healing, self-configuring, and self-optimizing in the management of complex IT systems with heterogeneous storage, servers, applications, networks, security mechanisms, and other system elements that can be virtualized across an enterprise. Amazon played a key role in the development of cloud computing by modernizing their data centres after the dot-com bubble, which, like most computer networks, were using as little as 10% of their capacity at any one time just to leave room for occasional spikes. Having found that the new cloud architecture resulted in significant internal efficiency improvements whereby small, fast-moving "two-pizza teams" could add new features faster and easier, Amazon started providing access to their systems through Amazon Web Services on a utility computing basis in 2005. This characterization of the genesis of Amazon Web Services has been characterized as an extreme over-simplification by a technical contributor to the Amazon Web Services project.

In 2007, Google, IBM, and a number of universities embarked on a large scale cloud computing research project.

By mid-2008, Gartner saw an opportunity for cloud computing "to shape the relationship among consumers of IT services, those who use IT services and those who sell them", and observed that "[o]rganisations are switching from company-owned hardware and software assets to per-use service-based models" so that the "projected shift to cloud computing... will result in dramatic growth in IT products in some areas and in significant reductions in other areas."

POLITICAL ISSUES

The Cloud spans many borders and "may be the ultimate form of globalization." As such, it becomes subject to complex geopolitical issues, and providers are pressed to satisfy myriad regulatory environments in order to deliver service to a global market. This dates back to the early days of the Internet, when libertarian thinkers felt that "cyberspace was a distinct place calling for laws and legal institutions of its own".

Despite efforts (such as US-EU Safe Harbor) to harmonize the legal environment, as of 2009, providers such as Amazon cater to major markets (typically the United States and the European Union) by deploying local infrastructure and allowing customers to select "availability zones." Nonetheless, concerns persist about security and privacy from individual through governmental levels (e.g., the USA PATRIOT Act, the use of national security letters, and the Electronic Communications Privacy Act's Stored Communications Act).

LEGAL ISSUES

In March 2007, Dell applied to trademark the term "cloud computing" (U.S. Trademark 77,139,082) in the United States. The "Notice of Allowance" the company received in July 2008 was cancelled in August, resulting in a formal rejection of the trademark application less than a week later.

In November 2007, the Free Software Foundation released the Affero General Public License, a version of GPLv3 intended to close a perceived legal loophole associated with free software designed to be run over a network. Founder and president, Richard Stallman has also warned that cloud computing "will force people to buy into locked, proprietary systems that will cost more and more over time".

KEY CHARACTERISTICS

- Agility improves with users able to rapidly and inexpensively re-provision technological infrastructure resources..
- Cost is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house).

- Device and location independence enable users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.
- Multi-tenancy enables sharing of resources and costs across a large pool of users thus allowing for:
- Centralization of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
- Peak-load capacity increases (users need not engineer for highest possible load-levels)
- Utilization and efficiency improvements for systems that are often only 10–20% utilized.
- Reliability improves through the use of multiple redundant sites, which makes cloud computing suitable for business continuity and disaster recovery. Nonetheless, many major cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.
- Scalability via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. Performance is monitored, and consistent and loosely-coupled architectures are constructed using web services as the system interface.
- Security typically improves due to centralization of data, increased security-focused resources, etc., but

concerns can persist about loss of control over certain sensitive data, and the lack of security for stored kernels. Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. Providers typically log accesses, but accessing the audit logs themselves can be difficult or impossible. Furthermore, the complexity of security is greatly increased when data is distributed over a wider area and/or number of devices.

- Sustainability comes about through improved resource utilization, more efficient systems, and carbon neutrality. Nonetheless, computers and associated infrastructure are major consumers of energy.

CATEGORIES

SOFTWARE AS A SERVICE

This type of cloud computing delivers a single application through the browser to thousands of customers using a multitenant architecture. On the customer side, it means no upfront investment in servers or software licensing; on the provider side, with just one app to maintain, costs are low compared to conventional hosting. Examples include:

- Oracle CRM On Demand
- Salesforce.com
- Workday
- Google Apps

- Zoho Office
- Box.net
- TradeBeam.com.

UTILITY COMPUTING

This type of cloud computing delivers storage and virtual servers that IT can access on demand. Early enterprise adopters mainly use utility computing for supplemental, non-mission-critical needs, but one day, they may replace parts of the datacentre. Other providers offer solutions that help IT create virtual datacentres from commodity servers. Examples include:

- Tera's AppLogic
- Cohesive Flexible Technologies' Elastic Server on Demand
- Liquid Computing's LiquidQ.

WEB SERVICES IN THE CLOUD

Closely related to SaaS, This form of cloud computing offers APIs that enable developers to exploit functionality over the Internet, rather than delivering full-blown applications. They range from providers offering discrete business services to the full range of APIs. Examples include:

- Strike Iron
- Xignite
- Google Maps
- ADP payroll processing
- U.S. Postal Service

- Bloomberg
- Conventional credit card processing services.

PLATFORM AS A SERVICE

Another SaaS variation, this form of cloud computing delivers development environments as a service. You build your own applications that run on the provider's infrastructure and are delivered to your users via the Internet from the provider's servers. Like Legos, these services are constrained by the vendor's design and capabilities, so you don't get complete freedom, but you do get predictability and pre-integration. Prime examples include:

- Salesforce.com's Force.com
- Google App Engine
- Yahoo Pipes
- Engineyard.com
- Dapper.net
- Heroku.com
- Informatica
- Cloud Services Depot.

MSP (MANAGED SERVICE PROVIDERS)

One of the oldest forms of cloud computing, a managed service is basically an application exposed to IT rather than to end-users, such as a virus scanning service for email or an application monitoring service (which Mercury, among others, provides). Examples include:

- Managed security services delivered by SecureWorks, IBM, and Verizon

- Anti-spam services as Postini, recently acquired by Google
- Desktop management services, such as those offered by Centre Beam or Everdream.

SERVICE COMMERCE PLATFORMS

A hybrid of SaaS and MSP, this cloud computing service offers a service hub that users interact with. They're most common in trading environments, such as expense management systems that allow users to order travel or secretarial services from a common platform that then coordinates the service delivery and pricing within the specifications set by the user. Think of it as an automated service bureau. Well-known examples include:

- Rearden Commerce
- Ariba.

INTERNET INTEGRATION

The integration of cloud-based services is in its early days. Examples include:

- OpSource Services Bus
- Workday ESB (enterprise service bus).

DATABASE AS A SERVICE

The centralization in the cloud of Database services. This typically range from simple key-value storage engine, often characterized by reduced functionality (e.g., limited data model, reduced ACID properties) but almost linear scalability. In this class are worth mentioning:

- Amazon Simple DB
- Yahoo Peanut
- Google BigTable.

Another important class includes full-featured SQL DBMS hosted in the cloud, some examples are:

- Amazon Relational Database Services
- Microsoft SQL Services
- LongJump
- Intuit.

More ambitious research efforts are aiming at developing dedicated novel architecture for DB in the cloud:

- MIT effort "relationalcloud.com"
- 28msec Inc: "Building a database on S3".

ARCHITECTURE

CLOUD COMPUTING SAMPLE ARCHITECTURE

Cloud architecture, the systems architecture of the software systems involved in the delivery of *cloud computing*, comprises hardware and software designed by a *cloud architect* who typically works for a *cloud integrator*. It typically involves multiple *cloud components* communicating with each other over application programming interfaces, usually web services.

This closely resembles the Unix philosophy of having multiple programs each doing one thing well and working together over universal interfaces. Complexity is controlled and the resulting systems are more manageable than their

monolithic counterparts. *Cloud architecture* extends to the client, where web browsers and/or software applications access *cloud applications*.

Cloud storage architecture is loosely coupled, where metadata operations are centralized enabling the data nodes to scale into the hundreds, each independently delivering data to applications or users.

TYPES

CLOUD COMPUTING TYPES PUBLIC CLOUD

Public cloud or *external cloud* describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who shares resources and bills on a fine-grained utility computing basis.

HYBRID CLOUD

A *hybrid cloud* environment consisting of multiple internal and/or external providers "will be typical for most enterprises". A hybrid cloud can describe configuration combining a local device, such as a Plug computer with cloud services. It can also describe configurations combining virtual and physical, colocated assets—for example, a mostly virtualized environment that requires physical servers, routers, or other hardware such as a network appliance acting as a firewall or spam filter.

PRIVATE CLOUD

Private cloud and *internal cloud* are neologisms that some vendors have recently used to describe offerings that emulate cloud computing on private networks. These (typically virtualisation automation) products claim to "deliver some benefits of cloud computing without the pitfalls", capitalising on data security, corporate governance, and reliability concerns. They have been criticized on the basis that users "still have to buy, build, and manage them" and as such do not benefit from lower up-front capital costs and less hands-on management, essentially "[lacking] the economic model that makes cloud computing such an intriguing concept".

While an analyst predicted in 2008 that private cloud networks would be the future of corporate IT, there is some uncertainty whether they are a reality even within the same firm.

Analysts also claim that within five years a "huge percentage" of small and medium enterprises will get most of their computing resources from external cloud computing providers as they "will not have economies of scale to make it worth staying in the IT business" or be able to afford private clouds.. Analysts have reported on Platform's view that private clouds are a stepping stone to external clouds, particularly for the financial services, and that future datacentres will look like internal clouds.

The term has also been used in the logical rather than physical sense, for example in reference to platform as a

service offerings, though such offerings including Microsoft's Azure Services Platform are not available for on-premises deployment.

CRITICISM

Critics of cloud computing cite its seemingly broad and vague definition. Oracle CEO Larry Ellison observes that cloud computing has been defined as "everything that we currently do". Forrester VP Frank Gillett expresses similar criticism. Many technologies that have been branded as "cloud computing" have existed for a long time before the "cloud" label came into existence. Examples include databases, load balanced on-demand web hosting services, network storage, real time online services, hosted services in general, etc.

ROLE IN BUSINESS

EIGHT WAYS THAT CLOUD COMPUTING WILL CHANGE BUSINESS

When a major change arrives on the IT scene it's not always clear what the implications will be, if any, and so for large organizations a risk-managed wait-and-see attitude tends to prevail. Occasionally however some shifts offer cost savings, improvements to operations, or ways to tackle business problems that offer significant strategic advantage.

The larger the benefit in one or more of these areas, then the more strategic the advance is and the greater potential it will impact the bottom line. Cloud computing is quickly

beginning to shape up as one of these major changes and the hundreds of thousands of business customers of cloud offerings from Amazon (Amazon Web Services), Salesforce (Force.com), and Google (many offerings, including Google App Engine), including a growing number of Fortune 500 companies, is showing both considerable interest and momentum in the space.

CLOUD COMPUTING: A DELICATE BALANCE OF RISK AND BENEFIT

To be clear, there are currently unanswered questions and inherent challenges — even some major risks — in adopting cloud computing for more that so-called "edge" computing of minor applications and non-critical business systems. Notably, these include security of enterprise data that stored in the cloud, risk of lock-in to cloud platform vendors, loss of control over cloud resources run and managed by someone else, and reliability.

On the other side of the coin are some benefits that can potentially change the game for many firms that are willing to be very proactive in managing potential downside. These include access to completely different levels of scale and economics in terms of the ability to scale very rapidly and to operate IT systems more cheaply that previously possible. Easier change management of infrastructure including maintenance and upgrades (cloud vendors extensively virtualize and commoditize the underlying components to make them non-disruptive to replace and improve) as well as offering improved agility to deploy solutions and choice between vendors, particularly when cloud interoperability becomes more of a reality than it is today. Cloud computing also offers an onramp to new computing advances such as non-relational databases, new languages, and frameworks that are designed to encourage scalability and take advantage of new innovations such as modern Web identity, open supply chains, and other advances.

In fact, cloud computing holds the potential to dramatically change the businesses that adopt it, even if the technologies are only used internally. While these possibilities are only now starting to become clear, we can get a decent sense of these now:

WAYS THAT CLOUD COMPUTING WILL CHANGE BUSINESS

1. The creation of a new generation of products and services. The economics of cloud computing lets innovative companies create products that either

weren't possible before or are significantly less expensive than the competition (or just more profitable.) This part of cloud computing is an arms race and there are short windows of opportunity since competitors can often put the economic advantages of cloud computing into their product formulations fairly quickly once they see that it works for you. Where it gets interesting is that many business ideas that required prohibitive amounts of computing power, scale, or radically new business models (the aforementioned open supply chains and Global SOA) but couldn't be implemented due to existing technical limitations or cost-effectiveness, can now be realized. Every improvement in storage, processing power, or technology enables innovations that weren't possible before (high speed Internet, for instance, made products like You Tube possible) and cloud computing makes these opportunities unusually accessible. Smart companies will take notice.

2. A new lightweight form of real-time partnerships and outsourcing with IT suppliers. Companies that did traditional outsourcing of their IT services a few years ago already know what this feels like; a large part of what used to be in-house is now being done somewhere else and changing anything is *hard*. But unlike traditional outsourcing of IT, cloud computing will provide agility and control that traditional outsource cannot match for the most part. Don't like your cloud vendor? Unless you negotiated a long-term contract,

you can often switch far easier than changing IT outsourcers. In fact, many cloud computing relationships consist of nothing more than a cancel-at-the-end-of-the-month commitment and corporate invoice. For many companies, this will actually be improvement over what they have now and give them choices they perhaps never had when everything required internal execution or to go through the outsourcing supplier relationship.

3. A new awareness and leverage of the greater Internet and Web 2.0 in particular. Most companies are still notoriously critical of Web technologies as "not serious" computing. But the Web has grown up considerably in the Web 2.0 era and the challenges in scale, performance, and satisfying fickle audiences of millions has created technologies, solutions, and architectures that can address them in powerful yet economic ways that many enterprise systems are finding hard to match. When cloud computing is adopted by an organization, they will find themselves thrown into the pool with the rest of the online world in many ways, whether this is the employment of social tools, SaaS, non-relational databases or a host of other technologies in their new cloud. And in the end, this will serve them very well and allow many companies to acquire the skills and perspectives required to compete effectively in the 21st century.
4. A reconciliation of traditional SOA with the cloud and other emerging IT models. A great post this week from

our very own Joe McKendrick illustrates how SOA is evolving because of the cloud. The advent of cloud technologies will have to be dealt with and somehow encompassed by SOA initiatives that are already looking at their current toolset of heavyweight approaches and technologies with an eye towards seeking an onramp to change and improvement. Web-Oriented Architecture fits very well with cloud technologies which are heavily Web-based and it's a natural, lightweight way of building SOA at virtually every level of the organization. For many organizations, the cloud will likely be the straw that broke the back of traditional SOA and move it to a place where it will meet new business and technical requirements, faster rates of changes, and new business conditions.

5. The rise of new industry leaders and IT vendors. While we're seeing many of the top players in computing use their existing strengths to create successful cloud computing offerings, there were also be a new generation of companies that businesses generally aren't used to dealing with as suppliers. Amazon and Google are two firms that generally aren't regarded as deeply experienced in the enterprise, and there are many others. While it doesn't seem that we'll see many entirely new players compete with the big firms, it's certainly not out of the question (and given the opportunity, likely from an investment standpoint) that we'll see some very well-funded new cloud startups that lack the baggage of existing leaders (thereby

moving very quickly) and bring a new sensibility (radical openness and transparency, new technologies, and Web-focus) that's often needed with cloud computing. We may see perhaps even before the downturn ends. Either way, the industry landscape will be remade by cloud computing as it is one of the very few new IT developments that will be very broadly adopted in the next several years.

6. More self-service IT from the business-side. Many cloud solutions, particularly as they relate to SaaS, will require increasingly less and less involvement from the IT department. Business users will be able to adopt many future cloud computing solutions entirely using self-service. This also heralds, as McKendrick indicates, that many of these scenarios will be much smaller and more numerous, tapping into the Long Tail of IT demand.
7. More tolerance for innovation and experimentation from businesses. With fewer technical and economic barriers to creating new ways to improve the business (LOB, marketing, sales, customer service, IT, horizontal services), cloud computing will enable prototyping and market validation of new approaches much faster and less expensively that before. While legal, branding, and compliance will often struggle to keep up the pace with the rest of the organization, there will be gradual thawing of the glacial pace of change as business possibilities become, well, more possible in the cloud computing world. This won't fix the often broken

innovation mechanisms in businesses, but then again, cloud computing is so accessible that many new internal entrepreneurs will use the tools to create new solutions anyway.

8. The slow-moving, dinosaur firms will have trouble keeping up more nimble adopters and fast-followers. Not adopting cloud computing doesn't spell the immediate demise of traditional companies that aren't good at making technology and cultural transitions (and make no mistake, cloud computing is a big cultural change), but it will pile onto other recent advancements and make it even harder to compete in the modern business environment. In the end, those too slow to adopt the benefits while managing the risk are likely going to face serious and growing economic and business disadvantage.

For many organizations in the short term the apparent potential of the individual changes above will often not be sufficient to them to make the transition to cloud computing, particularly as the cloud market is so new and major players such as IBM and HP have yet to arrive in full force. But gaining competency in cloud computing today by conducting pilots and building skills will server companies well and begin to position them for the future IT landscape. Longer term, cloud computing is increasingly appearing to be a transformative change in the business landscape.

HOW RISKY IS CLOUD COMPUTING?

Cloud computing is luring more businesses with its promise of minimal maintenance and low costs. But are companies putting their data at risk?

A new, free report released Friday by the European Network and Information Security Agency (ENISA) outlines the benefits and potential pitfalls of cloud computing. Based on an ongoing survey, the 123-page report, "Cloud Computing: Benefits, Risks and Recommendations for Information Security" (PDF), also offers recommendations to businesses on how to minimize the risks of entrusing their data to a cloud provider.

The benefits of cloud computing as described by ENISA are clear. Business content and services are always available. Companies can reduce costs by not overspending on the capacity of their own data centres. They can also scale up or down, depending on the services they use, and pay for those services only as needed. Internal IT is freed up by not having to implement or maintain certain hardware or software.

As more businesses hop onto the cloud, IDC expects worldwide spending on cloud services to hit $17.4 billion, revving up to $44.2 billion by 2013.

BUT CLOUD COMPUTING POSES CERTAIN KEY RISKS

"The picture we got back from the survey was clear," Giles Hogben, editor of the ENISA report, said in a statement. "The business case for cloud computing is obvious—it's computing on tap, available instantly, commitment-free and on-demand. But the number one issue holding many people back is security—how can I know if it's safe to trust the

cloud provider with my data and in some cases my entire business infrastructure?"

Though cloud-service providers promise 24-by-7 availability, their data centres can go down. Security is out of the hands of the customer, who must place trust in the service provider. Customers become dependent on a single provider and may face challenges if data and services need to be migrated to a different provider. By entrusting data to the cloud, companies could face risks and challenges from regulatory audits. Further, some cloud providers may not fully and properly delete data even if a customer requests it.

In its report, ENISA outlines measures companies can take when dealing with cloud-service providers.

Companies must perform risk assessments, comparing the potential risks of storing data in the cloud with keeping files in an internal data centre. Companies must also compare different cloud providers to narrow the list and then obtain service-level assurances from selected providers. Further, customers should clearly specify which services and tasks will be handled by internal IT and which by the cloud provider.

The report includes a checklist and detailed questions that customers can use when shopping for a cloud provider.

With the right provider, data can be safe and secure in the cloud. In fact, security with a cloud provider can be even more robust, flexible, and quicker to implement than when done internally. ENISA Executive Director Udo Helmbrecht

noted in a statement: "The scale and flexibility of cloud computing gives the providers a security edge. For example, providers can instantly call on extra defensive resources like filtering and re-routing. They can also roll out new security patches more efficiently and keep more comprehensive evidence for diagnostics."

HOW CLOUD COMPUTING WILL CHANGE BUSINESS

Many businesses are struggling to understand what this shift means for them. They're feeling their way forward, trying to figure out how best to take advantage of it. "In this area, we're a bit behind, so this is a huge step for us," says Dr. Leo Hartz, chief medical officer for Blue Cross of Northeastern Pennsylvania, which has started using a cloud computing system to let its 300,000 members find medical histories and claims information with their mobile phones. "It's new, but I expect to see some big changes."

There are experiments popping up all over that offer lessons for other businesses. Serena Software has switched almost entirely to cloud services, even using Facebook as its main source of internal communications. Genentech (DNA) has made medical experts available to sales reps in the field with a couple of button clicks. Coca-Cola Enterprises (CCE) is equipping 40,000 mobile workers, including truck drivers, merchandisers, and sales staff, with portable devices so they're better connected to the home office while on the road. They can alert their bosses instantly about shifts in demand or problems they encounter. Such examples suggest

the possibilities ahead for using these technologies to remake sales, distribution, and other parts of business.

It won't be easy for companies to make good on the opportunities. There is still a great deal of work to be done to get all these technologies functioning seamlessly and reliably. Tech companies have shifted a lot of the software applications that businesses typically handle for themselves over to the cloud, but many more have yet to be switched over.

Meanwhile, companies need increased reassurance that their data and communications will be secure and that the new services will be available whenever they need them. On May 14, an outage at Google left many customers unable to use its online applications. And while the tech industry has made it ever easier for information from different cloud services and devices to be fused together (personal profiles and calendars, for instance), a lot of the actual merging has yet to be done.

The shortcomings spell opportunity for plenty of companies in tech. Chipmakers such as Qualcomm (QCOM) and Intel (INTL) are creating products for portables that pack more capability on a single slice of silicon while reducing power consumption, making it easier to access information in the cloud from anywhere. Mobile-phone makers including Nokia (NOK) and Research in Motion (RIMM) are racing to come out with products aimed at business users that have all the ease-of-use of the iPhone (AAPL).

Hardware makers Hewlett-Packard (HPQ) and IBM (IBM), among others, are packing cloud technologies into their server computers. Software giants such as Microsoft and SAP (SAP) are developing cloud services. Salesforce.com (CRM) is providing mobile connections to its cloud software for corporate giants such as Avon and Genentech. And startups are coming out with technologies that reorganize our digital worlds. Silicon Valley's Xoopit, for instance, has built a specialized search engine capable of finding bits of information scattered among email systems, sales management programs, blogs, and online news sites. An executive could use the technology to pull together information about customer complaints from a variety of sources.

VIRTUAL PERSONAL ASSISTANTS

This is one of those turning points where small companies can explode onto the scene while industry giants miss out. One factor that puts some tech giants at a disadvantage is that the shift to a more personalized approach to computing is being led by companies born and raised in the consumer world. Apple and Google understand in their bones that simplicity and ease of use are essential to broad adoption of products and services. That lesson doesn't come so naturally to Microsoft and IBM.

But they are trying. For IBM, the change begins with encouraging its 400,000 employees to use tools it has created based on consumer social-networking sites. After IBM tests new consumer-like cloud computing capabilities internally,

it launches them as services for customers. On Apr. 1, IBM unveiled LotusLive Engage, a cloud service for corporations that combines social networking and collaboration. IBM now is working to make it possible for Engage users to search the LinkedIn professional social networking site right from their Engage pages to find people outside their companies whose expertise they need.

One of the most promising aspects of cloud computing is that it enables the creation of so-called virtual personal assistants. These software confections know people's interests and needs and go off and do useful things for them on the Internet, like suggesting a restaurant for a client meeting or offering reminders of where you have taken the client before. With GPS in smartphones, computing systems know where we are. And with artificial intelligence software, computers can be taught what we expect of them and how to anticipate our needs.

Silicon Valley startup Siri last month introduced a service that puts sophisticated artificial intelligence in an easy-to-use form. The first applications are designed to help people arrange travel and entertainment, but the founders anticipate developing powerful tools specifically for business. Example: A salesperson asks her virtual assistant to help pull together the best pitch she can make to a particular customer. The assistant draws information from a variety of sources that the salesperson can use to create a proposal. "The goal is

simple and practical: to help people perform tasks in their lives faster, easier, and in a more personalized way," says Adam Cheyer, Siri's vice-president for engineering. Simple, yes. But it has taken nearly 20 years and a tremendous amount of innovation to get here. At last, though, the tech industry is beginning to make good on Gates' vision.

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Cloud as a Service to Customer

The cloud computing that are evolving as a service in the cloud are being provided by big enterprises with a heavy investment with resource and technology which are accessed by others via the internet. The resources are accessed in this manner as a service – often on a subscription basis. The users of the services being offered often have very little knowledge of the technology being used. The users also have no control over the infrastructure that supports the technology they are using. There are six different forms that have been consolidated so far to understand how the services are being provided to the customers:

SAAS AND TYPES OF CLOUD COMPUTING

This types of cloud computing delivers a single application through the browser to thousands of customers using a multitenant architecture. On the customer side, it means no

upfront investment in servers or software licensing; on the provider side, with just one app to maintain, costs are low compared to conventional hosting. SaaS is also common for HR apps and has even worked its way up the food chain to ERP, with players such as Workday. And some who could have predicted the sudden rise of SaaS desktop applications, such as Google Apps and Zoho Office.

UTILITY COMPUTING

The idea is not new, but this form of cloud computing is getting new life from Amazon.com, Sun, IBM, and others who now offer storage and virtual servers that IT can access on demand. Early enterprise adopters mainly use utility computing for supplemental, non-mission-critical needs, but one day, they may replace parts of the datacenter. Other providers offer solutions that help IT create virtual datacenters from commodity servers, such as 3Tera's AppLogic and Cohesive Flexible Technologies Elastic Server on Demand. Liquid Computing's LiquidQ offers similar capabilities, enabling IT to stitch together memory, I/O, storage, and computational capacity as a virtualized resource pool available over the network.

WEB SERVICES IN THE CLOUD INTIMATELY RELATED TO SAAS

Web service providers offer APIs that enable developers to exploit functionality over the Internet, rather than delivering full-blown applications. They range from providers offering discrete business services -- such as Strike Iron and

Xignite — to the full range of APIs offered by Google Maps, ADP payroll processing, the U.S. Postal Service, Bloomberg, and even conventional credit card processing services.

PLATFORM AS A SERVICE 'ONE MORE SAAS VARIATION'

This type of cloud computing deliver development environments as a service. You build your own applications that run on the provider's infrastructure and are delivered to your users via the Internet from the provider's servers.

Like Legos, these services are constrained by the vendor's design and capabilities, so you don't get complete freedom, but you do get predictability and pre-integration. Prime examples include Coghead and the new Google App Engine. For extremely lightweight development, cloud-based abound, such as Yahoo Pipes or Dapper.net.

MSP (MANAGED SERVICE PROVIDERS)

One of the oldest forms of cloud computing, a managed service is basically an application exposed to IT rather than to end-users, such as a virus scanning service for e-mail or an application monitoring service (which Mercury, among others, provides). Managed security services delivered by SecureWorks, IBM, and Verizon fall into this category, as do such cloud-based anti-spam services as Postini, recently acquired by Google. Other offerings include desktop management services, such as those offered by CenterBeam or Everdream.

SERVICE COMMERCE PLATFORMS

A hybrid of SaaS and MSP, this cloud computing service offers a service hub that users interact with. They're most common in trading environments, such as expense management systems that allow users to order travel or secretarial services from a common platform that then coordinates the service delivery and pricing within the specifications set by the user. Think of it as an automated service bureau. Well- known examples include Rearden Commerce and Ariba.

CLOUD COMPUTING SERVICES

Cloud computing is among the leading disruptive trends and strategic technologies of this decade that offers a new IT delivery model. Several recent new developments have made security, risk management and governance in the Cloud more manageable, and hence opened up new options for enterprises that want to leverage the Cloud.

Enterprises stand to derive a host of benefits from a smart and consistent Cloud strategy. iGATE can help you along your transformation journey to Cloud enabled IT for addressing the challenges faced by you today, namely:

- Reducing Capital Expenditure (CapEx)
- Adjusting to fluctuations in demand for computing resources based on dynamic business conditions
- Rapidly setting up technology stacks for IT projects to be delivered in critical timelines

- Maximizing utilization of computing resources, reducing their management complexity, flexibly reusing computing resources across widely ranging needs of multiple projects
- Catering to high-end expensive IT infrastructure needs for which investment in CapEx is not a practical approach for you. These include:
  - Large scale compute resources for short-term experimentation or testing
  - High performance computing resources for compute-intensive processing
  - Distributed fault-tolerant environment for high availability and business continuity.

Cloud provides several features that help to overcome these challenges:

- It offers a variety of pre-installed, dynamically scalable computing and storage infrastructure, platform and application software as a service
- It is accessed on-demand from distributed locations using Open standards based automated, self-service interfaces
- It is charged on subscription or usage basis at low rates that benefit from economies of scale
- It is hosted on an optimized, fault-tolerant, highly scalable, secure infrastructure
- Its management is automated and its complexity is hidden from users.

HOW IGATE CAN HELP YOU

We deliver end-to-end Cloud services from consulting, architecture, design, implementation to management-monitoring to help you throughout the lifecycle of your Cloud adoption initiative. We can extend your IT to a Cloud in public domain to satisfy your needs of Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Application Software-as-a-Service (SaaS), or help to transform your data centre into a private cloud for internal use, or implement and manage a hybrid cloud for you. We also deliver industry facing Cloud solutions.

Our services enable you to gain several benefits:

- CapEx Reduction and Dynamic Scalability: We take a consulting-led approach. Through our Cloud Acceleration Programme (CAP), we help you to make complex decisions such as which of your applications to transition to Cloud, Cloud type and vendor platform to be chosen, and provide a smooth roadmap for transitioning to Cloud infrastructure that flexibly scales up or down as your demand varies and reduces CapEx and procurement cycle time.
- Business Focus and Speed to remain Competitive: Our Development/Testing on Cloud (DToC) and Testing-as-a-Service (TaaS) offerings allow you to flexibly use required pre-configured development/ testing technology stacks on demand from Cloud, and get you quickly started, reducing time-to-market,

allowing focus on business problems enabling business innovation in order to remain competitive.

- Efficiency, Agility, Availability and Accountability: Our Private Cloud offering enables transforming your data centre or server rooms into Cloud under your control for enterprise-wide use. It also enables optimal and flexible utilization of fault-tolerant IT resources providing efficiency, agility, availability; and allows intelligence and accountability to be provided for shared IT resource consumption by business users.
- Risk Reduction: Our Unified Cloud Management and Monitoring offering enables visibility, control of IT operation seamlessly across Cloud based and on-premise IT to reduce risk.

IGATE ADVANTAGE

Leveraging our deep expertise, proven methods, frameworks, and multi-vendor alliances, we accelerate, and lower the risk of, transitioning your IT to the best suited Cloud to derive the above benefits.

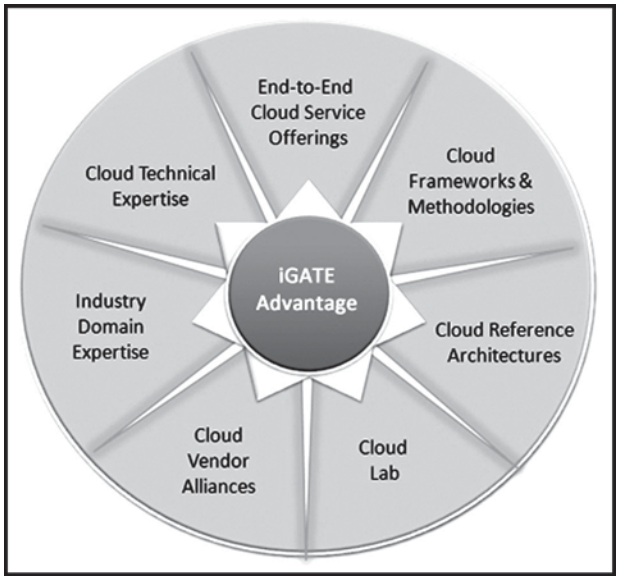
- *Expert Team for Superior Solution:* We have a team of trained-certified, experienced Cloud Computing experts who continuously explore evolving Cloud technology, develop deep skills through hands-on work in our Cloud Lab and by networking with allied major Cloud ecosystem vendors. Our internal training programmes and Cloud Computing Community of Practice enable rapid generation of Cloud Computing skills.
- *Proven Methods for Accelerated Delivery and Lowered Risk:* We perform structured delivery of services using accelerators tested in our Lab that capture our

expertise and best practices that combined with our global delivery model reduce your risks and time in transitioning to Cloud. Our integrated technology and operations (iTOPS) led delivery model ensures assured business outcomes.

- *Multi-vendor Approach for Best-of-Breed Technology-based Solution:* We take a multi-vendor approach to recommend a solution based on best-of-breed technologies most suited to your problem and environment.

Track Record for Client Success:

- Messaging and collaboration Proof-of-Concept, Private cloud on Microsoft Platforms for a global foods manufacturer serving 28000 restaurants worldwide
- Proof-of-Concept on AWS public cloud for HPC design automation with multiple tool compatibility for one of the global top three electronic design automation companies



- Migration of operations management and reporting system to Azure platform, SSO system for 1.6 million+ transient user population for one of the world's largest quick service restaurant chains
- Cloud-readiness assessment on six core applications for one of the largest North American power utilities company
- Consulting and migration to hybrid environment including private and public cloud platforms for a leading American real-estate owner-operator with over $1 billion revenues.

CLOUD SERVICE ARCHITECTURE

The new way of the world for most web software development is the assembly of applications from cloud-based APIs. Developers are saving loads of time by pulling in various cloud services and focusing their attention on the novel business logic of their solutions.

Hundreds of new APIs are sprouting up monthly, as tracked on ProgrammableWeb. And as the very existence of a web site dedicated to tracking APIs implies, application assembly has fundamentally changed software development. Yet as monumental as that is, it's the tip of the iceberg when it comes to realizing the potential of a cloud service-based architecture. Distributing the logic within an application across numerous centralized cloud services will enable more automated, intelligent applications. And the timing couldn't be better.

Interestingly, this separation is similar to how software defined networking (SDN) splits the components of a network into a "control" plane and "data" plane to enable more automated, intelligent networks. Just as an SDN controller can analyse data from the various nodes in a network and automatically change the behaviour of a network to improve performance or security, a cloud service can analyse data across all the applications it powers and make changes to the applications to improve their behaviour or performance. In fact, a deeper look at SDN offers important clues about the benefits a decoupled architecture can provide for cloud applications. The control plane in SDN contains the intelligence responsible for defining the behaviour of the network (the "rules") while the data plane moves packets within the network according to these rules (the "processing"). Separating the "rules" of how network packets should be processed from the actual processing allows the feedback loop of measure, analyse, and modify that is critical for enabling automated, intelligent networks.

Cloud application architecture does bear some resemblance to SDN, where a centralized intelligent element (a cloud service) often plays the role of analysing data from across numerous end nodes (in this case application instances) and modifying the behaviour of those end nodes. Most startups haven't exploited this because they have been able to deliver so much value to customers by simply offering a service or application with a modern web-based delivery model. That in and of itself adds enough of a value proposition to get off the ground.

However, as they mature, more and more of these companies will deploy intelligence and automation in their service. This will enable them to use the SDN qualities of their architecture to analyse data from all the applications powered by these services and then modify the application to improve performance or change the behaviour of these applications.

One area already leveraging the intelligence enabled by a disaggregated architecture to provide a leap forward in value delivered to customers is security, where large-scale correlation analyses, machine learning, and other big-data techniques are utilized to determine if a threat is present. If a threat is detected, the data is shared across the network, alerting people of the threat. This is an intelligent cloud service at its best.

When I meet with startups offering cloud-based services, the discussion often leads to the tremendous value of the data they are gathering from all the applications that implement their service. But in order to benefit from this data, machine learning heuristics and other advanced analysis techniques will need to be applied so that action can be taken in real time to modify these applications. Centralized, intelligent cloud services will improve the functionality or performance of applications automatically based on the data they are seeing — not unlike Amazon making recommendations for you based on past purchases or ad-tech companies optimize retargeting. While a majority of cloud services startups today are creating a lot of value

simply by delivering their service as an easy-to-use API, intelligence and automation is where the next large opportunity lies.

CUSTOMER RELATIONSHIP MANAGEMENT

INTRODUCTION

The better a business can manage the relationships it has with its customers the more successful it will become. Therefore IT systems that specifically address the problems of dealing with customers on a day-to-day basis are growing in popularity.

Customer relationship management (CRM) is not just the application of technology, but is a strategy to learn more about customers' needs and behaviours in order to develop stronger relationships with them. As such, it is more of a business philosophy than a technical solution to assist in dealing with customers effectively and efficiently. Nevertheless, successful CRM relies on the use of technology. This guide will outline the business benefits and the potential drawbacks of implementing CRM. It will also offer help on the types of solution you could choose and how to implement them.

WHY CRM?

In the commercial world the importance of retaining existing customers and expanding business is paramount. The costs associated with finding new customers mean that every existing customer could be important.

The more opportunities that a customer has to conduct business with your company the better, and one way of achieving this is by opening up channels such as direct sales, online sales, franchises, use of agents, etc. However, the more channels you have, the greater the need to manage your interaction with your customer base. Customer relationship management (CRM) helps businesses to gain an insight into the behaviour of their customers and modify their business operations to ensure that customers are served in the best possible way. In essence, CRM helps a business to recognise the value of its customers and to capitalise on improved customer relations. The better you understand your customers, the more responsive you can be to their needs.

CRM can be Achieved by:

- finding out about your customers' purchasing habits, opinions and preferences
- profiling individuals and groups to market more effectively and increase sales
- changing the way you operate to improve customer service and marketing

Benefiting from CRM is not just a question of buying the right software. You must also adapt your business to the needs of your customers.

BUSINESS BENEFITS OF CRM

Implementing a customer relationship management (CRM) solution might involve considerable time and expense.

However, there are many potential benefits. A major benefit can be the development of better relations with your existing customers, which can lead to:

- increased sales through better timing by anticipating needs based on historic trends
- identifying needs more effectively by understanding specific customer requirements
- cross-selling of other products by highlighting and suggesting alternatives or enhancements
- identifying which of your customers are profitable and which are not

This can lead to better marketing of your products or services by focusing on:

- effective targeted marketing communications aimed specifically at customer needs
- a more personal approach and the development of new or improved products and services in order to win more business in the future.

Ultimately this could lead to:

- enhanced customer satisfaction and retention, ensuring that your good reputation in the marketplace continues to grow
- increased value from your existing customers and reduced costs associated with supporting and servicing them, increasing your overall efficiency and reducing total cost of sales
- improved profitability by focusing on the most profitable customers and dealing with the unprofitable in more cost effective ways.

Once your business starts to look after its existing customers effectively, efforts can be concentrated on finding new customers and expanding your market. The more you know about your customers, the easier it is to identify new prospects and increase your customer base. Even with years of accumulated knowledge, there's always room for improvement. Customer needs change over time, and technology can make it easier to find out more about customers and ensure that everyone in an organisation can exploit this information.

TYPES OF CRM SOLUTION

Customer relationship management (CRM) is important in running a successful business. The better the relationship, the easier it is to conduct business and generate revenue. Therefore using technology to improve CRM makes good business sense. CRM solutions fall into the following four broad categories.

OUTSOURCED SOLUTIONS

Application service providers can provide web-based CRM solutions for your business. This approach is ideal if you need to implement a solution quickly and your company does not have the in-house skills necessary to tackle the job from scratch. It is also a good solution if you are already geared towards online e-commerce.

OFF-THE-SHELF SOLUTIONS

Several software companies offer CRM applications that integrate with existing packages. Cut-down versions of such

software may be suitable for smaller businesses. This approach is generally the cheapest option as you are investing in standard software components. The downside is that the software may not always do precisely what you want and you may have to trade off functionality for convenience and price. The key to success is to be flexible without compromising too much.

BESPOKE SOFTWARE

For the ultimate in tailored CRM solutions, consultants and software engineers will customise or create a CRM system and integrate it with your existing software. However, this can be expensive and time consuming. If you choose this option, make sure you carefully specify exactly what you want. This will usually be the most expensive option and costs will vary depending on what your software designer quotes.

MANAGED SOLUTIONS

A half-way house between bespoke and outsourced solutions, this involves renting a customised suite of CRM applications as a bespoke package. This can be cost effective but it may mean that you have to compromise in terms of functionality.

HOW TO IMPLEMENT CRM

The implementation of a customer relationship management (CRM) solution is best treated as a six-stage process, moving from collecting information about your

customers and processing it to using that information to improve your marketing and the customer experience.

STAGE 1-COLLECTING INFORMATION

The priority should be to capture the information you need to identify your customers and categorise their behaviour. Those businesses with a website and online customer service have an advantage as customers can enter and maintain their own details when they buy.

STAGE 2-STORING INFORMATION

The most effective way to store and manage your customer information is in a relational database-a centralised customer database that will allow you to run all your systems from the same source, ensuring that everyone uses up-to-date information.

STAGE 3-ACCESSING INFORMATION

With information collected and stored centrally, the next stage is to make this information available to staff in the most useful format.

STAGE 4-ANALYSING CUSTOMER BEHAVIOUR

Using data mining tools in spreadsheet programs, which analyse data to identify patterns or relationships, you can begin to profile customers and develop sales strategies.

STAGE 5-MARKETING MORE EFFECTIVELY

Many businesses find that a small percentage of their customers generate a high percentage of their profits. Using

CRM to gain a better understanding of your customers' needs, desires and self-perception, you can reward and target your most valuable customers.

STAGE 6-ENHANCING THE CUSTOMER EXPERIENCE

Just as a small group of customers are the most profitable, a small number of complaining customers often take up a disproportionate amount of staff time. If their problems can be identified and resolved quickly, your staff will have more time

POTENTIAL DRAWBACKS OF CRM

There are several reasons why implementing a customer relationship management (CRM) solution might not have the desired results. There could be a lack of commitment from people within the company to the implementation of a CRM solution. Adapting to a customer-focused approach may require a cultural change. There is a danger that relationships with customers will break down somewhere along the line, unless everyone in the business is committed to viewing their operations from the customers' perspective. The result is customer dissatisfaction and eventual loss of revenue.

Poor communication can prevent buy-in. In order to make CRM work, all the relevant people in your business must know what information you need and how to use it.

Weak leadership could cause problems for any CRM implementation plan. The onus is on management to lead

by example and push for a customer focus on every project. If a proposed plan isn't right for your customers, don't do it. Send your teams back to the drawing board to come up with a solution that will work.

Trying to implement CRM as a complete solution in one go is a tempting but risky strategy. It is better to break your CRM project down into manageable pieces by setting up pilot programs and short-term milestones. Consider starting with a pilot project that incorporates all the necessary departments and groups but is small and flexible enough to allow adjustments along the way.

Don't underestimate how much data you will require, and make sure that you can expand your systems if necessary. You need to carefully consider what data is collected and stored to ensure that only useful data is kept.

You must also ensure you comply with the eight principles of the Data Protection Act that govern the processing of information on living, identifiable individuals.

Avoid adopting rigid rules which cannot be changed. Rules should be flexible to allow the needs of individual customers to be met.

QUESTIONS FOR CRM SUPPLIERS

For many businesses customer relationship management (CRM) can be a large investment. Therefore it is vital to choose your supplier carefully. Making the wrong choice could be expensive and even jeopardise your business.

Before implementing a solution based on CRM technology, you might want to ask any potential suppliers the following questions:

- How long has the supplier been established?
- What are the specific costs associated with the product, ie a one-off purchase price, an annual renewable license, a charge per user etc?
- Does the supplier offer any form of evaluation software so that you can try before you buy?
- How much is charged for technical support?
- Does the supplier provide consultancy and, if so, at what rates?
- Is the system scalable? If your customer base grows will the system expand to cope?
- Can the supplier recommend any third-party developers that make use of their core CRM products?
- Is there an active independent user group where experience and ideas can be freely exchanged?
- Can the supplier provide references for businesses in your industry sector that use their software?
- Does it offer training in the CRM solution and, if so, at what typical cost?

HERE'S HOW CRM SOFTWARE IMPROVED MY BUSINESS

Based in Runcorn, Cheshire, with 60 employees, Chance & Hunt specialises in supply chain management for the international chemical industry.

Here managing director Joan Traynor describes the benefits that Customer Relationship Management (CRM) software has brought to the business.

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Cloud Computing Security

Cloud computing changes personal and enterprise computing models in a way that makes information security as relevant as it is for online banking services. Though cloud computing has been applied to network security, it remains to be seen whether its architecture is an information trap that is ripe for misuse or exploitation. To provide secure services, cloud computing must address this issue at the following three levels:

HOW DOES CLOUD SECURITY WORK?

In the current networking environment, client-based Trojan checks are increasingly discredited as a solution. To check malicious codes, security vendors need a cloud computing platform where an inbuilt cloud security system pre-scans web pages and immediately informs the user of a page's safety. The advantage of cloud security is its ability to

scan all web pages using large-scale computing capabilities. For end users, the web is only one danger source; others include e-mails and USBs, though the cloud security system does not apply to users who do not wish to publish their personal information.

However, the cloud security system has a fatal weakness– its over-reliance on transmission channels. User information and resources are handed over to the cloud for processing and transmission and security depends on the internal transmission channels. In order for cloud computing to unleash its potential, cloud service providers must work with broadband service providers to build a broadband transmission system appropriate for cloud services. A recommended solution involves the integration of the cloud security system into telecom networks so that the former scans web pages and the latter sends risk alerts.

IS THE CLOUD ITSELF SAFE?

The cloud must be open to provide service. Openness usually leads to vulnerability, though. So it is a problem how to protect the cloud against attacks and ensure that the cloud provides services continuously. The recent system crash at Amazon web services, the cloud service provider, caused Twitter and other prominent web sites to fail. If this type of crash causes loss of user data, users will doubt the security of cloud computing. Solutions may include backups and additional monitoring, both of which should provide vital areas for future research.

HOW DOES THE CLOUD ENSURE USER SECURITY?

In the cloud, the security level of user routines is not analysed, nor is data copied, in order to protect business secrets and personal data of users. Cloud services can be widely used only when they are reliable. However, unlike investigating a retailer before buying products from it, cloud service users cannot check the reliability of a cloud because they do not know which part of the cloud is serving them. If users transmit encrypted data, the user routines will be inefficient.

The openness of a cloud may render it a malicious tool. Currently, harmful Internet activities require the control of the terminal. For example, phishing requires fake sites that look and feel almost identical to legitimate ones, and Trojans require network controllers. The cloud model opens up new possibilities for criminal and malicious behaviour.

ECONOMICS OF CLOUD COMPUTING

The rationale behind the cloud model and the idea behind resource provision is flexibility. For example, a user requires 10,000 computers as nodes to work at a full load for a couple of months but for the rest of the year requires only 5 per cent to 20 per cent of these nodes. Such a user can apply for 200 to 1,000 nodes for normal operation and 10,000 nodes in the peak period.

To ensure security, some existing cloud systems provide exclusive private resources for users at certain costs that basically equal those required to own these resources. This

solution obviously goes against the economics of cloud computing, making it unnecessary for users to apply for resources in the cloud. It remains a subject of debate and research whether this is in fact a cloud model.

CLOUD MANAGEMENT TOOLS GUIDE FOR BEGINNERS

Cloud management is a hot topic, so hot that every startup and established vendor has some form of tool for managing cloud computing environments. There are tools that monitor, tools that provision, and tools that cross the divide between both. Then there's just vaporware, and sorting through that can be a challenge.

If your cloud deployment is fairly static or not mission-critical, then you may not need a dynamic provisioning system. In that case, the standard tools for resource adds/changes/removals included with the product may suffice. Several providers have products designed for cloud computing management (VMware, OpenQRM, CloudKick, and Managed Methods), along with the big players like BMC, HP, IBM Tivoli and CA. Each uses a variety of methods to warn of impending problems or send up the red flag when a sudden problem occurs. Each also tracks performance trends.

While they all have features that differentiate them from each other, they're also focused on one key concept: providing information about cloud computing systems. If your needs

run into provisioning, the choices become more distinct than choosing "agent vs. agentless" or "SNMP vs. WBEM."

The main cloud infrastructure management products offer similar core features:

- Most support different cloud types (often referred to as hybrid clouds).
- Most support the on-the-fly creation and provisioning of new objects and the destruction of unnecessary objects, like servers, storage, and/or apps.
- Most provide the usual suite of reports on status (uptime, response time, quota use, etc.) and have a dashboard that can be drilled into.

When it comes to meeting those three criteria, there are a few vendors that offer pervasive approaches in handling provisioning and managing metrics in hybrid environments: RightScale, Kaavo, Zeus, Scalr and Morph. There are also options offered by cloud vendors themselves that meet the second and third criteria, such as CloudWatch from Amazon Web Services.

The large companies known for their traditional data centre monitoring applications have been slow to hit the cloud market, and what products they do have are rehashes of existing applications that do little in the way of providing more than reporting and alerting tools. CA is on an acquisition spree to fix this and just acquired 3Tera, a cloud provisioning player.

An example of the confusion in the industry is IBM's Tivoli product page for cloud computing. You'll notice that clicking

the Getting Started tab results in a 404 error. Nice work, IBM. Meanwhile, HP's OpenView (now called Operations Manager) can manage cloud-based servers, but only insofar as it can manage any other server. BMC is working on a cloud management tool, but doesn't have anything beyond its normal products out at the moment. In place of these behemoths, secondary players making splashes on the market are offering monitoring-focused applications from companies like Scout, UpTime Systems, Cloudkick, NetIQ and ScienceLogic. There is also the "app formerly known as" Hyperic, now owned by VMware through the acquisition of SpringSource. In truth, we could rival John Steinbeck and Robert Jordan in word count when it comes to writing about all the products in this field, though within a year or two it should be a much smaller space as acquisitions occur, companies fail and the market sorts itself out. There's a lot on the way in cloud computing, not the least of which is specifications. Right now the cloud is the Wild West: vast, underpopulated, and lacking order except for a few spots of light.

These are the best infrastructure management and provisioning options available today:

RIGHTSCALE

RightScale is the big boy on the block right now. Like many vendors in the nascent market, they offer a free edition with limitations on features and capacity, designed to introduce you to the product (and maybe get you hooked, ala K.C. Gillette's famous business model at the turn of the 20th century).

RightScale's product is broken down into four components:

1. Cloud Management Environment
2. Cloud-Ready ServerTemplate and Best Practice Deployment Library
3. Adaptable Automation Engine
4. Multi-Cloud Engine

A fifth feature states that the "Readily Extensible Platform supports programmatic access to the functionality of the RightScale Platform." In looking at the product, these features aren't really separate from one another, but make a nice, integrated offering.

RightScale's management environment is the main interface users will have with the software. It is designed to walk a user through the initial process of migrating to the cloud using their templates and library. The management environment is then used for (surprise!) managing that environment, namely continuing builds and ensuring resource availability. This is where the automation engine comes into play: being able to quickly provision and put into operation additional capacity, or remove that excess capacity, as needed. Lastly, there is the Multi-Cloud Engine, supporting Amazon, GoGrid, Eucalyptus and Rackspace. RightScale is also working on supporting the Chef open-source systems integration specifications, as well. Chef is designed from the ground up for the cloud.

KAAVO

Kaavo plays in a very similar space to RightScale.

The product is typically used for:

- Single-click deployment of complex multi-tier applications in the cloud (Dev, QA, Prod)
- Handling demand bursts/variations by automatically adding/removing resources
- Run-time management of application infrastructure in the cloud
- Encryption of persisted data in the cloud
- Automation of workflows to handle run-time production exceptions without human intervention

The core of Kaavo's product is called IMOD. IMOD handles configuration, provisioning and changes (adjustments in their terminology) to the cloud environment, and across multiple vendors in a hybrid model. Like all major CIM players, Kaavo's IMOD sits at the "top" of the stack, managing the infrastructure and application layers. One great feature in IMOD is its multi-cloud, single system tool. For instance, you can create a database backend in Rackspace while putting your presentation servers on Amazon. Supporting Amazon and Rackspace in the public space and Eucalyptus in the private space is a strong selling point, though it should be noted that most cloud management can support Eucalyptus if it can also support Amazon, as Eucalyptus mimics Amazon EC2 very closely.

Both Kaavo and RightScale offer scheduled "ramp-ups" or "ramp-downs" (dynamic allocation based on demand) and monitoring tools to ensure that information and internal metrics (like SLAs) are transparently available. The dynamic allocation even helps meet the demands of those SLAs. Both

offer the ability to keep templates as well to ease the deployment of multi-tier systems.

ZEUS

Zeus was famous for its rock-solid Web server, one that didn't have a lot of market share but *did* have a lot of fanatical fans and top-tier customers. With Apache, and to a lesser-extent, IIS, dominating that market, not to mention the glut of load balancers out there, Zeus took its expertise in the application server space and came up with the Application Delivery Controller piece of the Zeus Traffic Controller. It uses traditional load balancing tools to test availability and then spontaneously generate or destroy additional instances in the cloud, providing on-the-fly provisioning. Zeus currently supports this on the Rackspace and, to a lesser extent, Amazon platforms.

SCALR

Scalr is a young project hosted on Google Code and Scalr.net that creates dynamic clusters, similar to Kaavo and RightScale, on the Amazon platform. It supports triggered upsizing and downsizing based on traffic demands, snapshots (which can be shared, incidentally, a very cool feature), and the custom building of images for each server or server-type, also similar to RightScale. Being a new release, Scalr does not support the wide number of platforms, operating systems, applications, and databases that the largest competitors do, sticking to the traditional expanded-LAMP architecture (LAMP plus Ruby, Tomcat, etc.) that comprises many content systems.

MORPH

While not a true management platform, the MSP-minded Morph products offers similar functionality in its own private space. Morph CloudServer is a newer product on the market, filling the management and provisioning space as an appliance. It is aimed at the enterprise seeking to deploy a private cloud. Its top-tier product, the Morph CloudServer is based on the IBM BladeCenter, and supports hundreds of virtual machines.

Under the core is an Ubuntu Linux operating system and the Eucalyptus cloud computing platform. Aimed at the managed service provider market, Morph allows for the creation of private clouds and the dynamic provisioning within those closed clouds. While still up-and-coming, Morph has made quite a splash and bears watching, particularly because of its open-source roots and participation in open-cloud organizations.

CLOUDWATCH

Amazon's CloudWatch works on Amazon's platform only, which limits its overall usefulness as it cannot be a hybrid cloud management tool. Since Amazon's Elastic Compute Cloud (EC2) is the biggest platform out there (though Rackspace claims it is closing that gap quickly), it still bears mentioning. CloudWatch for EC2 supports dynamic provisioning (called auto-scaling), monitoring, and load-balancing, all managed through a central management console — the same central management console used by Amazon Web Services. Its biggest advantage is that it requires no additional software to install and no additional web site

to access applications through. While the product is clearly not for enterprises that need hybrid support, those that exclusively use Amazon should know that it is as robust and functional as the other market players.

INFORMATION SECURITY AND COMPLIANCE

There is ongoing legal research and argument that data protection law is outdated and is currently not a good fit with cloud computing. In particular, it is argued that unreasonable demands are being placed on data controllers wishing to transfer data overseas. Furthermore, due to the nature of the cloud and the amount of control the cloud provider may exert over the data and its movement, there is a view that a cloud provider is also the data controller (and that therefore an institution is effectively passing its data to a third party). However, despite the legal debate, the current position in UK law is that an institution will usually be considered the data controller with regard to its personal data being processed using cloud computing facilities. As such, your institution will need to comply with the Data Protection Act 1998.

The Data Protection Act 1998 (DPA) applies to the 'processing' of personal data. The definition of processing is broad and will include transfer, storage, alteration, and deletion *i.e.* it covers all interaction with the data. The DPA applies to personal data only. This is defined as data relating to a living individual from which you can identify the

individual or which, if combined with other data, may identify the individual. In using a cloud service, an institution will usually be the data controller responsible for compliance with the DPA when processing personal data and the cloud provider will be the data processor. The cloud provider as data processor should act in accordance with the agreed terms under the contract with your institution in order to ensure compliance with the DPA.

Institutions will also have other confidential data which is not personal data, for example, sensitive financial planning data which it will consider as confidential or highly sensitive and requiring adequate protection from unauthorised access or release. This will be discussed in more detail under confidentiality below.

Whether outsourcing data processing to a processor (*i.e.* the cloud provider) or processing the information within the institution, a data controller has eight data protection principles to adhere to in order to comply with the DPA. The principles are intended to provide a technology-neutral framework for balancing an organisation's need to make the best use of personal data, while safeguarding that information and respecting individuals' private lives.

The eight data protection principles state that personal data must be:

- Fairly and lawfully processed.
- Processed for limited, stated purposes.
- Adequate, relevant and not excessive.

- Accurate and up-to-date.
- Kept no longer than necessary.
- Processed in accordance with the individual's rights.
- Secure.
- Not transferred to a country outside the European Economic Area unless that country has adequate data protection itself.

There are also additional conditions to meet to ensure compliance and these depend on whether the data is personal data or sensitive personal data. As stated above, 'Personal data' is any information, including photographs or other images, about an identifiable living individual regardless of the format of information. The overriding test is whether the information in question on its own or when combined with other information, is significant biographical information that would identify the individual. 'Sensitive personal data' includes information regarding an individual's race or ethnic origin, and physical or mental health.

SECURITY OF PERSONAL DATA

An institution as data controller has an obligation to ensure that the cloud provider has adequate measures in place to protect personal data securely against unauthorised or unlawful processing, and against accidental loss, destruction, and damage. There is no set definition of what would constitute 'adequate security' and the Information Commissioner's Office (ICO), which is responsible for enforcing compliance with the DPA, suggests a risk based

approach. When choosing a cloud provider, your institution should enquire as to how that provider handles personal data. It should also investigate assurances offered, responses to breaches, reactions to UK DPA requirements, and use of security measures such as encryption. It is important to ascertain which other third parties have access to the data, for example, those to whom elements of the cloud service provided is subcontracted *e.g.* an IAAS or PAAS.

Your institution will need to consider whether the security level offered meets both the institution's requirements and that of the DPA. It will also need to ensure that the terms of the contract with the cloud provider reflect these requirements.

TRANSFER OF INFORMATION TO A COUNTRY OUTSIDE THE EEA

The DPA states that personal data is not to be transferred outside the EEA (European Economic Area) unless there is an adequate level of protection for the data subjects regarding the processing of personal data.

Cloud providers intrinsically store and move data around multiple servers potentially situated in a number of jurisdictions which may very likely be outside the EEA. This activity will breach the DPA unless these jurisdictions have adequate security measures in place.

Compliance may be achieved through using EU approved contract terms with your cloud provider, or a cloud provider in the US who has signed up to the Safe Harbour provisions,

or by getting informed consent from the data subjects to transfer it to an 'unsafe' location (which is not a recommended solution).

JURISDICTION

Broadly speaking, a UK court can only rule on a dispute if it has jurisdiction and similarly, law enforcement agencies such as the police may only operate where they have agreement or jurisdiction. To complicate matters, there are a number of international agreements relating to jurisdiction. Varying rules as to which jurisdiction applies have been agreed upon depending on the area of law and nature of the dispute. In addition, there may be layering of provision, for example, a cloud provider may outsource some of his service provision *e.g.* data storage or infrastructure. This will make it more difficult to ascertain where the information is at any given time. Also, local laws may apply which permit wider access than you anticipated. A well publicised example of this is the US Patriot Act. The Patriot Act is intended to assist terrorism prevention in the US and permits access to data by the US Federal Government in certain circumstances, mainly in the interest of national security. The assumption is that in using a cloud provider, data will be moved. However, without knowing the jurisdiction to which it is moved, it will be difficult to assess the jurisdiction and its suitability. If this issue is not discussed and agreed at the outset, the result may be protracted disputes. There are examples of such disputes involving Google and Yahoo. Law enforcement agencies may also experience difficulty in (a) tracking down

information and (b) finding information in jurisdictions where they have no authority.

CONFIDENTIALITY

The flow and movement integral to cloud computing may make it difficult to locate the data at any given time and difficult to ascertain whether it is in a secure location. It may often be difficult to assess which third parties have access or access capability to the data as this may change with new or additional providers, services and server locations. Information handled in a cloud environment, although not personal data, may be confidential in nature. An example would be an institution's dealings with a commercial research collaborator (*e.g.* a pharmaceutical company), where your institution may be subject to contract confidentiality clauses which constitute a legal obligation of confidence. If confidentiality of information is crucial, then risk decisions will need to be made as to its security. Although it might be implied that the cloud provider will maintain confidentiality, it may be desirable to state clearly in the contract terms what obligations of confidentiality are owed between the parties.

FREEDOM OF INFORMATION

Institutions in the UK, as public authorities, have a legal duty to comply with freedom of information (Freedom of Information Act 2000 and Freedom of Information (Scotland) Act 2002) and other related legislation such as the environmental regulations. If a request is made to an

institution for information and your institution holds the information, it is required to release it to the requester within 20 days, unless an exemption or an exception applies. It is likely that even although the information may be stored in the cloud, an institution will still be deemed to be holding it for the purpose of FOI. It is therefore necessary to ensure that access to information is timely - outage, failure, and back-up details should be assessed when choosing your cloud provider.

INTELLECTUAL PROPERTY RIGHTS

Intellectual property rights (IPR) are, broadly, rights granted to creators and owners of works that are the result of human intellectual creativity. These works can be in the industrial, scientific, literary or artistic domains. The types of IPR considered here are copyright, the database right, and patents.

Essentially, copyright protects original works, including films or broadcasts, and the typographical layout of published editions. This will include works such as teaching and research materials and blogs. Software (computer programmes) and databases may be protected as literary works, in addition to other possible rights such as database right.

A college or university will usually be the owner of copyright works created by its staff, unless there is an agreement otherwise. A copyright owner has the right to control the copying, adaptation, publishing, performance and

broadcast of the work, and under what conditions this may be done. In addition to creating materials to which copyright will apply, staff and students of colleges and universities are likely to use work that belongs to others extensively. Compliance with copyright law remains necessary in migration to the cloud.

In addition to any copyright protection, a database may be protected by the database right. The database right applies in the EU and is intended to protect and reward investment in the creation and arrangement of databases.

A patent protects the features and processes that make things work, allowing inventors to profit from their inventions. It gives the patent owner the right to prevent others from making, using, importing or selling the invention without permission.

Using a cloud provider for IT service provision raises particular IPR issues for institutions to consider prior to agreeing the terms of their cloud computing provision.

Two main issues arise:

1. The cloud provider (*i.e.* a third party) may have access to data belonging to an institution
2. The location of the data is not fixed

This has implications for an institution's IPR compliance.

LICENCE RESTRICTIONS

Software licences may be location specific and these will require review to ensure continued compliance when

considering a cloud infrastructure service. An institution will have contractually agreed with publishers via current educational resource licences (*e.g.* Copyright Licensing Agency Limited (CLA) licence) to safeguard resources.

The licence agreement, for example, may state that only authorised persons *e.g.* staff and students may view the digital resource or storage of digital material may be restricted under the licence to local servers. There is a possibility of third party (*i.e.* cloud provider and their sub-contractors) access and the cloud is intrinsically not location specific. Contractual agreements with your resource suppliers, on access and location, need to be reflected in your contract with your cloud provider via warranties. The cloud provider should provide assurances that best efforts will be made to prevent access by unlicensed users and to prevent any unauthorised usage of the licensed resources.

CREATION OF CONTENT IN THE CLOUD

Where content is created in the cloud then whilst it may usually be possible to identify the creator and therefore the first copyright owner, it may be more difficult to identify where the material was created. This will not affect copyright protection *per se*, but may affect whether correct formalities have been followed in a particular jurisdiction, which in turn may affect ability to take court action if necessary.

DATABASE RIGHT

If a database is recorded on a server in an EU member state then it is clear that a valid database right may apply,

provided of course that the database meets the criteria outlined above for protection. However, research has raised the question of whether it is where the database is made or where it is recorded that is key and whether these are different places according to the legislation. This may potentially affect whether database right applies or not as there is no database right, for example, in the US. As there is no court decision on the interpretation, some uncertainty exists as to whether a database recorded on a non EU server will be protected by the database right. It is important to ensure that no residual database rights should be created for the cloud provider.

4

Important Cloud Computing for Business Users

Like any new IT trend, Cloud Computing gets its fair share of hype, and with it comes a multitude of vendors that use the terms in ways it was never intended for, therefore making it devoid of any sense. When pushed to the extreme, a simple server connected to a network seems to qualify as a cloud, thereby allowing pundits such as Larry Ellison to deride the concept to no end.

Yet Cloud Computing is much more than a passing fad. It is a major step forward in the development of distributed computing, and one that will reshape the IT industry for years to come. But for it to happen, we must agree on a clear definition of the concept, and the less technical it is, the better. Let us introduce one that focuses exclusively on the business benefits of cloud computing.

Defines cloud computing in the following fashion:

- "Cloud computing is the provision of dynamically scalable and often virtualised resources as a service over the Internet. Users need not have knowledge of, expertise in, or control over the technology infrastructure in the "cloud" that supports them. Cloud computing services often provide common business applications online that are accessed from a web browser, while the software and data are stored on the servers."

UTILITY PRICING OF CLOUD COMPUTING

Cloud Computing is first a foremost defined by its utility-based pricing model. Users of the platform consume computing and storage services on demand and pay for them as they go, using an Operating Expenses (OPEX) budget, instead of paying for infrastructure resources up-front using Capital Expenditures (CAPEX).

For example, a Director of Sales can create CRM accounts for 10 of her sales people on Salesforce.com by using her corporate credit card, without having to ask the CFO for a budget, and without having the IT Department initiate a requisition process for a new server.

ELASTIC RESOURCE CAPACITY

Cloud Computing differs from more traditional forms of distributed computing in the way it scales computing and storage resources up and down. Instead of tapping from a fixed set of resources, users can add or remove capacity at

will, almost instantaneously, and only pay for what they actually use. While utility pricing let users pay as they go, elastic resource capacity let them pay as they grow (or shrink). Following our previous example, the Director of Sales can add 5 more accounts for the sales people that were recently added to her team following the merger with another company, without having to worry about adding new servers or buying more hard drives.

VIRTUALIZED CAPITAL

Cloud Computing would not be possible without virtualization, not for arcane technical reasons, but for one obvious business requirement: the need for multi-tenancy. In order to benefit from economies of scale, cloud computing is predicated upon the sharing of a common infrastructure by multiple groups of users, often referred to as tenants. And multi-tenancy can only be achieved through some kind of virtualization, either at the database level (Salesforce.com), application server level (Google AppEngine), kernel level (Red Hat), or CPU level (Amazon EC2). Unlike grid computing, which often pooled and aggregated distributed computing resources for the purpose of handling very large computing jobs that could not fit or would take took long to complete on a single server, Cloud Computing creates virtual slices of resources from clusters of servers and storage devices, perfectly sized to fit the specific needs of multiple users. Such virtual resources can be small or large, and scale elastically as user needs evolve over time. In our previous example, virtualization means that the CRM application used by our

sales team is served by an infrastructure also used by over 60,000 other tenants, all securely isolated from each other (hopefully).

ORGANIZATION AUTOMATION

Cloud Computing platforms differ from traditional corporate data-centres in one major way: standardization. While your typical data-centre will usually host every versions of every operating systems and databases known to mankind, thereby creating massive management overhead, most Cloud Computing platforms usually standardize on a single kind of CPU (x86-based predominantly), a single hypervisor (VMware, Xen, etc.), a single operating system (some Linux distribution usually), and a single database (MySQL rules). This standardization has an obvious business benefit: dramatic reduction of operating costs through aggressive management automation. Following our previous example, the sales team's CRM application is served by one of 16 instances, each made of a few dozens servers. Altogether, this infrastructure might require anywhere from 100 to 200 full-time resources to manage. As a point of comparison, if each of Salesforce.com's 60,000 customers were to require a dedicated infrastructure, it would take several thousands full-time resources to manage it all.

SELF-SERVICE PROVISIONING

Cloud Computing and Software as a Service is often compared to the Application Service Provider (ASP) model that became popular for a brief period of time ten years ago.

One element makes them fundamentally different from each other though: self-service provisioning. With the ASP model, dedicated servers had to be provisioned for each customers, which meant that technical resources had to be involved every time a new customer would be signed. Hefty setup fees would be added to the bill, and the service would become operational within a few days at best. With Cloud Computing, business end users like our Director of Sales can provision applications and user accounts in a few mouse clicks, and these become available instantly.

THIRD-PARTY OWNERSHIP

Cloud Computing is also a new form of outsourcing. Customers trying to focus the allocation of scarce capital resources to their core businesses soon realize the benefits of moving IT infrastructure off their balance sheet. Furthermore, as technology evolves and leading service providers roll-out ever larger data-centres, the acquisition and operation of state-of-the-art data-centre facilities makes less and less sense from an economic standpoint for most organizations.

Cloud Computing is all about the transfer of ownership for such resources to a third-party that specializes in their deployment. According to our previous example, the company using the CRM application provided by Salesforce.com does not own any infrastructure beyond a few laptop computers. Everything else, from data-centres to servers and storage systems is owned by Salesforce.com, Inc.

MANAGED OPERATIONS

Cloud Computing is finally about allocating human resources to tasks that will directly impact the business, rather than simply managing the infrastructure that supports it. As such, Cloud Computing advocates a model according to which the IT infrastructure is not only owned by a third-party, but managed by the third-party as well. Software upgrades, data backups, and the countless other tasks required to manage mission-critical business applications on a day to day basis become the responsibility of a third-party, according to well-defined Service Level Agreements. Following our example, the Director of Sales discovered this morning the snowman adorned logo for the Winter 2010 version of Salesforce.com, without having taken any part in the software upgrade process that took place over the week-end. In the cloud, ignorance is bliss.

CLOUD COMPUTING IS A SERVICE

The simplest thing that a computer does is allow us to store and retrieve information. We can store our family photographs, our favourite songs, or even save movies on it. This is also the most basic service offered by cloud computing. Flickr is a great example of cloud computing as a service. While Flickr started with an emphasis on sharing photos and images, it has emerged as a great place to store those images. In many ways, it is superior to storing the images on your computer. First, Flickr allows you to easily access your images no matter where you are or what type of device you

are using. While you might upload the photos of your vacation to Greece from your home computer, you can easily access them from your laptop while on the road or even from your iPhone while sitting in your local coffee house.

Second, Flickr lets you share the images. There's no need to burn them to a compact disc or save them on a flash drive. You can just send someone your Flickr address. Third, Flickr provides data security. If you keep your photos on your local computer, what happens if your hard drive crashes? You'd better hope you backed them up to a CD or a flash drive! By uploading the images to Flickr, you are providing yourself with data security by creating a backup on the web. And while it is always best to keep a local copy — either on your computer, a compact disc or a flash drive — the truth is that you are far more likely to lose the images you store locally than Flickr is of losing your images. This is also where grid computing comes into play. Beyond just being used as a place to store and share information, cloud computing can be used to manipulate information. For example, instead of using a local database, businesses could rent CPU time on a web-based database.

The downside? It is not all clear skies and violin music. The major drawback to using cloud computing as a service is that it requires an Internet connection. So, while there are many benefits, you'll lose them off if you are cut off from the Web.

CLOUD COMPUTING IS A PLATFORM

The web is the operating system of the future. While not exactly true — we'll always need a local operating system — this popular saying really means that the web is the next

great platform. What's a platform? It is the basic structure on which applications stand. In other words, it is what runs our apps. Windows is a platform. The Mac OS is a platform. But a platform doesn't have to be an operating system. Java is a platform even though it is not an operating system.

Through cloud computing, the web is becoming a platform. With trends such as Office 2.0, we are seeing more and more applications that were once the province of desktop computers being converted into web applications. Word processors like Buzzword and office suites likeGoogle Docs are slowly becoming as functional as their desktop counterparts and could easily replace software such as Microsoft Office in many homes or small offices. But cloud computing transcends Office 2.0 to deliver applications of all shapes and sizes from web mashups to Facebook applications to web-based massively multiplayer online role-playing games. With new technologies that help web applications store some information locally — which allows an online word processor to be used offline as well — and a new browser called Chrome to push the envelope, Google is a major player in turning cloud computing into a platform.

CLOUD COMPUTING AND INTEROPERABILITY

A major barrier to cloud computing is the interoperability of applications. While it is possible to insert an Adobe Acrobat file into a Microsoft Word document, things get a little bit stickier when we talk about web-based applications.

This is where some of the most attractive elements to cloud computing — storing the information on the web and allowing the web to do most of the 'computing' — becomes a

barrier to getting things done. While we might one day be able to insert our Google Docs word processor document into our Google Docs spreadsheet, things are a little stickier when it comes to inserting a Buzzword document into our Google Docs spreadsheet.

Ignoring for a moment that Google probably doesn't want you to have the ability to insert a competitor's document into their spreadsheet, this creates a ton of data security issues. So not only would we need a standard for web 'documents' to become web 'objects' capable of being generically inserted into any other web document, we'll also need a system to maintain a certain level of security when it comes to this type of data sharing. Possible? Certainly, but it isn't anything that will happen overnight.

SOFTWARE SALES VS. NETWORK OUTSOURCING

The customer accord for Google Apps quoted in section 4.1 takes a familiar form: it gives a blanket warranty disclaimer and a blanket liability disclaimer, just like the shrink-wrapped licences with which software is sold on physical media. However, it is not clear that physical software sales give the best analogy for cloud computing. When software is sold on a physical medium the purchaser owns the software and only pays once to use it as many times as she wishes. An alternative analogy is the network outsourcing business, in which the network owner makes a regular payment to the outsourcer (often related to the amount of

services that are actually used) to manage the network. As in cloud computing, outsourced computations may be carried out on hardware that is owned and maintained by the service provider. Network outsourcing contracts can be a hundred pages long. They typically include a detailed service level agreement that may specify a percentage network uptime, data backup intervals, response times, an audit standard and a data security standard, which must be provided by the service provider, with penalties (usually in the form of credits for future services) if the specified service level is not met. Drafting, negotiating and disputing such contracts are lawyer-intensive activities. Jennifer Jones' advice for companies purchasing this type of service is "First, hire all the lawyers."

It is likely that in the future cloud computing will go both ways. There will be one market in which services are cheap or free and advertising-supported and in which the customer takes nearly all the risk. This is the typical model for cloud computing agreements at the moment. But there will also be a market for cloud computing in which the service provider takes more of the risk in return for more payment.

Service level agreements are already being offered for some cloud computing services, but they are at present rudimentary compared to those offered for network outsourcing. Amazon has had a service level agreement for its storage service Amazon S3 since October 2007, and for its computing service Amazon EC2 since October 2008. These promise 99.9 per cent availability measured over a month

for S3 and 99.95 per cent availability over a year for EC2 (excluding *force majeure* downtime) or a refund of 10 per cent-25 per cent of a customer's payment for the last billing period, paid in service credits. In order to receive the service credits customers have to document details of outages and make a claim to Amazon. The Amazon S3 service had outages lasting over an hour in February and July 2008. In contrast, some contracts for outsourced management of onsite networks specify 99.999 per cent network availability. However there are many applications for which the availability given by Amazon S3 and EC2 is perfectly adequate.

There is an intriguing clause in the Amazon Web Services customer agreement which forbids customers from disclosing, for three years after the end of the term of the agreement, "the nature, content and existence of any discussions or negotiations between you and us." It is not indicated what these negotiations might be about, but one possibility is that Amazon may be prepared to offer selected customers a more reliable service in return for higher fees.

Legal requirements for the handling of particular types of data (for example health data and financial data) are one of the forces creating a market for cloud services with more stringent service level requirements. Some laws and regulatory regimes place requirements for auditing or data security that may not be provided by current cloud services. Pharmaceutical companies and financial organisations have best-practice requirements that some kinds of data have to be stored on an identifiable server. It should not be impossible

to build a cloud storage service which can identify for the customer the precise server or servers on which their data is currently stored, although such a service might be less efficient.

Similarly, although UK companies storing personal data with some cloud computing services might find themselves in breach of the seventh principle of the *Data Protection Act 1998* if the standard subscription agreement for the services does not give sufficient (or indeed any) guarantees that the computers that the data will be stored on are appropriately secure, it is possible to create cloud services that meet industry security standards; for example, Google Apps has SAS70 Type II certification.

On the other hand, other legal requirements may present more difficult obstacles to the use of cloud computing for some applications. In particular, some licensing models for software and for copyright data fit poorly with cloud computing. Jimmy Lin of the University of Maryland gives an example of data whose license restrictions forbid it to be copied onto computers outside Maryland. Per-seat pricing for software can have the effect of disallowing use of the software in cloud computing.

5

Artificial Intelligence in Business

ARTIFICIAL INTELLIGENCE (AI)

Artificial intelligence (Al) encompasses a diverse number of computer applications, or components within applications, that use sets of rules and knowledge to make inferences. Unlike its roots as an esoteric discipline of trying to make computers emulate the human mind, modern Al—along with the technologies it has inspired—has many practical ramifications and delivers real benefits to users. In business applications, Al capabilities are often integrated with systems that serve the day-to-day needs of the enterprise, such as inventory tracking, manufacturing process controls, and customer service databases. Often, however, these newer, practical implementations of Al may not be labelled as such because of negative associations with the term.

WHAT IS ARTIFICIAL INTELLIGENCE?

Defining AI succinctly is difficult because it takes so many forms. One area of agreement is that artificial intelligence is a field of scientific inquiry, rather than an end product. AI is difficult to define with any precision partially because several different groups of researchers with drastically different motivations are working in the field. Perhaps the best definition is that coined by M.L. Minsky, "Artificial intelligence is the science of making machines do things that would require intelligence if done by men."

HISTORY OF ARTIFICIAL INTELLIGENCE

Charles Babbage (1792-1871), an English mathematician, is generally acknowledged to be the father of modern computing. Around 1823 he invented a working model of the world's first practical mechanical calculator. Then, he began work on his "analytical engine," which had the basic elements of a modern-day computer. Unfortunately, he was unable to raise the funds needed to build his machine. Nevertheless, his ideas lived on.

Herman Hollerith (1860-1929), an American inventor, actually created the first working calculating machine, which was used to tabulate the results of the 1890 U.S. census. There ensued a series of rapid improvements to machines which allegedly "thought." The first true electronic computer, the Electronic Numerical Integrator and Computer (ENIAC), was developed in 1946. The so-called "giant brain" replaced mechanical switches with glass vacuum tubes. ENIAC used 17,468 vacuum tubes and occupied 1,800 square feet—the

size of an average house. It weighed 30 tons. Scientists began at once to build smaller computers.

In 1959, scientists at Bell Laboratories invented the transistor, which marked the beginning of the second generation of computers. Transistors replaced vacuum tubes and sped up processing considerably. They also made possible a large increase in computer memory. Ten years later, International Business Machines Corp. (IBM) created third-generation computers when they replaced transistors with integrated circuits. A single integrated circuit could replace a large number of transistors in a silicon chip less than one-eighth of an inch square! More importantly, integrated circuits allowed manufacturers to dramatically reduce the size of computers. New software that made use of increased speed and memory complemented these third-generation computers—which themselves proved to be short lived.

Only two years after the appearance of integrated circuits, Intel Corp. introduced microprocessor chips. One chip contained a computer's central processing unit. Prior to that time, computers contained specialized chips for functions such as logic and programming. Intel's invention placed all of the computers' functions on one chip. Scientists continued to improve on computers.

Miniaturization of chips led to large-scale integrated circuitry (LSI) and very-large-scale integrated circuitry (VLSI). LSI and VLSI enabled software and printers to react faster with each other and with computers. They also contributed

to the invention of microcomputers, which revolutionized the role of computers in business. More importantly, LSI and VLSI heightened scientists' interest in the development of Al.

DEVELOPMENTS IN ARTIFICIAL INTELLIGENCE

AI is the construction and/or programming of computers to imitate human thought processes. Scientists are trying to design computers capable of processing natural languages and reasoning. They believe that once machines can process natural languages such as English or Spanish, humans will be able to give instructions and ask questions without learning special computer languages. When that day arrives, machines, like humans, will be able to learn from past experience and apply what they have learned to solve new problems. Scientists have a long way to go, but they have made what they believe is a giant step in that direction with the invention of "fuzzy logic."

FUZZY LOGIC

Since their inception, computers have always acted on a "yes" or "no" basis. They simply have not been able to recognize "maybe." Even the most sophisticated computers, capable of performing millions of calculations per second, cannot distinguish between "slightly" or "very." This simple difference has confused Al scientists for years. However, an American researcher, Dr. Lofti A. Zadeh, of the University of California, presented a possible answer, which he termed "fuzzy logic."

The concept is based on feeding the computer "fuzzy sets," or groupings of concrete information and relative concepts. For example, in a fuzzy set for industrial furnaces, a temperature of 1,000 degrees might have a "membership" (relative value) of 0.95, while a temperature of 600 might have a membership of 0.50. A computer program might then utilize instructions such as, "the higher the temperature, the lower the pressure must be." This solution means that programmers can teach machines to compute with words, instead of numbers.

Historically, most complex mathematical models developed by programmers compute strictly with numbers. However, the fuzzy logic approach to Al did not catch on in the American scientific community. It did, however, among the Japanese.

Japan-based Hitachi, Ltd. developed an artificial intelligence system based on fuzzy logic that allowed an automated subway system in Sendai, Japan, to brake more swiftly and smoothly than it could under human guidance. The Japanese Ministry of International Trade and Industry budgeted $36 million in 1990 to subsidize the initial operation of a Laboratory for International Fuzzy Engineering. Development of fuzzy engineering also took hold in China, Russia, and much of Western Europe. American scientists, however, pursued other aspects of Al. In the early 1990s, a University of North Carolina professor developed a microprocessor chip using an all-digital architecture, which would allow it to run in conventional computers. The chip

can handle 580,000 "if-then" decisions per second, which is more than 100 times faster than the best Japanese fuzzy-logic chip can operate. Many U.S. companies have been experimenting with this and similar chips. The Oak Ridge National Laboratory is using the chip in robots to be employed in radioactive areas of nuclear power plants. The Oricon Corporation has used fuzzy logic in a signal analysis system for submarines. NASA has also experimented with using fuzzy logic to help dock spacecraft.

EXPERT SYSTEMS

Other Al applications are also in use; one is the so-called expert system. Expert systems are computer-based systems that apply the substantial knowledge of a specialist—be it in medicine, law, insurance, or almost any field—to help solve complex problems without requiring a human to work through each one. In developing such systems, designers usually work with experts to determine the information and decision rules (heuristics) that the experts use when confronted with particular types of problems. In essence, these programs are simply attempting to imitate human behaviour, rather than solving problems by themselves.

There are several advantages to expert systems. For example, they give novices "instant expertise" in a particular area. They capture knowledge and expertise that might be lost if a human expert retires or dies. Moreover, the knowledge of multiple experts can be integrated, at least theoretically, to make the system's expertise more comprehensive than that of any individual. Expert systems are not subject to

human problems of illness or fatigue, and, if they are well designed, can be less prone to inconsistencies and mistakes. These benefits make them particularly attractive to businesses.

Companies also use expert systems for training and analysis. General Electric, for instance, developed a system called Delta that helps maintenance workers identify and correct malfunctions in locomotives. Digital Equipment Corporation uses XCON (derived from "expert configurer") to match customers' needs with the most appropriate combination of computer input, output, and memory devices. The system uses more than 3,000 decision rules and 5,000 product descriptions to analyze sales orders and design lay-outs, ensuring that the company's equipment will work when it arrives at customers' sites. XCON catches most configuration errors, and eliminates the need for completely assembling a computer system for testing and then breaking it down again for shipment to the customer. The system is expensive, however. DEC spends $2 million per year just to update XCON. In fact, cost is one of the most prohibitive factors involved in the development of Al systems. However, when such a system is implemented effectively, the money it saves in staff hours and costs from averted human errors can quickly recoup development costs. In large corporations the savings can accrue in the tens of millions of dollars per year.

A moderate-sized system, consisting of about 300 decision rules, generally costs between $250,000 and $500,000 to

design. That is a great deal of money to spend on creating systems that do little more than play chess—which was what some designers did back in the 1960s.

EXPERIMENTAL GAMES

Scientists in the 1960s developed machines that could play chess in an attempt to create machines that could think by themselves. They made tremendous strides in developing sophisticated decision trees that could map out possible moves, but those programs included so many potential alternatives that even contemporary supercomputers cannot assess them within a reasonable amount of time. They reduced the number of alternatives, which allowed the machines to play at the chess master level. To simulate the thinking process, the computers processed large amounts of data on alternative moves. Some of these experiments continue through the present. A highly publicized success in this area came in 1997 when an IBM supercomputer named Deep Blue beat world chess champion Garry Kasparov in a match.

NEURAL NETWORKS

Neural networks go one step further than expert systems in bringing stored knowledge to bear on practical problems. Instead of just leading the user to the appropriate piece of knowledge that has been captured in the system, neural networks process patterns of information to arrive at new abilities they weren't equipped with on day one. In a sense, they learn to do things for the user based on special

preparation that involves feeding the system data which it then analyses for patterns. This approach has proven highly effective in a number of fields, including finance, information technology management, and health care.

For instance, a neural network might be employed to predict which loan applicants are too risky. Rather than programming the computer with exact, user-defined criteria for what constitutes a risky applicant, the neural network would be trained on a large volume of application data from past loans— especially on details about the problematic ones. The neural network would process the data thoroughly and arrive at its own evaluation criteria. Then as new applications come in, the computer would use this knowledge to predict the risks involved. As time passes, the neural network could receive periodic (or even continuous) retraining on new data so that it continues to hone its accuracy based on current trends. Real-life systems such as this have enjoyed a high success rate and have been able to reduce the number of bad loans at the lending institutions that use them.

APPLICATIONS OF AL IN THE BUSINESS WORLD

Al is being used extensively in the business world, despite the fact that the discipline itself is still in the embryonic stages of development. Its applications cross a wide spectrum. For example, Al is being applied in management and administration, science, engineering, manufacturing, financial and legal areas, military and space endeavours, medicine, and diagnostics.

Some Al implementations include natural language processing, database retrieval, expert consulting systems, theorem proving, robotics, automatic programming, scheduling, and solving perceptual problems. Management is relying more and more on knowledge work systems, which are systems used to aid professionals such as architects, engineers, and medical technicians in the creation and dissemination of new knowledge and information. One such system is in use at Square D, an electrical component manufacturer. A computer does the design work for giant units of electrical equipment. The units generally share the same basic elements but vary in required size, specifications, and features. However, as is the case with most Al-type systems, human intervention is still required. An engineer is needed to check the computer-produced drawing before the equipment is put into production.

Senior managers in many companies use Al-based strategic planning systems to assist in functions like competitive analysis, technology deployment, and resource allocation. They also use programs to assist in equipment configuration design, product distribution, regulatory-compliance advisement, and personnel assessment. Al is contributing heavily to management's organization, planning, and controlling operations, and will continue to do so with more frequency as programs are refined.

AI is also influential in science and engineering. The applications developed were used to organize and manipulate the ever-increasing amounts of information available to

scientists and engineers. AI has been used in complex processes such as mass spectrometry analysis, biological classifications, and the creation of semiconductor circuits and automobile components. Al has been used with increasing frequency in diffraction and image analysis; power plant and space station design; and robot sensing, control, and programming. It is the increased use of robotics in business that is alarming many critics of artificial intelligence.

Robots are being utilized more frequently in the business world. In 1990, over 200,000 robots were in use in U.S. factories. Experts predict that by the year 2025 robots could potentially replace humans in almost all manufacturing jobs. This includes not only the mundane tasks, but also those requiring specialized skills. They will be performing jobs such as shearing sheep, scraping barnacles from the bottoms of ships, and sandblasting walls. However, there are jobs that robots will never be able to perform, such as surgery. Of course, there will still be a need for individuals to design, build, and maintain robots. Yet, once scientists develop robots that can think, as well as act, there may be less of a need for human intervention. Thus, the social ramifications of Al is of major concern to people today.

POTENTIAL BENEFITS OF ARTIFICIAL INTELLIGENCE APPLICATIONS

IMPROVE TRAINING

Train employees, customers, and partners faster and more reliably using simulated scenarios and automated

coaching, performance evaluation, and feedback. Increase the effectiveness of simulation-based training for safety, hazardous conditions, emergency response, and other critical situations (e.g., pilots, nuclear power plant operators, military personnel, and equipment operators.

IMPROVE PRODUCTS AND SERVICES

Enhance the competitiveness of your company's product or service by automating some of its functions or by making it easier to use.

LEVERAGE CORPORATE KNOWLEDGE

Make corporate expertise more widely available throughout your company to improve the quality of decisions. Save, retrieve, and build on corporate expertise that is often lost when employees leave or transfer within the company.

IMPROVE COLLABORATION

Help geographically-distributed employees, customers, and partners work together more effectively by providing intelligent, computer-assist supporting collaboration.

AUTOMATE UNPLEASANT TASKS

Automate boring, dangerous or unpleasant tasks, reducing the need for employees to work in these conditions.

COMPLEMENT YOUR EMPLOYEE'S REASONING SKILLS

Complement the reasoning abilities of humans (pattern recognition and association) with those of computers (data

retrieval, logical analysis). Business Intelligence through Hybrid Intelligent System Approach: Application to Retail Banking

Continuing business in today's competitive world is full of uncertainty and risk. Capturing new customers and retaining the existing ones is a challenge. To bring efficiency and cost advantage, organizations have to learn to manage not only the organizational resources intelligently but also precious expertise within the organization and learn from the experience. To bring efficiency and cost advantages, analytical tools help managers to model the problems, create various scenarios, perform sensitivity and what-if analysis, forecasting, etc. as a component of decision making process to manage and use resources well and optimally. Analytical methods are scientific techniques and tools to analyse the problems and find the solutions to the managerial decision problems. While analytical tools assist and support managers in making decisions, they don't assist in accumulating, reusing and managing precious expertise available in the organizations. Intelligent systems are best suited to do this. They facilitate to acquire, extract, preserve, use and apply the knowledge in the organization and thereby making it intelligent. These systems bring expertise and use the past experience of organization to deal with new problems. Facilitate to preserve the corporate knowledge (which a valuable asset of any organization) even after the decision maker leaves the organization.

The retail portfolio of banks has been growing at fast pace and volume is increasing. Consumers demand quick

and effective service. The manager has to manage between prompt service v/s better assessment of customer and minimization of risk. Getting best business out of the customer, the managers have to understand and analyse the customer-well, profile them and look for right cross-selling and up-selling opportunities. Along with increase in retail customers, there is increase in number of transactions. To keep track of transactions manually for possible fraudulent or suspicious transaction is very difficult job and may not be technically possible to do. The RBI has already come with comprehensive KYC (Know Your Customer) and AML (Anti-Money Laundering) guidelines to take care of such issues. The banks are offering new and customized products. The products are becoming complex and it takes time for customer to understand the products, their features etc. In such an environment intelligent systems play a very crucial role in automating some of these tasks and supplement managers in their decision-making and to be compliant. [1,5,11]. In the following sections we have proposed and discussed a hybrid intelligent approach to address the applications in retail banking. The section 2 describes the basic intelligent framework used in the system, section 3 discusses the application of this approach to retail banking. 2 Hybrid Intelligent System Approach and Framework 2.1 Hybrid Intelligent Systems The widely used intelligent systems in management are expert systems, neural networks, case-based reasoning, fuzzy systems and genetic algorithms [9]. Brief definition of intelligent systems we discussed in the paper is given bellow.

EXPERT SYSTEM

It is a system that stores explicit knowledge (about a particular application area) and uses it. It acts as an expert consultant to solve the problems by using and applying the knowledge intelligently. Knowledge consists of the facts: data about the problem to be solved and a set of rules to solve the problem. In Q & A (Question and Answer) mode, expert system works like a doctor asking series of relevant questions (to know symptoms) and gives expert opinion (diagnosis) based on answers (symptoms). *Case Based Reasoning* A CBR system contains *case-base*, a repository of solved problems (cases). It digs out the implicit expertise in the past cases and uses it to address a new problem (problem case). It finds out the most closely matching case/s with the problem case and recommends the decisions by re-using, and adapting the decisions in those cases. The CBR system contains domain and conceptual knowledge to match, reuse and adapt cases. *Artificial Neural Networks* Simulate the working of biological nervous systems; upon training them to solve the problem by providing the past data, they learn complex relationships, patterns, etc. in the data. They hold this learnt relationship, patterns etc. (as an implicit knowledge) and use it to solve new problems.

Intelligent systems differ in ways they get, store and apply the knowledge, deal with uncertainty and incomplete information and knowledge, adapt to new knowledge, maintain the knowledge and so on [2,4]. Comparison between expert system, neural network and case-based reasoning technology. Expert systems are good when expertise is

available and easy to extract from the human experts and various knowledge sources. Neural networks can learn and model complex relationships. Case-based reasoning helps to dig out the hidden expertise/knowledge in already solved problems (with partial domain knowledge) and use that to solve new problems of similar kind. Fuzzy systems deal with ambiguity and uncertainty in human decision making while genetic algorithms are based on evolution principal and suitable for applications involving searching best solutions and optimizing. Each of these systems has some inherent weaknesses and strengths. This makes them less suitable for solving problems using a single technique. For example problem with expert systems is extracting knowledge from experts, which is time consuming and costly, expert systems can not learn on their own and adapt, but these systems are good in giving qualitative explanations and justifications for decisions they make. While, neural networks are best in learning and adapting but they are poor in explaining their results.

Integrating these techniques enhance their overall strengths and lessen weaknesses thereby helping to solve overall problem in effective way [2,4]. Various strategies, architectures, models and classification schemes have been suggested by many authors to integrate various intelligent systems for practical applications [2,3,4,6,7]. Some of them based on functionality and characteristics of intelligent systems while others based on techniques and mechanisms used to integrate the systems. However, the final goal is to model the problem by taking advantages of strengths to

achieve effectiveness and efficiency. Combining analytical methods and intelligent systems gives advantages of having and applying knowledge about the problem and solving problem using various mathematical modelling techniques.

The major advantages of combining these two types of systems are: a) understanding of operation and results of the decision support system in consistent and objective manner; b) the quantitative results are transformed to qualitative explanations, which are easier to understand, and are often of greater significance to the decision makers, c) using domain knowledge about the problem, knowledge about usability and suitability of analytical techniques, etc. before starting decision-making process, d) the objectiveness and completeness of the results are ensured: the combination of both increases the objectives of the final results, e) solving the problem not only considering quantitative facts but also analysing the problem qualitatively, and, f) managing and controlling overall decision making process intelligently. A Hybrid Intelligent System Framework the architecture of framework that integrates various intelligent systems. This framework is used to develop, deploy and run web-applications and decision support systems backed by integrated architectures of expert system, neural network, case-based reasoning, genetic algorithms and analytical methods. The framework is completely web-based and supports thin client and server-based computing. All the intelligent systems use XML (eXtensible Markup Language).

The framework has XML-database access layer to extract, map and transform the data from data sources. The framework uses a unique and novel way of integrating

various intelligent systems and data sources in web environment [8]. Representing the problem as well as result (output) as a case in a common XML format makes it flexible to store, interchange, and use the session data across various intelligent systems. Framework allows to host multiple expert system, CBR and neural network systems.

HYBRID INTELLIGENT SYSTEMS AND RETAIL BANKING

1 Retail Banking The retail banking functions other than transaction support have been broadly classified into following broad areas:

a. Customer Analysis: Understanding and analysing customer well, their preferences. Profiling and segmentation. Looking for right marketing, cross-selling opportunities and up-selling opportunities to right people and so on.

b. Decision Support: Evaluating customer, credit rating and scoring etc.

c. Help-Desk and Self-Service: Providing help to customer on products and services. Facilitating them to explore information such as statements, past transactions and so on.

d. Transaction Monitoring: Continuously monitoring the transactions to detect suspicious and abnormal transactions.

e. Information Retrieval: Managers and decision makers can access required information quickly and easily.

2 Hybrid Approach to Retail Banking, how retail functionality discussed in above paragraph is implemented using hybrid intelligent framework. The domain generic vocabulary required for modelling various applications is divided into three broad groups: customer, product and transaction. Customer group has set of parameters, which represents almost all information about customer like *Name*, *Sex, Age,* etc.

The information about the customer, product and transaction is extracted from the databases is mapped and transformed into instances at run-time. This makes the approach independent of database and database schema. The intelligent system layer has rule-based expert system engine, neural network modules, case-based reasoning engine and libraries of analytical methods. This layer has repository of various neural network models, case schemas and global expert system rules. These models and rules are logically separated into groups depending upon the applications. These intelligent systems and models use the data extracted, mapped and transformed to common vocabulary.

CUSTOMER ANALYSIS

Intelligent systems play very important role in analysing a new customer and existing customers. The combination of expert system and case-based reasoning is used. Expert systems has been used to put set of standard and common-sense rules to understand and analyse the customer. These rules are defined in consultation with domain experts or

derived from automated learning tools. For example, set of rules to determine to whom to target when a new product is introduced, rules to customize customer preferences and on. Each customer's information is treated as case and all customer database as a case-base. Modelling a customer using case-based reasoning gives edge over other automated learning techniques because they are supplement by domain knowledge. In CBR the domain knowledge plays very important role in searching and intelligent matching. This helps to profile the customers based on conceptual similarity rather than just numbers and figures. For example, a neural network may not understand the difference between two designations or qualifications. However, in CBR, the knowledge component takes care of this. It takes the new customer into the profile of nearest conceptually matching ones (cluster). One can study the characteristics of the cluster and understand many things like what is the age profile, what kind of products these people buy, what kind of communication channel they respond etc.

Automated Help Desk Help-desk operations can be automated through web-based systems backed by expert system and case-based reasoning techniques. There is lot of information made available on websites on products and services. But most of time, the visitor wants specific information and customized answers rather than ending up with reading, understanding and evaluating through lots of web pages. This really requires knowledge of searching the right information. Similarly help-desk executives need to be trained for new products and services. Automated help-

desk provide expert interface like human experts that guides the customer intelligently on the path leading towards the right product. This enables customers to find the right and the best product suitable for them or they are looking for, subject to their profiles, needs, objective and constraints. These interfaces are intelligent capable of engaging the customers like intelligent sales person through series of questions and answers. The questions and answer options may be put in a simple layman's language (including multilingual) to be understood by average customer instead using technical jargons. The system can control the flow of questions intelligently (avoid asking irrelevant questions), by judging what user wants, based on user answers. Automated web-based help-desks not only help customers to find right product in an easy way but also help organizations to capture such conversations with visitors to keep track of what kind of customers visit, show interest in what kind of products. Such information organizations can use for cross-selling opportunities, keeping track of user profiles, their expectations, popular products, target promotional materials etc.

TRANSACTION MONITORING

Whenever a transaction is about to authorize, the statistics like *average transaction amount*, *max amount transacted* so far, *minimum duration between two transactions*, *standard deviation of transaction amount and time* etc. is generated. The expert system compares current transaction with statistics generated to detect deviations.

Expert system has rules to check consistency and inspect the transaction. For example, a simple rule to generate alert 'Odd transaction time' whenever a credit card transaction happens between midnight to morning at grocery merchant location. There can be personalized customized rules depending upon customer's requests. A CBR system can be modelled which conceptually matches current transaction with past ones in terms of *location*, *time*, *amount*, *date*, *type*, etc. and find the deviation. CBR system can also be managed to match the customer transaction pattern with the fraudulent ones.

Information Retrieval & Reporting Most of the time, required information is not found quickly and easily and it takes lot of time in searching. Expert system and case-based reasoning systems can help to find out required matching information quickly and easily. Report interfaces backed by expert system facilitate to retrieve or drill-down the information from databases about the customer, product and transactions in very interactive Q & A way. The approach of simple Q & A is heuristic and can be mapped to SQL (Structured Query Language) engine, can lead to right information the decision-maker is looking for easily and quickly avoiding remembering technical syntax of ad-hoc SQL queries. For example, a manager may be looking for most profitable customers in a particular locality or the list of customers to whom a particular product can be marketed etc. Expert systems and CBR can be customized to take care of common needs of users.

Intelligent systems play very crucial role in automating expertise and reusing organizational experience. Hybrid approach is more suitable to retail banking because it involves analysis of lot of data with different perspectives. Retail banking involves various tasks and needs better analysis and understanding of customers, products and transactions. Using only one intelligent technique for analysis may not be suitable or would play limited role. The intelligent retail-banking framework described above integrates various intelligent systems along with analytical methods. Banking organizations would definitely going to benefit from hybrid approach for better and quick customer service, better management of in-house expertise, reuse of experience of dealing with customers, monitor transactions closely and better help-desks for products. Apart from these, intelligent systems bring consistency, objectivity in decision-making along quick response and flexibility.

MOBILE COMPUTING: CHARACTERISTICS, BUSINESS BENEFITS, AND THE MOBILE FRAMEWORK

Mobile computing is a versatile and potentially strategic technology that improves information quality and accessibility, increases operational efficiency, and enhances management effectiveness. A successive examination of the characteristics and benefits of mobile computing is used to achieve this goal.

As a starting point, a definition of mobile computing is provided. Next, the technologies that make mobile computing

possible (hardware, software, and communications) are examined. The discussion of mobile computing technologies leads into an overview of the types of applications that are commonly found on mobile computers. With this background established, the following two sections demonstrate the ability of mobile computing to improve both information quality and information accessibility. Using this knowledge in conjunction with mobile computing case examples, the ability of mobile computing to improve operational efficiency is subsequently supported. Then, the ability of mobile computing to increase management effectiveness is similarly supported.

The previously discussed improvements in information quality, information accessibility, operational efficiency, and management effectiveness are then used to demonstrate that mobile computing is a versatile technology. Additionally, three separate existing frameworks for understanding the strategic nature of information technology are used to illustrate the strategic qualities of mobile computing.

As with any technology, mobile computing must be used appropriately in order to attain the benefits that have been discussed. To this end, a set of heuristics called the MOBILE framework is developed by the author to assist information technology professionals in achieving the stated benefits of mobile computing. The MOBILE framework assists information technology professionals by defining the types of problems, opportunities, and directives that are best addressed through mobile computing technology.

Before concluding, the paper discusses the continuous evolution and change that is occurring within the field of mobile computing. Two examples of new technologies that will impact mobile computing in the future are examined. The paper concludes with a review of the material covered and a reassertion of the stated benefits of mobile computing.

MOBILE COMPUTING DEFINED

The term "Mobile computing" is used to describe the use of computing devices—which usually interact in some fashion with a central information system—while away from the normal, fixed workplace. Mobile computing technology enables the mobile worker to: (a) create; (b) access; (c) process; (d) store; and (e) communicate information without being constrained to a single location. By extending the reach of an organization's fixed information system, mobile computing enables interaction with organizational personnel that were previously disconnected. Throughout this paper, the concept of mobile computing will be further refined through: (a) an examination of the technologies that make mobile computing possible; (b) an analysis of the many benefits of mobile computing; and (c) the presentation of the MOBILE framework, that provides guidance on when mobile computing is best applied to a problem, opportunity, or directive. Mobile computing is an extremely versatile, capable, and exciting technology that offers many otherwise unattainable benefits to organizations that choose to integrate it into their fixed information system.

MOBILE COMPUTING TECHNOLOGY

Mobile computing is accomplished using a combination of: (a) computer hardware; (b) system and applications software; and (c) some form of communications medium. Powerful mobile solutions have recently become possible because of the availability of: (a) extremely powerful and small computing devices; (b) specialized software; and (c) improved telecommunications. ("SOLID White", 1998) This section provides a brief overview of the general types of hardware, software, and communications mediums that are commonly integrated to create mobile computing solutions.

HARDWARE

The characteristics of mobile computing hardware are defined by the: (a) size and form factor; (b) weight; (c) microprocessor; (d) primary storage; (e) secondary storage; (f) screen size and type; (g) means of input; (h) means of output; (i) battery life; (j) communications capabilities; (k) expandability; and (l) durability of the device. Using these hardware characteristics, mobile computing hardware can be grouped into the following general categories: (a) Palmtop; (b) Clamshell; (c) Handheld Penkey; (d) Penslate; and (e) Laptop. The following table—based on an amalgamation of data—depicts the prevalent characteristics of mobile computing hardware in each category. (Buyer's Guide, 1998) (Intermec Technologies, 1999) (Product Comparison Guide, 1999) (Intermec Technologies, 1999a)

Users need and want access to their data wherever they go, and they will use a wide assortment of mobile computing devices to get it. Except for possibly high-end laptops, none of the categories of mobile computing hardware are replacements for a loaded desktop PC. Instead, each category of device fills a niche that helps to satisfy the demands created by mobile users' many computing needs. Although a lot of mobile hardware has many eye-catching characteristics, the decision about which hardware to employ should be based entirely on clear business needs. (Radcliff, 1998) Defining these needs, and having a solid strategic plan for how the new hardware will be used, is the best way to avoid disappointment and missed opportunities. (Paisner, 1998) While many specific makes and models of hardware exist, the general categories of mobile computing hardware depicted in the previous table adequately characterize the majority of mobile computing devices available today. References to mobile computing hardware during the subsequent analysis of the benefits of mobile computing will make reference to these categories.

SOFTWARE

Mobile computers make use of a wide variety of system and application software. The most common system software and operating environments used on mobile computers include: (a) MSDOS; (b) Windows 3.1/3.11/95/98/NT; (c) Windows for Pen Computing; (d) Windows CE; (e) PenDOS; (f) PenRight!; (g) Palm OS; (h) Psion EPOC32; and (i) Unix. (Buyer's Guide, 1998) (Boling, 1998, xiii-xv) These operating

environments range in capabilities from a minimalist graphically-enhanced-pen-enabled DOS environment (PenDOS and PenRight! for DOS) to the powerful capabilities of Windows NT. Each operating system/environment has some form of integrated development environment (IDE) for application development. Most of the operating environments provide more than one development environment option for custom application development. For example, Windows ons between mobile devices. This allows the developer to concentrate on the application and not the specifics of the hardware being utilized. (Besaha, 1998)

All mobile computing application software does not have to be custom-designed. Prewritten application software can be purchased for many application areas, such as sales force automation. Additionally, many companies that develop mobile computing software offer systems integration services, and will work with the client to modify their existing application to fulfil the client's specific needs.

COMMUNICATIONS

The ability of a mobile computer to communicate in some fashion with a fixed information system is a defining characteristic of mobile computing. The type and availability of communication medium significantly impacts the type of mobile computing application that can be created.

MODES OF COMMUNICATION

The way a mobile computing device communicates with a fixed information system can be categorized as: (a)

connected; (b) weakly connected; (c) batch; and (d) disconnected. (Muller, 1998, 112-113) The connected category implies a continuously available high-speed connection. The ability to communicate continuously, but at slow speeds (i.e. < 28 Kbps), allows mobile computers to be weakly connected to the fixed information system. A batch connection means that the mobile computer is not continuously available for communication with the fixed information system. In the batch mode, communication is established randomly or periodically to exchange and update information between the mobile computer and fixed information systems. Mobile computers may operate in batch mode over communication mediums that are capable of continuous operation, reducing the wireless airtime and associated fees. Disconnected mobile computers allow users to improve efficiency by making calculations, storing contact information, keeping a schedule, and other non-communications oriented tasks. This mode of operation is of little interest because the mobile device is incapable of electronically interacting and exchanging information with the fixed organizational information system. Exchange of information with a disconnected mobile computing device can only be accomplished by manually entering information into the device or copying from the device's screen and manually entering the information into the fixed information system. This mode of information exchange is no more efficient than using paper and is effectively nonexistent, since virtually all modern mobile computing hardware is capable of some form of native electronic data communications.

AVAILABLE TECHNOLOGIES

There are many communications technologies available today that enable mobile computers to communicate. The most common of these technologies are: (a) Wireless Local Area Networks (WLANs); (b) Satellite; (c) Cellular Digital Packet Data (CDPD); (d) Personal Communications Systems (PCS); (e) Global System for Mobile communications (GSM); (f) RAM and ARDIS data networks; (g) Specialized Mobile Radio (SMR) service; (h) one and two-way paging; (i) plain old telephone system (POTS); (j) Internet; (k) infra-red; (l) docking (serial, parallel, LAN); and (m) disk swapping. These diverse communications technologies make available a continuum of connectivity that provides communications capabilities ranging from manual-assisted batch transfers to high-speed continuous communication.

MAKING THE CHOICE

The specific mobile application, hardware, software, and operating location/environment determine which communications mediums are appropriate to use for a mobile computing solution. (Muller, 1998, 303-392) Achieving the desired communication capability requires matching the communications medium with the appropriate mobile computing hardware. Most mobile computing hardware is designed to take advantage of multiple communications mediums. Specialized hardware and software is also available which enables many mobile computing devices to utilize communications mediums for which they were not originally designed. Again, the desired operating location and

environmental conditions within which the mobile device will operate must significantly impact the choice of communications medium. The proper selection and utilization of the communications medium ensures that the mobile computing device is capable of reliable communications to support the mobile computing application and fulfil the business need.

MOBILE COMPUTING APPLICATIONS

The real power of mobile computing becomes apparent when mobile hardware, software, and communications are optimally configured and used to accomplish a specified mobile task. Although many varied applications exist, mobile computing applications can generally be divided into two categories—horizontal and vertical.

HORIZONTAL

Horizontal applications have broad-based appeal and include software that performs functions such as: (a) email; (b) Web browsing; (c) word processing; (d) scheduling; (e) contact management; (f) to-do lists; (g) massaging; (h) presentation. These types of applications usually come standard on Palmtops, Clamshells, and laptops with systems software such as Windows 95.

VERTICAL

Vertical applications are industry-specific and only have appeal within the specific industry for which the application was written. Vertical applications are commonly used in

industries such as: (a) retailing; (b) utilities; (c) warehousing; (d) shipping; (e) medical; and (f) law enforcement and public safety. (Dhawan, 1997, 15-57) These vertical applications are often transaction oriented and normally interface with a corporate database.

APPLICATION CATEGORIES

The specific requirements of a mobile computing application generally determine the type of hardware and operating environment required to support the application. The common types of applications for each category of mobile computer. (Pen Computer Solutions, 1999) (Dhawan, 1997, 78)

This list is by no means exhaustive. Other application areas include: (a) mining; (b) forestry; (c) agriculture; and (d) surveying. (Lauzon Computer, 1997) The application areas depicted in the table demonstrate the general capabilities offered through mobile computing. Many of these application areas will be examined in further detail during the subsequent sections of this paper that discuss the benefits of mobile computing.

CONTENT DIMENSION

Mobile computing enables information to be captured at its source, that is, its point of creation. The obvious advantage of this type of data capture is that it eliminates the need to reenter the data at a later time by transcribing it into a computer from the original paper copy. Besides eliminating redundancy, source data capture with mobile computing

offers additional advantages. Complex and complete information can be quickly and easily captured through special mobile input devices such as barcode readers. The amount of information captured by special input devices and the speed with which it is captured could not be duplicated by human-based input means. The software application on the mobile computing device can be programmed to use error-checking routines that ensure the captured data is complete and free from errors. Furthermore, the software can use context sensitive questions and intelligent forms to ensure that the proper scope of information is retrieved and that no extra, unnecessary or irrelevant information is accepted. The mobile computing device may also perform preprocessing on the data that is being collected before it is ultimately transferred to a fixed information system. Since the information being transferred from the mobile device to the fixed information system is high quality, the information that is transferred back from the fixed information system to the mobile computing device will generally also be of higher quality. Mobile computing application software can be used to intelligently request information from the central fixed information system, so the mobile device only receives the desired information from the central system. These characteristics of mobile computing enable it to improve the content dimension (accuracy, relevance, completeness, conciseness, and scope) of information quality.

FORM DIMENSION

Mobile computing applications use hardware and software that are specifically configured so that information can be viewed in a format that is: (a) easy for the mobile user to use; and (b) unambiguous. Since the information that is transmitted or stored in the mobile device is in digital format, it can normally be: (a) viewed in either a detailed or summary form; (b) sorted as required; (c) manipulated into tables or charts as required; and (d) viewed on the screen or printed out. Mobile computing applications can use a wide variety of devices which enhance the ability of the mobile worker to capture and distribute data. Mobile computers can take advantage of: (a) barcodes; (b) magnetic stripe readers; (c) portable printers; (d) signature capture; (e) smart cards; (f) radio frequency identification; (g) voice recognition; (h) still image capture; (i) video image capture; and (j) the Global Positioning System (GPS). (Intermec Technologies, 1998) Additionally, the internal storage and processing capability of mobile computers allow immediate access to large quantities of localized digital information. For example, a utility employee may carry a mobile device that contains a CDROM with maps of the entire city within which she works. From this discussion, it can be seen that mobile computing improves the form dimension of information quality by improving the characteristics of clarity, detail, order, presentation, and media.

OVERALL QUALITY

Mobile computing improves the time, content, and form dimensions of information quality. Since each dimension is

improved, the resulting overall quality of information generated by an organizational information system that utilizes mobile computing is also improved.

IMPROVED INFORMATION ACCESSIBILITY

Mobile computing enables improvements in information accessibility. The degree of improvement is directly dependent upon the mobile hardware and communications equipment in use. For example, a Penslate computer that is operating in the connected mode via a wireless local area network will have much greater information accessibility than a clamshell mobile computer that is operating in batch mode and only connects randomly throughout the day. The degree of information accessibility required—which defines the hardware and communications requirements—is determined by the business needs that are driving the mobile computing application. Mobile computing technology (hardware, software, and communications) provides a wide range of options that can be mixed and matched to fit the needs of each individual mobile computing application.

The improvements in information accessibility enabled by mobile computing result in improved information flow both to and from the central fixed information system. The mobile computer enables quick and efficient information retrieval from the central information system. The ability to access central information and make fixed or ad hoc queries of corporate databases enables employees to get the information they need to complete the job. The mobile computer also enables transmission of current operational

data, in native digital format, from the mobile user to the central fixed information system.

Once transmitted to the fixed information system, the data from the mobile user can be processed and made available for all other users of the central information system. Thus, the information available to a mobile user from the central information system reflects current information from other mobile users as well. Mobile computing eliminates the delay that occurs when an employee must physically return to the office at the end of the day and submit paper forms so that data entry personnel can enter the information into the central information system.

Even employees that are not continuously connected to the fixed organizational information system via a wireless link will experience significantly improved information accessibility through mobile computing. One phone call at the end of the day from the mobile user via a standard modem is all that is required to transmit the entire day's transactions to the central computer, saving travel and data entry time. Additionally, any scheduling or assignment changes for the mobile employee for the following day can be transmitted to the employee during the same phone call.

Mobile computing also significantly speeds information accessibility when other media, such as: (a) facsimile; (b) audio files; or (c) still images are concerned. Digital images or audio files can be accessed by the mobile user or transmitted from the mobile user to the central fixed organizational information system. If matched properly to

the work environment and task to be accomplished, the mobile computer will always be in the possession of the mobile worker during the course of the day. Especially in the connected or weakly connected modes of operation, this means that the mobile employee may be contacted throughout the workday via the mobile computing device. Additionally, it means that the employee has access to other mobile employees via email or other massaging schemes. As with many mobile computing applications, the type of mobile application and the hardware, software, and communications used to support it will normally determine the degree and type of information accessibility.

The direct measurable results of improved information accessibility—both to and from the mobile worker—are many. They include: (a) improved customer service; (b) reduced cycle times; (c) greater accuracy; (d) fewer complaints; and (e) a reduction in required intermediate support staff. Improved information accessibility can also support many other improvements such as: (a) elimination of extra travel; (b) reduction of selling times; and (c) saving lives.

INCREASED OPERATIONAL EFFICIENCY

Mobile computing enables improvements in the operational efficiency of organizations that integrate the technology into their fixed information systems. It enables the computing power and information contained within the fixed information system to be structured around the optimum work flow of a mobile worker, instead of altering the mobile worker's work flow to meet the optimum

configuration for computing. The mobile computer stays with the mobile employee, instead of the employee being required to travel to the computer. Mobile computing can improve efficiency in many ways, including: (a) saving time; (b) reducing waste; (c) cutting cycle times; (d) reducing rework; (e) enabling business process reengineering; (f) improving accuracy; (g) decreasing time spent on customer complaints; and (h) reducing unnecessary travel. (Dhawan, 14) Representative examples from actual real-world mobile computing implementations will be presented to demonstrate the ways in which mobile computing can improve the operational efficiency of an organization.

FIELD SALES

The operational efficiency of sales personnel is significantly enhanced through mobile computing. An excellent example of these improvements can be seen by examining how mobile computing improves the efficiency of remote insurance and financial planning sales. The mobile computer frees the sales agent to meet with the client at the client's home, office, or other location. Customer data is collected, estimates and comparisons are immediately calculated, the customer decides on the program of choice, the central computer is immediately updated, and the customer is enrolled in the insurance or financial planning program. (Dhawan, 34) Without mobile computing, this sales process would take days instead of minutes. In addition to accessing and updating customer account information, mobile sales personnel can accomplish

tasks such as printing invoices or other information to leave with the customer. (Automated Wireless, 1999)

TRANSPORTATION AND SHIPPING

The transportation and shipping industries benefit greatly from mobile computing. Using mobile computers in conjunction with GPS/GIS and an accompanying vehicle information system (VIS), the operations of an entire transportation fleet can be managed from a central location. The central office knows the location, status, and condition of all vehicles, and operators have two-way communication with the operations centre. Using this information, vehicles can be optimally dispatched to maximize efficiency as measured by: (a) time; (b) fuel consumption; and (c) delivery priority. (Dhawan, 52) The mobile computers enable significant performance improvements, achieved simultaneously with operational cost reductions.

Averitt Express, a North Carolina trucking company that specializes in less-than-truckload deliveries, significantly improved its operational efficiency with a mobile computing solution that utilizes Penkey computers and continuous wireless connectivity. Before the mobile computing solution was introduced, the company managed its trucking assets using a manual tracking system and two-way voice radio. The system was not providing the desired efficiency or quality of customer service that Averitt needed for competitiveness. Using the new system, dispatchers enter customer pickup information directly into the central computer, which automatically selects and notifies the

appropriate truck via the driver's Penkey computer. Drivers record information about deliveries, such as the time of delivery and the person who signed for it, on the mobile computer. This information is automatically transmitted to the central computer and customer service representatives can use it to provide better delivery information to customers. Since the introductions of the mobile computing solution, operations are more efficient and customers are happier. (Intermec Technologies, 1998a)

GENERAL DISPATCHING

Mobile computers used in conjunction with Global Positioning System (GPS) and Geographical Information System (GIS) data allow significant improvements in the operational efficiency of various dispatch operations. (Dhawan, 27) For example, the central computer at a taxi company can track the location and status of all its taxicabs and electronically dispatch the most appropriate car to a customer's location. Additionally, the central computer can calculate an accurate approximation of when the taxi will arrive, enabling improved customer service.

HOTEL OPERATIONS

Connecting the cleaning and hospitality staff of a hotel with mobile computing can significantly improve the efficiency of hotel operations. As guests check out and rooms are vacated, the central computer wirelessly signals cleaning staff that the rooms are ready for cleaning. Problems that are identified during cleaning, such as broken appliances

or faulty plumbing, are immediately communicated to the mobile maintenance team for action. As soon as cleaning is complete and repairs are accomplished, the cleaning staff member wirelessly updates the central computer and the room is immediately available for check-in by a new guest. The same system can be used to efficiently direct mobile hospitality personnel in response to guest requests for information and service. (Dhawan, 57)

NEWS REPORTING

Mobile computers dramatically improve the efficiency of news media operations. Reporters equipped with mobile computers and accompanying electronic devices can cover a news or sporting event, take digital video or still photographs, digitally record audio interviews, compose the text of the news story, and transmit the completed product back to the central agency for editing and immediate publication. (Dhawan, 56) In the media industry, the timing and quality of news coverage is critical. Mobile computing increases the quality of the information from the media crews and significantly decreases the time required to process and transmit the story for publication.

HEALTH CARE

Mobile medical care, whether in-home, on the road, or within a hospital, is more efficient with mobile computing. The mobile healthcare worker can access patient records for reference purposes, and is able to update records with current diagnosis and treatment information. Emergency

medical technicians (EMTs) responding at the scene of an accident can use mobile computers to capture patient information, treatments accomplished, vital signs, and other critical data. This information is wirelessly transmitted to the receiving hospital, which then prepares to receive and treat the patient, or recommend another hospital facility with more appropriate treatment facilities—depending upon the nature and severity of the injuries. The more efficient hand-off between ambulance EMTs and hospital staff made possible by mobile computing can save lives that otherwise might have been lost. (Dhawan, 44-46)

CAR RENTAL AGENCIES

Car rental agencies have taken advantage of the improved operational efficiency made possible by mobile computing. Using handheld computers, rental company employees can now process a rental car return without the customer ever being required to enter the office. The process works as follows: (a) The customer arrives with a car for drop-off; (b) an employee greets the customer, receives the keys to the vehicle, and performs an interior and exterior vehicle inspection; and (c) upon inspection completion, the employee uses the mobile computer to settle the account and record the car as returned. Additionally, the vehicle cleaning and maintenance staff is automatically notified when the vehicle is returned, so it can quickly be returned to a rentable status.

FIELDWORK

Almost any form of fieldwork can be made significantly more efficient through the application of mobile computing.

Parking control officers and utility inspectors are two examples of field workers who can receive operational benefits from mobile computing. Parking control officers use handheld computers to check the registration and violation history of parking offenders. Parking violations are issued immediately and towing/backup can be requested when required. Utility inspectors have historically used paper forms to capture information such as consumer power consumption and utility equipment status (transformers, transmission towers, etc.). Using mobile computers, inspectors can be given instructions on inspections to be accomplished and information can be captured and validated at the source. (Dhawan, 50-51)

MOBILE AUTOMATION

General business travellers also reap the benefits of mobile computing. Email, spreadsheets, presentations, and word processing are the four primary tasks accomplished by these business travellers. Laptops, Palmtops, and portable Clamshell computers with usable-size keyboards enable businesspeople to stay in touch and accomplish the tasks they need for job effectiveness. (Gillin, 1998) Using powerful mobile computers in conjunction with high-speed connectivity, mobile workers can perform work normally accomplished at the office while on the road or in the field. (Dhawan, 77)

RESULTS

These examples have demonstrated the types of operational efficiency improvements that can be gained

through the use of mobile computing technology. The improvements in efficiency made possible by mobile computing are impressive. Mobile computing technology can be applied to a diverse range of problems and achieve similar improvements in operational efficiency.

INCREASED MANAGEMENT EFFECTIVENESS

Mobile computing technology can improve management effectiveness by improving information quality, information flow, and ability to control a mobile workforce. It makes the most current and accurate information available to both the mobile worker and the users of the fixed information system with which the mobile worker communicates. These benefits can be seen in all areas of the information system, from the fixed reports generated by a management information system all the way to ad hoc systems such as decision support and executive information systems.

Many of the management benefits of mobile computing have already been seen in the examples previously presented in the operational efficiency section of this paper. Companies like Averitt Express not only improved their efficiency through mobile computing, but they also improved their ability to manage operations. Often, it is the improved ability to manage operations that is partly responsible for the performance improvements seen in companies that introduce mobile computing technology. Several examples will be presented in this section, in order to further demonstrate the ability of mobile computing to improve management effectiveness.

CAMPUS ACCESS

Elected government officials, such as state senators, have dramatically improved their management effectiveness through the use of mobile computing. A wireless LAN is used to connect the senators to a campus-wide network. Through this network, senators access private and global information; allowing access to: (a) private files; (b) email; (c) current legislation; (d) scheduling information; and (e) many other services. Additionally, the mobile computer makes the senator continuously accessible to his or her office staff. (Dhawan, 49) This type of system can be implemented using laptops, pen-slates, or even hand-held computers, depending on the individual processing needs and information requirements of each senator. By staying in touch and having continuous access to current information and works-in-progress, senators are better able to manage their time and the many political requirements of the job.

SEARS

Sears, Roebuck & Co. uses mobile computers to improve their ability to manage over 14,000 service technicians that are dispersed throughout the United States. Using specially designed, durable laptop computers and wireless connectivity, Sears directs the activities of its technician staff. Each morning, technicians download their schedule for the day, including customer information and service history. Throughout the day, the technicians record their progress on the mobile computer. During service calls, the

technician uses the computer to accomplish tasks such as verifying the price and availability of repair parts. Once a service call is complete, the central dispatch facility is automatically notified via wireless communication. Technicians that finish service calls early, or that have cancelled appointments, can be dynamically redirected to another service call in the immediate area. The mobile computing solution has dramatically improved the ability of Sears to manage its mobile technician staff. (Flanagan, 1998)

OTHER

Stock traders use handheld mobile computers to gain immediate access to financial data and manage transactions. (Dhawan, 36) Airlines use handhelds with built-in barcode scanners to scan baggage as it is moved through the handling system, improving the ability to real-time track and manage baggage movement. (Dhawan, 41) Mobile computers and wireless networks have also proven to be a significant management tool to assist with coordination during disaster recovery operations.

RESULTS

Just as mobile computing enables improved operational efficiency, it also enables improved management effectiveness. Mobile computers make more timely and accurate information available to managers. Mobile computers improve the manager's ability to track work in progress. They also improve the ability of managers to

communicate with mobile personnel. Additionally, mobile computers provide better information to mobile employees, so they can make more informed decisions locally and minimize the need for management decisions from the central office.

MOBILE COMPUTING IS VERSATILE

As can be seen from the previous examples, mobile computing is an extremely versatile technology. It can be instrumental in: (a) process reengineering; (b) reducing operational and administrative staff; (c) improving communications; (d) improving customer service; (e) reducing manufacturing costs; (f) shortening business cycles; and (g) many other benefits. The variety of hardware, software, and communications systems available and the many ways they can be integrated to solve problems add to the versatility of mobile computing. Mobile computers can be used in harsh outdoor environments as well as indoor office environments. They can be operated by workers while standing, walking, or driving. They can be operated by workers with no existing keyboard skills as well as those that work with gloves on or who normally only have one hand free. Anyone who understands how to use a pen and paper can easily be trained to use most mobile computers. (Lauzon Computer, 1997)

EXAMPLES OF VERSATILITY

The true versatility of mobile computing can be seen by recalling examples of how it is currently being utilized to

enhance business and other operations. It delivers critical medical information from mobile emergency medical technicians to emergency rooms, so the doctors can be ready to treat the patient immediately upon arrival. It enables a salesperson to demonstrate product options, calculate delivery fees, check availability, verify customer credit, and accept payment all during one short visit. It makes it possible for a regional manager to quickly reference his region's current and past performance with a Penslate computer and WLAN connection; answering important questions without ever leaving the meeting table.

VERSATILITY SUMMARY

Yes, mobile computing is versatile. It extends the reach of an organizational information system and enables interaction with employees who otherwise would not have access. The versatility of mobile computing will continue to expand over the next few years as a predicted proliferation of new mobile computing devices and the expanded usage of existing devices comes to fruition. (Needle, 1998)

STRATEGIC NATURE OF MOBILE COMPUTING

"The strategic role of information systems involves using information technology to develop products, services, and capabilities that give a company strategic advantages over the competitive forces it faces in the global marketplace." (O'Brien, 1996, p. 402) Mobile computing is a key enabling technology for the creation of strategic information systems.

FIVE COMPETITIVE FORCES

Mobile computing's strategic nature can be seen by examining how mobile computing influences the five competitive forces that impact businesses. As discussed by O'Brien, (1996, pp. 402-408) the five competitive forces described by Michael Porter are: (a) rivalry among competitors; (b) threat of new entrants; (c) threat of substitute products; (d) bargaining power of suppliers; and (e) bargaining power of customers. An organization can counter these competitive forces by pursuing one or more of the following strategies: (a) cost leadership; (b) differentiation; (c) innovation; (d) growth; and (e) alliance. In each case, mobile computing information technology can be an important part of implementing the competitive strategy. Mobile computing can significantly reduce the operational costs associated with business processes. These savings can be passed on to the customer and enable a cost leadership strategy. Mobile computers can enable a more satisfying experience for the customer or an entirely new and innovative way of doing business, enabling a differentiation and/or innovation strategy. Mobile computers simplify: (a) the capture of data; (b) communication; and (c) the management of complex operations, thus enabling growth. Mobile computing technology enables real time tracking and management of business operations, which are both important for attaining the performance and reliability required for inter-organizational alliances such as just-in-time inventory agreements. Additionally, a strategic information system that is aligned with company goals and

takes advantage of the benefits of mobile computing technology represents a significant barrier to entry for any other businesses that are considering entry into the market.

CATEGORIES OF STRATEGIC SYSTEMS

The strategic nature of mobile computing can be further seen by examining how it supports the primary categories of strategic information systems. Although a multitude of specific examples of strategic information systems exist, all these systems can generally be classified as belonging to one or more of four main types of strategic information systems. (Ward & Griffiths, 1996) The defining characteristics of these four categories of strategic information systems are: (a) those that change the nature of a relationship with consumers, customers, and/or suppliers by sharing information via technology-based systems; (b) those that improve the organization's value-adding processes by more effectively integrating the use of information; (c) those that use information to develop, market, produce, and deliver enhanced or new services or products; and (d) those that support executive management decision-making in the areas of development and implementation of strategy, by providing them with information. Each of these categories is directly supported and enhanced by mobile computing. As seen in previous case examples, mobile computing can be directly responsible for changing the nature of relationships, improving key processes through information, enabling new products or services, and supporting executive decision making. These

examples further support the assertion that mobile computing can play a major role in strategic information systems and thus is a strategic technology.

STRATEGIC VALUE OF INFORMATION TECHNOLOGY

The key categories of information technology application that define the sources of information technology strategic value have also been defined by Applegate, McFarlan, and McKenney (1996). They have defined these categories as: (a) process performance improvements; (b) individual/work group decision quality and workgroup improvements; and (c) competitive advantage. It has been shown that mobile computing improves business process performance. Mobile computing enables better individual decision quality by the mobile worker because the mobile worker with a mobile computer has access to more information and computing resources than one without. Potential for improved group decision making is also possible because more current and higher quality information is made available through the use of mobile computers.

ARTIFICIAL INTELLIGENCE IN MANUFACTURING

As the manufacturing industry becomes increasingly competitive, sophisticated technology has emerged to improve productivity. Artificial Intelligence in manufacturing can be applied to a variety of systems. It can recognize patterns,

plus perform time consuming and mentally challenging tasks. Artificial Intelligence can optimize your production schedule and production runs. In order for organizations to meet ever increasing customer demands, and to be able to survive in an environment where change is inevitable, it is crucial that they offer more reliable delivery dates and control their costs by analysing them on a continual basis. For businesses, being capable of delivering high quality goods at low costs and short delivery times is akin to operating in a whirlpool environment like the Devil's Triangle, and this is no easy task for any organization. Managing so that production takes place at the right time, on the right equipment, and using the right tools will minimize any deviations in delivery dates promised to the customer. Utilizing equipment, personnel and tools to their maximal efficiency will no doubt improve any organization's competitive strength. In return, proper utilization of these capabilities will result in lower costs for the organization

Optimal scheduling of jobs on equipment, without the use of computer software, is a truly difficult undertaking. Performing planning using the "Deterministic Simulation Method" will provide you with schedules that will indicate job loads per equipment. Even in the case limited to a single piece of equipment, as the number of jobs to schedule on that equipment increases, finding the right solution in the "Possible Solutions Set" becomes next to impossible. And in the real world, the difficulties arising from the large size of the solutions set due to the recipes formed by jobs,

equipment and products, and shaped by the technological restrictions, as well as the complexity in finding a close to ideal solution, are readily apparent.

Research and studies are being conducted worldwide on the subject of scheduling. Software vendors working in this area follow developments closely, and they are coming out with new products to better meet demands. "Genetic Algorithms", "Artificial Intelligence", and "Neural Networks" are some of the technologies being used for scheduling

ADVANTAGES

- View your best product runs and the corresponding settings.
- Increase efficiency and quality by using optimal settings from past production.
- Artificial Intelligence can optimize your schedule beyond normal human capabilities.
- Increase productivity by eliminating downtime due to unpredictable changes in the schedule.

ARTIFICIAL INTELLIGENCE IN FINANCIAL SERVICES

AI has found a home in financial services and is recognized as a valuable addition to numerous business applications. Sophisticated technologies encompassing neural networks and business rules along with AI-based techniques are yielding positive results in transaction-oriented scenarios for financial services. AI has been widely adopted in such areas of risk management, compliance, and securities trading

and monitoring, with an extension into customer relationship management (CRM). Tangible benefits of AI adoption include reduced risk of fraud, increased revenues from existing customers due to newer opportunities, avoidance of fines stemming from non-compliance and averted securities trade exceptions that could result in delayed settlement, if not detected.

Warren Buffet is known as the ultimate investor in this age. So good is he, in fact, that artificial intelligence software developed in Carnegie Mellon that predicts stock movements was named after him by. But can machines really take the place of human traders, much less surpass them? When Deep Blue defeated Chess Grandmaster Kasparov in 1997, AI was propelled into the limelight. Indeed, if a machine can whiz through the intricacies of the ultimate game of strategy, why not beat man in other fields as well – thereby facilitating work, decreasing costs and errors and increasing productivity and quality. This study focuses on applying AI in Finance, particularly in stock trading. In the field of Finance, artificial intelligence has long been used. Some applications of Artificial Intelligence are

- Credit authorization screening
- Mortgage risk assessment
- Project management and bidding strategy
- Financial and economic forecasting
- Risk rating of exchange-traded, fixed income investments
- Detection of regularities in security price movements

- Prediction of default and bankruptcy
- Security/and or Asset Portfolio Management.

Artificial intelligence types used in finance include neural networks, fuzzy logic, genetic algorithms, expert systems and intelligent agents. They are often used in combination with each other. When AI first appeared a decade ago, it generated mass media hype but delivered inconsistent results. A number of those who praised its ability were paralyzed in the end. One such case is Fidelity Investments. In this paper, we set the stage by describing how traditional stock trading differs from AI-powered stock trading. We define the various AI systems available and also explore the various solutions available in the market, their IT foundations and how salient they are. Then, we move into how AI systems for stock trading will affect traders, companies and individuals. Benefits, risks and competitive strategy will be defined and real-world examples cited, as grounding for our recommendations in the end. Recommendations include getting management buy-in, implementing the system and managing the whole structure to succeed.

ARTIFICIAL INTELLIGENCE IN MARKETING

Advances in artificial intelligence (AI) eventually could turbo-boost customer analytics to give companies speedier insights into individual buying patterns and a host of other consumer habits.

Artificial intelligence functions are made possible by computerized neural networks that simulate the same types

of connections that are made in the human brain to generate thought. Currently, the technology is used mostly to analyze data for genetics, pharmaceutical and other scientific research. It's seeing little use in CRM right now, though it has tremendous potential in the future

AI-enhanced analytics programs also provide survival modelling capabilities — suggesting changes to products based on use. For example, customer patterns are analysed to learn ways to extend the life of light bulbs or to help decide the correct dosage for medications.

High-tech data mining can give companies a precise view of how particular segments of the customer base react to a product or service and propose changes consistent with those findings. In addition to further exploring customers" buying patterns, analytics could help companies react much more quickly to the marketplace.

According to Meta Group vice president Liz Shahnam, intelligent agents could let companies make real-time changes to marketing campaigns. "New technologies would have the model refreshed on the fly based on each new incoming piece of customer information — reaction to the campaign — for a more targeted offer,"

ARTIFICIAL INTELLIGENCE IN HR

It is widely believed that the role of managers is becoming a key determinant for enterprises' competitiveness in today's knowledge economy era. Owing to fast development of information technologies (ITs), corporations are employed to

enhance the capability of human resource management, which is called human resource information system (HRIS). Recently, due to promising results of artificial neural networks (ANNs) and fuzzy theory in engineering, they have also become candidates for HRIS. The artificial intelligence (AT) field can play a role in this, especially; in assuring that the fuzzy neural network has the characteristics and functions of training, learning, and simulation to make an optimal and accurate judgment according to the human thinking model. The main purposes of the study are to discuss the appointment of managers in enterprises through fuzzy neural network, to construct a new model for evaluation of managerial talent, and accordingly to develop a decision support system in human resource selection. Therefore, the research methods of reviewing literature, in-depth interview, questionnaire survey, and fuzzy neural network are used in the study. The fuzzy neural network is used to train the concrete database, based on 191 questionnaires from experts, for getting the best network model in different training conditions. In order to let decision-makers adjust weighted values and obtain decisive results of each phase's scores, we adopted the simple additive weighting (SAW) and fuzzy analytic hierarchy process (FAHP) methods in the study. Finally, the human resource selection system of Java user interface has been constructed by FNN in the study.

CONCLUSION

It is difficult for business to see general relevance from AI. This is probably one of the reasons for the

compartmentalization of AI into things like Knowledge Based Systems, Neural Networks, and Genetic Algorithms etc. Some of these separate sub topics have been shown to be very useful in solving certain difficult business and industrial problems and consequently funding bodies influence research directions by encouraging work on these more application based areas. This can have a positive effect for business benefit and has lead to some very useful systems that have found their way into the heart of business activity. Business should not lose sight of where AI could go because there are many potential benefits to current and new businesses of future research. The idea of robotic domestic workers is still far fetched but companies are making progress even here. There is already a Robot Vacuum Cleaner marketed by Electrolux and doubtless improved systems with better functionality will follow.

I would like to close by quoting from Tom Peters, a leading management guru: "When you think you've reached the top, tear down everything and do it all over again. If you don't, your competitor will." To this, I would like to add my own: "If your competitor won't, new investors will enter the market segment who will do the same job better."

THE FUTURE OF ARTIFICIAL INTELLIGENCE

In spite of its great advances and strong promise, Al, in name, has suffered from low esteem in both academic and corporate settings. To some, the name is inexorably—and

unfavorably—associated with impractical chess-playing computers and recluse professors trying to build a "thinking machine." As a result, many developers of Al theories and applications consciously shun the moniker, preferring instead to use the newer jargon of fuzzy applications, flexible software, and data-mining tools. In avoiding the label Al, they have found more receptive audiences among corporate decision-makers and private investors for their Al-inspired technologies. Thus, while the practices and ideas known as Al are hardly dead, the name itself is drifting toward obscurity. This is true not only because of the perceived stigma, but also as a consequence of the diversity and heterogeneity of ways in which Al concepts have been implemented. Furthermore, these concepts are verging on ubiquity in software applications programming. Such disparate objectives as building a customer order system, implementing a self-diagnostic manufacturing system, designing a sophisticated search engine, and adding voice-recognition capabilities to applications all employ AI theories and methods. Indeed, Ford Motor Company was slated to implement an engine-diagnostic neural network in its car computers beginning in the 2001 model year. With Al so entrenched in modern software development, it has lost many of its distinctions from software generally.

CAN YOUR BUSINESS USE ARTIFICIAL BUSINESS

Artificial intelligence (AI) can be thought of as the art of making computers do things that would require intelligence

or judgment if done by humans. For example, computers approve American Express purchases, diagnose diesel locomotive faults for GE, configure VAXs for Digital, advise on tax matters for Arthur Andersen, schedule production for Westinghouse, and assign rooms for Holiday Inns. Every Fortune 500 company has AI applications online, in development, or as the subject of a feasibility study.

Pattern recognition, computer vision, and robotics all employ AI, as do computer programs for chess playing, automated reasoning, and problem solving. Natural language applications of AI range from low-level spelling and grammar checkers to speech recognition and machine translation. There's now an English to Spanish translating application on the market for microcomputers.

AI APPLICATIONS IN BUSINESS

The chief business use of AI is in expert systems, which assist human experts in solving difficult problems. All of the specific examples just mentioned are expert systems. Expert systems embody the knowledge and reasoning of human experts. They aid managers in understanding their businesses and in establishing control of business processes. In addition, they secure valuable intellectual resources for the company and enforce uniform application of policy.

When Campbell Soup's chief engineer was approaching retirement age, his knowledge and experience in keeping the huge cookers running were captured in an expert system and made available to younger engineers. The same scenario

was repeated at GE, resulting in the expert system Delta for repairing diesel locomotives. In both of these cases, an important resource was not allowed to retire.

Typically, a firm has many employees upon whose expertise the firm depends. Even the smallest company will depend upon the expertise of at least one person. The very process of making this expert knowledge explicit in such a way that it can be incorporated into an expert system is itself one of the greatest benefits of developing an expert system. During this process, one can become aware of many aspects of the business that had been only vaguely understood previously. This increased understanding can lead to greater control over the business.

The firm of Peat, Marwick, Main (PMM) has implemented an expert system to help their various offices evaluate loan portfolios of lending institutions. PMM had noticed that expertise in evaluating loans varied greatly from office to office, and in some cases the evaluation was even being performed by partners because of the lack of expertise at lower levels. Their problem was to take the expertise of those few persons known as expert evaluators of loan portfolios and make it available, at least in some meaningful part, to employees throughout the company. PMM's success in doing so had the added benefit of establishing uniform standards for loan evaluations at their various offices so there were no longer any significant differences between the way a loan might be evaluated in Minneapolis and the way a similar loan would be evaluated in Memphis.

As a side benefit after a couple of years, employees have tended to consult the system much less frequently, presumably because they have absorbed much of the expertise embodied within the system. In other words, the expert system is proving to be a long-term training tool for employees.

COMPETITIVE ASPECTS OF EXPERT SYSTEMS

The usual considerations of maximizing desirability and feasibility apply equally well to expert systems concerning traditional computer applications. A more distinctive issue is to decide which tasks are appropriate for expert systems and which ones are better handled by other methods. Researchers G. Gorry and M. Scott-Morton proposed a framework for decisions that can be useful in selecting those that can benefit most from expertise, whether human or artificial.

Unstructured (on the vertical axis) and how levels of managerial action can be analysed in terms of operational control, management control, and strategic planning (on the horizontal axis). Structured tasks (the first row), of course, usually require very little expertise and can be handled with traditional algorithmic solutions, whereas unstructured tasks (the third row) may very well resist the imposition of any structure, including that of an expert system. Semi-structured tasks seem to be the ones most typically chosen for expert system development.

Some of the classic successes in expert systems have been semi-structured tasks at the level of operational control,

such as Digital's XCON system for configuring computer systems. Many expert systems, however, have been developed to aid in decisions at the managerial and strategic levels; and the competitive potential of applications at these levels is, of course, even greater than that of applications at the operational level. Yet there is no reason why even unstructured tasks cannot benefit from expert systems provided that there are human experts who can explain to others what they do.

Finally, potential expert system applications can be evaluated in terms of their position in the value chain (i.e., within a business, the arrangement of tasks that add value). As with other types of technology, the relevant question is whether expert systems are being retrofitted to low value-added applications or being used to exploit opportunities further up the value-added axis.

EXPERT SYSTEM LIFE CYCLE

A variety of issues emerge in the development stage of expert systems. Prototyping, however, is the most important expert system development tool and typically consumes a large share of resources. The two parts of an expert system—the knowledge base (the representation of expert knowledge) and the shell (the remainder of the system)—require separate development and maintenance skills.

It is relatively easy to build an impressive prototype of an expert system in a fairly short time. Completing the system, however, typically takes much longer.

Finally, expert system projects are often seen as risky, since the technology is relatively new and the applications tend to address unstructured problems. This risk needs to be considered in any commitment to development of an AI application. Such risk can be minimized by seeking the counsel of experienced AI consultants.

GETTING STARTED WITH AI

The way to start an AI project is the same as with any other information system application. If a firm is large enough, it will have information system specialists. If not, the firm will probably depend upon an outside consultant for information systems needs. In either case, the initial steps are the same and are the traditional ones—conduct a needs analysis and a feasibility study together with a careful evaluation of costs and benefits. It is important to choose an application that is suited for an expert system—one that will provide cost savings large enough to justify the investment and its risk, or one that gives a firm a strategic advantage in the marketplace. The evaluation of costs and benefits is particularly important in the case of expert systems, since their relative riskiness and their typically lengthy development time require an unusually careful analysis of expected future returns. The analysis and design of expert systems can depend upon the skills of a knowledge engineer—someone with experience in helping persons with expertise in a firm to articulate that expertise in such a way that it can be incorporated into an expert system. A company's personnel can and should develop the

skills of knowledge engineers over time by starting with small, manageable projects. It is more feasible in most cases, however, to call upon consultants who already have such experience.

RISKS AND REWARDS

AI and expert systems provide a wide range of opportunities for automation beyond those of more restricted, traditional computer applications. Yet the risks and applications of new technologies to problems that are difficult to define may deter one from taking advantage of them. At the same time, a wait-and-see attitude may be even more risky, since AI and expert systems can give one's competition an advantage. As with any other project, careful analysis and planning usually translate into tangible benefits. Broadly speaking, information and expertise are assets of the corporation. Expert systems can be a tool to help solve stubborn problems, a tool for leveraging expertise. Those firms that implement expert systems in their operations, as well as at the managerial and strategic levels, may be able to move ahead of their competition.

Above all, the very experience with AI and expert systems can be leveraged. Those who can invest in such potentially valuable technology are positioned to reap the greatest benefits. Mr. Byrne is a doctoral candidate in accounting at Memphis State University. Dr. Franklin is a professor in the Mathematical Sciences department and a member of the Institute for Intelligent Systems at MSU.

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Business Intelligence

Business intelligence (BI) mainly refers to computer-based techniques used in identifying, extracting, and analysing business data, such as sales revenue by products and/or departments, or by associated costs and incomes.

BI technologies provide historical, current and predictive views of business operations. Common functions of business intelligence technologies are reporting, online analytical processing, analytics, data mining, process mining, business performance management, benchmarking, text mining and predictive analytics. Business intelligence aims to support better business decision-making. Thus a BI system can be called a decision support system (DSS). Though the term business intelligence is sometimes used as a synonym for competitive intelligence, because they both support decision making, BI uses technologies, processes, and applications

to analyse mostly internal, structured data and business processes while competitive intelligence gathers, analyses and disseminates information with a topical focus on company competitors. Business intelligence understood broadly can include the subset of competitive intelligence.

HISTORY

In a 1958 article, IBM researchers Hans Peter Luhn used the term business intelligence. He defined intelligence as: "the ability to apprehend the interrelationships of presented facts in such a way as to guide action towards a desired goal." Business intelligence as it is understood today is said to have evolved from the decision support systems which began in the 1960s and developed throughout the mid-80s. DSS originated in the computer-aided models created to assist with decision making and planning. From DSS, data warehouses, Executive Information Systems, OLAP and business intelligence came into focus beginning in the late 80s.

In 1989 Howard Dresner (later a Gartner Group analyst) proposed "business intelligence" as an umbrella term to describe "concepts and methods to improve business decision making by using fact-based support systems." It was not until the late 1990s that this usage was widespread.

BUSINESS INTELLIGENCE AND DATA WAREHOUSING

Often BI applications use data gathered from a data warehouse or a data mart. However, not all data warehouses

are used for business intelligence, nor do all business intelligence applications require a data warehouse. In order to distinguish between concepts of business intelligence and data warehouses, Forrester Research often defines business intelligence in one of two ways:

> Typically, Forrester uses the following broad definition: "Business Intelligence is a set of methodologies, processes, architectures, and technologies that transform raw data into meaningful and useful information used to enable more effective strategic, tactical, and operational insights and decision-making." When using this definition, business intelligence also includes technologies such as data integration, data quality, data warehousing, master data management, text and content analytics, and many others that the market sometimes lumps into the Information Management segment. Therefore, Forrester refers to *data preparation* and *data usage* as two separate, but closely linked segments of the business intelligence architectural stack.

Forrester defines the latter, narrower business intelligence market as "referring to just the top layers of the BI architectural stack such as reporting, analytics and dashboards."

BUSINESS INTELLIGENCE AND BUSINESS ANALYTICS

Thomas Davenport has argued that business intelligence should be divided into querying, reporting, OLAP, an "alerts"

tool, and business analytics. In this definition, business analytics is the subset of BI based on statistics, prediction, and optimization.

APPLICATIONS IN AN ENTERPRISE

Business Intelligence can be applied to the following business purposes (MARCKM), in order to drive business value:

1. Measurement – program that creates a hierarchy of Performance metrics and Benchmarking that informs business leaders about progress towards business goals (AKA Business process management).
2. Analytics – program that builds quantitative processes for a business to arrive at optimal decisions and to perform Business Knowledge Discovery. Frequently involves: data mining, process mining, statistical analysis, Predictive analytics, Predictive modelling, Business process modelling
3. Reporting/Enterprise Reporting – program that builds infrastructure for Strategic Reporting to serve the Strategic management of a business, NOT Operational Reporting. Frequently involves: Data visualization, Executive information system, OLAP
4. Collaboration/Collaboration platform – program that gets different areas (both inside and outside the business) to work together through Data sharing and Electronic Data Interchange.
5. Knowledge Management – program to make the company data driven through strategies and practices

to identify, create, represent, distribute, and enable adoption of insights and experiences that are true business knowledge. Knowledge Management leads to Learning Management and Regulatory compliance/ Compliance

REQUIREMENTS GATHERING

According to Kimball business users and their requirements impact nearly every decision made throughout the design and implementation of a DW/BI system. The business requirements sit at the Centre of the business core and are related to all aspects of the daily business processes. They are therefore extremely critical to successful data warehousing. Business requirements analysis occurs at two distinct levels:

- Macro level: understand the business's needs and priorities relative to a program perspective
- Micro level: understand the users' needs and desires in the context of a single, relatively narrowly defined project.

BUILDING REPUTATION THROUGH STAKEHOLDER MANAGEMENT

The stakeholder theory says corporations should be run for the benefit of all "stakeholders," not just the shareholders. Stakeholders of a company include any individual or group that can influence or is influenced by a company's practices. The stakeholders of a company can be suppliers, consumers, employees, shareholders, financial community, government,

and media. Companies must properly manage the relationships between stakeholder groups and they must consider interest of each stakeholder group carefully. Therefore, it becomes essential to integrate public relations into corporate governance to manage the relationships between these stakeholders which will enhance the organization's reputation. Corporations or institutions which behave ethically and governed in a good manner builds a reputational capital which is a competitive advantage. According to Fombrun, a good reputation enhances profitability because it attracts customers to products, investors to securities and employees to its jobs.

Company's reputation is an asset and wealth that gives that company a competitive advantage because this kind of a company will be regarded as a reliable, credible, trustworthy and responsible for employees, customers, shareholders and financial markets. In addition, according to MORI's survey of about 200 managers in the private sector, 99% responded the management of corporate reputation is very (83%) or fairly (16%) important. Reputation is a reflection of companies' culture and identity. Also, it is the outcome of managers' efforts to prove their success and excellence. It is sustained through acting reliable, credible, trustworthy and responsible in the market. It can be sustained through consistent communication activities both internally and externally with key stakeholder groups. This directly influences a public company's stock prices in the financial market. Therefore, this reputation makes a reputational capital as a strategic asset and advantage for

that company. As a consequence, public relations must be used in order to establish long lasting relationships with the stakeholders, which will enhance the reputation of the company.

CEO REPUTATION

Research has shown the reputation of the CEO is inextricably linked to the reputation of the company. CEOs set the tone, define company direction, attract talent, and are the human face of the organization. Increasingly, CEOs are building their brands on credibility, not celebrity. In times of uncertainty, the CEO is called upon to speak on behalf of the organization. Books on building CEO reputation and company reputation include *Reputation* by Charles Fombrun, "*Building Reputational Capital*" by Kevin T. Jackson, *The 18 Immutable Laws of Corporate Reputation* by Ron Alsop, and *CEO Capital: A Guide to Building CEO Reputation and Company Success* by Leslie Gaines-Ross.

CAUSES-CORPORATE REPUTATION-CONSEQUENCES

Kevin Money and Carola Hillenbrand (2006) recognise that there are many different and often conflicting models of reputation. Terminology such as reputation, branding, image and identity is often used interchangeably, or to distinguish differences between related constructs. Much of this confusion has been alleviated by recent work integrates reputation models in terms of underlying psychological theory. According to Money and Hillenbrand reputation

models can be placed in a framework that relates to reputation, its causes and its consequences. In this approach it is important not only to understand reputation, but also identify the causes of reputation and its consequences.

Causes of reputation are seen to reside in stakeholder experiences. Stakeholder experiences relate to a company's day-to-day business operations, its branding and marketing and noise in the system, such as the media and word of mouth.

Reputation is seen to reside in the beliefs that stakeholders hold about a company (the cognitive element)and the feelings that stakeholders have about a company (the affective element). While the cognitive element of reputation can reflect the uniqueness of a company or products in terms characteristics such as brand attributes (whether an organisation is delivering high quality products, is international, friendly etc.), the affective element is always evaluative. In other words, it gives an indication of whether stakeholders like, admire or trust a company and its attributes. A unique and distinctive cognitive evaluation of a company only has value if this results in a positive affective evaluation and positive consequences of reputation.

The consequences of reputation reside in the behaviours (supportive or otherwise) that stakeholders demonstrate towards a company. Behaviours such as advocacy, commitment and cooperation are key positive outcomes of a positive reputation.

ONLINE REPUTATION

Online reputation is a factor in any online community where trust is important. It affects a pseudonym rather than a person. Examples include eBay, an auction service which uses a system of customer feedback to publicly rate each member's reputation. Amazon.com has a similar reputation mechanism in place and merchants develop their reputations across different dimensions. One study found that a good reputation added 7.6% to the price received. In addition, building and maintaining a good reputation can be a significant motivation for contributing to online communities. To begin developing an online reputation, consider how your personal or company brand should be perceived. What is your brand identity/what is your value proposition/selling point/unique voice? Once you have developed the image you would like your constituencies to perceive, develop a strategy to build your brand. Are you seeking credibility in the marketplace (consider blogging, answering questions on LinkedIn), gain market leadership (create innovative tools for your industry) or connection (build a network of contacts in professional and/or social sites). Once you have begun developing an online reputation it is important to try and protect it. One strategy that many people employ to ensure that they keep up with their online reputation is monitoring. Given the number of sites on the internet, it is impossible to try and manually monitor the entire internet for pages that may affect your online reputation. Tools such as Radian 6 and Google Alerts can help you to keep tabs on your online reputation.

Another way to look at online reputation is how well it's being managed. This form of reputation is usually called web or digital reputation to distinguish it from the online reputation. Indeed, Digital of Web reputation does not concern the virtual on-line reputation only, but the whole real reputation of a person or a company as it is affected by the Web. Nearly seven out of 10 global business executives see their reputations online as vulnerable. This high estimate reflects executive anxiety over reputation erosion in a fiercely competitive and unpredictable business environment.

An online reputation is the perception that one has on the Internet based on their digital footprint. Digital footprints accumulate through all of the content shared, feedback provided and information that created online. People aspire to have a positive online reputation. If someone has a bad online reputation, he can easily change his pseudonym. This is why new accounts on eBay or Amazon are usually untrusted. If a person or a company want to manage his web reputation, he will have many more difficulties. This is why a merchant on the web having a physical shop (with real name, real address) is usually more trusted. The greatest reputation threat online to companies is negative media coverage (84% say so). The next two greatest threats are customer complaints in the media or on grievance sites online (71%)and negative word of mouth (54%). This negative word of mouth could be from dissatisfied customers but from employees as well. Leaders also worry about confidential leaks which seem to be growing at a rapid pace online. Employers have begun using the online reputations of job

applicants to help their hiring choices.. By checking on your social networking profiles on sites such as Facebook, Twitter and MySpace, employers gain insight into how they believe you will fit into their business.

REPUTATION AS EXTENSION OF EGO

Concern over reputation is sometimes considered a human fault, exaggerated in importance due to the fragile nature of the human ego. William Shakespeare provides the following insight from *Othello:*

Cassio: Reputation, reputation, reputation! O! I have lost my reputation. I have lost the immortal part of myself, and what remains is bestial. My reputation, Iago, my reputation! -Shakespeare, *Othello*, the Moor of Venice Act II. Scene III, 242-244. Iago: As I am an honest man, I thought you had received some bodily wound; there is more offence in that than in reputation. Reputation is an idle and most false imposition; oft got without merit, and lost without deserving: you have lost no reputation at all, unless you repute yourself such a loser. -Shakespeare, *Othello*, the Moor of Venice Act II. Scene III, 245-249.

REPUTATION OFFICERS

Despite the rising interest in reputation, few companies have reputation officers. Although many companies will say company reputation is the job of the CEO, managing reputation is a daily function and can best be given to an individual in the organization. There are only a handful of people in the business world with the word “reputation” in

their titles — Dow Chemical, SABMiller, Coca-Cola, Allstate, Repsol YPF, Weber Shandwick, and GlaxoSmithKline (although no longer). Hoover's has a list of officers with the term "reputation" in their titles. Foro de Reputación Corporativa is a group of 11 companies in Spain that has reputation officers. Despite the great interest in reputation, there only remains 25 or fewer people as reputation officers. Some would argue reputation-building and protection is the job of the CEO and not any direct report. Others would say that the CEO has too many responsibilities to focus on reputation.

REPUTATION RECOVERY

The convergence of globalization, instantaneous news and online citizen journalism magnifies any corporate wrongdoing or misstep. Barely a day goes by without some company facing new assaults on its reputation. Reputation recovery is the long and arduous path to rebuilding equity in a company's good name. Research has found it takes approximately 3.5 years to fully recover reputation. James C. Collins of *Good to Great* fame says it takes a company seven years to go from good to great. The path is clearly long. The reason reputation recovery has risen in importance is that the "stumble rate " among companies has risen exponentially over the past five years. In fact, 79% of the world's most admired companies have lost their number one positions in industries in that time period. Companies which were once heralded as invincible no longer are.

REPUTATION MANAGEMENT

Reputation management. also known as directory management, is the process of tracking an entity's actions and other entities' opinions about those actions; reporting on those actions and opinions; and reacting to that report creating a feedback loop. All entities involved are generally people, but that need not always be the case. Other examples of entities include animals, businesses, or even locations or materials. The tracking and reporting may range from word-of-mouth to statistical analysis of thousands of data points.

Reputation management has come into wide use with the advent of widespread computing. This is evidenced by a front page story in the Washington Post. featuring several online reputation management firms. Reputation management systems use various predefined criteria for processing complex data to report reputation. However, these systems only facilitate and automate the process of determining trustworthiness. This process is central to all kinds of human interaction, including interpersonal relationships, international diplomacy, stock markets, communication through marketing and public relations and sports. A number of enterprise reputation management software solutions exist in the international market. These software services are typically designed to connect organizations to their stakeholders, track the orchestration of stakeholder engagement and analyse, measure and manage the results.

7

The Role of Computers in Reshaping the Work Force Business Management

Today's versatile computers have some impact on nearly every occupation and industry in the U.S. economy, unlike past technology which usually affected only specific jobs

Computers may be the most profound technology since steam power ignited the Industrial Revolution. Computer technology is altering the form, nature, and future course of the American economy, increasing the flow of products, creating entirely new products and services altering the way firms respond to demand, and launching an information highway that is leading to the globalization of product and financial markets. In addition to affecting the methods of production among firms, computers are changing the relationship between labour and organization. The traditional

pyramid-shaped organizational structure of most corporate firm is the by-product of the Industrial Revolution, which moved work from the individual or family unit to an organizational structure. Computer technology challenges the traditional management hierarchy, moving many organizations from a pyramid-shaped structure to a flatter structure. Historically, decisions were passed from top management to the next management layer; today, computers permit companies to communicate throughout their organizations instantaneously, without regard for traditional management structures. Such wider distribution of authority in some companies has put new emphasis on enhancing labour efficiency by replacing fragmented work with integrated work tasks. This can lead to upgrading worker skills, as shifting flexibility among the production of various goods and services requires a more highly trained work force.

This issue of the Monthly Labour Review explains how computers have affected jobs in selected manufacturing and services industries and in high-tech defence industries, and discusses an emerging market made possible by computers-the home market. This chapter presents an overview of the six articles included in this series; it begins by summarizing some of the rapid changes that have occurred in computer technology over the years.

WORKFLOW/BUSINESS PROCESS MANAGEMENT

Workflow (WF) and business process management (BPM) differ substantially.

There are Different Types of Workflow, for Example:

- production workflow uses predefined sequences to guide and control processes, and
- in ad-hoc workflow, the user determines the process sequence on the fly.

Workflow Solutions can be Implemented as:

- workflow solutions, with autonomous clients which users mostly work with, or as
- workflow engines, which act as a background service controlling the information and data flow, without requiring an own client for this.

Workflow Management Includes the Following Functions, Among Others:

- visualisation of process and organization structures;
- capture, administration, visualization, and delivery of grouped information with its associated documents or data;
- incorporation of data processing tools (such as specific applications) and documents (such as office products);
- parallel and sequential processing of procedures including simultaneous saving;
- reminders, deadlines, delegation and other administration functionalities;
- monitoring and documentation of process status, routing, and outcomes, and
- tools for designing and displaying process.

The objective is to largely automate processes by incorporating all necessary resources. Business process

management (BPM) goes a step further than workflow. Although the words are often used interchangeably, BPM aims at the complete integration of all affected applications within an enterprise, with monitoring of processes and assembling of all required information. Among BPM's functions are:

- complete workflow functionality;
- process and data monitoring at the server level;
- enterprise application integration (EAI), to link different applications, and
- business intelligence (BI), with rule structures, integration of information warehouses, and utilities that assist users in their work.

Today, "manage" components are offered individually or integrated as suites. In many cases they already include the "store" components.

STORE

"Store" components are used for the temporary storage of information which it is not required or desired to archive. Even if it uses media that are suitable for long-term archiving, "Store" is still separate from "Preserve."

The "Store" components listed by AIIM can be divided into three categories: "Repositories" as storage locations, "Library Services" as administration components for repositories, and storage "Technologies". These infrastructure components are sometimes held at the operating system level like the file system, and also include security

technologies which will be discussed further below in the "Deliver" section. However, security technologies including access control are superordinated components of an ECM solution.

REPOSITORIES

Different kinds of ECM repositories can be used in combination. Among the possible kinds are:

FILE SYSTEMS

File systems are used primarily for temporary storage, as input and output caches. The goal of ECM is to reduce the data burden on the file system and make the information generally available through "manage," "store" and "preserve" technologies;

CONTENT MANAGEMENT SYSTEMS

This is the actual storage and repository system for content, which can be a database or a specialized storage system;

DATABASES

Databases administer access information, but can also be used for the direct storage of documents, content, or media assets;

DATA WAREHOUSES

These are complex storage systems based on databases, which reference or provide information from all kinds of sources; they can also be designed with more global functions such as document or information warehouses.

LIBRARY SERVICES

Library services have to do with libraries only in a metaphorical way. They are the administrative components close to the system that handle access to information. The library service is responsible for taking in and storing information from the "capture" and "manage" components. It also manages the storage locations in dynamic storage, the actual "store," and in the long-term "preserve" archive.

The storage location is determined only by the characteristics and classification of the information. The library service works in concert with the database of the "manage" components. This serves the necessary functions of search and retrieval.

While the database does not "know" the physical location of a stored object, the library service manages:

- Online storage (direct access to data and documents);
- Nearline storage (data and documents on a medium that the drive can access, but for which robotics or something similar must first be set up), and
- offline storage (data and documents on a medium that is removed from system access).

If there is not a superordinated document management system to provide the functionality, the library service must have:

- a version management to control the status of information, and
- a check-in/check-out, for controlled information provision.

An important library service function is the generation of logs and journals on information usage and edits, called an "audit trail."

STORAGE TECHNOLOGIES

A wide variety of technologies can be used to store information, depending on the application and system environment:

READ AND WRITE MAGNETIC ONLINE MEDIA

this includes hard drives as RAID (redundant array of independent disks) server drive subsystems, storage area networks (SANs) as storage infrastructures and network-attached storage (NAS) as directly accessible network storage areas;

MAGNETIC TAPE

in automated storage units like "libraries" or "silos" with robotics for access, used like DAT in smaller environments for backup but not online access;

DIGITAL OPTICAL MEDIA

CD (CD-R for write-once, read-only Compact Disc, CD/RW for read-and-write compact disk), digital versatile disk (DVD)), MO (magneto optical), and other formats can be used for storage and distribution, or in jukeboxes for online storage.

CLOUD COMPUTING

Storage of data on external servers off-site where they can be accessed via the internet.

PRESERVE

The "Preserve" components of ECM handle the long-term, safe storage and backup of static, unchanging information, as well as temporary storage of information that it is not desired or required to archive.

This is sometimes called "electronic archiving," but that has substantially broader functionality than that of "Preserve." Electronic archiving systems today generally consist of a combination of administration software like records management, imaging or document management, library services (IRS — information retrieval system) and storage subsystems.

But it is not just electronic media that are suitable for long-term archiving. For purely securing information, microfilm is still viable, and is now offered in hybrid systems with electronic media and database-supported access.

The decisive factor for all long-term storage systems is the timely planning and regular performance of migrations, in order to keep information available in the changing technical landscape.

This ongoing process is called *continuous migration*. The "Preserve" components contain special viewers, conversion and migration tools, and long term storage media:

RAPID COMPUTER TECHNOLOGY

In the last 20 years, there have been dramatic changes in computer technology. In the 1970s, computers were

time-sharing mainframe and mini computer systems which allowed dumb terminals to share informations and computing services.

The 1980s saw personal computing. The microprocessor-based computer brought computing power to the individual at the office and home. The development of user-friendly software applications allowed for more uses, however, for the most part, computing was still done in isolation. The use of local-area networks in the workplace helped users communicate beyond the desktops, but only to other users within the organization.

Network computing arrived a decade later, ringing in the age of the information highway. The Internet, a confederation of interconnected networks, connects millions of computers using existing telephone lines. With the help of special software a powerful new computing platform on which to build brand new computing applications is open to all types of computers. Network computing is possible because of speed and cost of die technology. The power of the devices and networks run by microprocessors and software is increasing at a rate never seen before, roughly doubling in performance every 18 months or so. This trend has caused the unprecedented reduction in the cost of microchip-based technology, allowing computers to be used more widely and rapidly.

The decline in costs has assumed a central role in the use of computers. As the production costs of hardware and software fall in comparison to the development cost, it

makes sense for firms to sell their products at a lower cost to establish a market hold.

PRODUCTION FLEXIBILITY IN MANUFACTURING

Semiconductors. Computers have reshaped manufacturing plants, allowing manufacturing firms to serve many markets and produce a wider range of goods. Computer technology helps engineers, managers, and workers schedule the flow of materials, control quality, and change production lines as the demand for products changes.

It allows manufacturers to respond quickly to demand, and deliver a larger variety of products more quickly. With computers, retailers can gather and aggregate sales data electronically, convert the data into orders and transmit the information to manufacturers. Manufacturers with computer links to production systems, distributors and customer networks can respond quickly to the markets. For manufacturers, customized runs can now compete on a cost basis with production runs of standardized products with dedicated assembly runs. All of this depends on the speed and functions of a computers which "in turn is determined by the system design and the underlying capabilities of its components."

Computer manufacturing. Computer manufacturing is an industry in which new rules of production call for redefining the value of a product for which the cost of raw technology is rapidly declining. Jacqueline Warnke explores consumers, demand for computers, as prices for computers

decline and the economy and society take advantage of this lower-priced and higher-quality resource.

VERSATILITY IN SERVICE INDUSTRIES

During the last two centuries, technological innovations in agriculture and manufacturing have increased output, improved productivity, and raised the standards of living for the industrial economies.

This was mainly the case in the past, because for technological innovations to be effectively applied required an industry with a certain size and capital intensity. Typically, service industries were in a less favourable position to apply technological innovations because of the labour intensive nature of most of these establishments.

Due to its versatility and declining cost, computer technology has been applied in many unrelated service industries such as banking, power utilities, retailers, wholesalers, and health services. Computers can fill out and check mortgage-loan forms, transfer calls, and electronically gather and aggregate sales data for retail stores, to name a few uses. Investment by service producers in computer technology has steadily increased since 1975. As of 1993, the top four private sector industries ranked by the U.S. Bureau of the Census as having the greatest percentage of employees working with a computer were service-related industries.

Banking. Investment in computer-related technologies has caused employment adjustments.

In commercial banks, for example, the application of automated teller machines (ATM's) and other related technologies have lessened the need for customers to use a bank teller. Teresa Morisi examines employment changes in commercial banks and discusses how commercial banks, forced to be more competitive after deregulation in 1980, use computer technology to cut costs and offers new products and services to attract customers.

Computer services and engineering. Computer technology has created economies of scale for many services industries, but, more interestingly, has generated a secondary effect called "economies of scope." Many service producers have found that computer technology enables them to offer more services and attract a larger range of customers. (For example, commercial banks are able to offer several methods for their customers to access their accounts, such as automatic teller machines debit cards and personal computers.)

However, some service industries are totally dependent on technology, such as computer and data processing firms which owe their existence to computer technology. William Goodman examines employment trends in computer services and engineering-two service industries that design a large range of products and play important roles in creating and changing computer technology.

THE HOME MARKET

The computer has launched the information highway, creating a whole new market segment-the home market. It

is now the home market that represents a new frontier for computer and software manufactures. This market is considered one of the major opportunities for business investment over the next 20 years. As a result of the decline in cost of personal computers and the increased speed with which computers run, the buyer of a computer for die home now can obtain a high-powered machine that is able to run sophisticated software programs and link to the Internet. Laura Freeman explores this new market, examining the current market trend and its impact on employment.

HIGH-TECH DEFENCE

The modern computer originated during World War II when funds were provided to defence contractors to create military products for intelligence uses. Up to the end of the cold war, defence contractors were instrumental in the development of computer-related technologies such as those found in space vehicles and electronic guidance systems in aircraft, missiles, and rockets. Although still on the cutting edge of technology, defence contractors increasingly have fewer defence funds for development in areas such as computers and microelectronics. Ron Hetrick examines efforts to soften this impact on defence-related private sector employment in a post cold-war era economy.

IN SUM, computer technology is changing the nature and number of jobs. Its impact is extensive because die technology, network system, and software is similar across firms and industries. This is in contrast to technological innovations in the past, which often affected specific

occupations and industries. Computer technology is versatile and affects many unrelated industries and almost every job category.

In some cases, computer technology displaces workers, for example, bank tellers are being replaced with ATM's. But, while the technology is eliminating jobs, it also is creating new ones. Job growth has occurred in semiconductor and computer manufacturing as well as in computer and engineering service industries. However, die rate of job growth in these industries has been decelerating as the technology continues to improve labour efficiency.

Computerization and the emerging information highway is transforming the American economy. Computers are changing the composition and distribution of labour, improving labour efficiency, and creating new markets and new forms of organizations. The series of articles that follow discusses in more detail how computer technology is affecting employment in selected industries.

MANAGING SMALL BUSINESSES, ONE BYTE AT A TIME

The Internet has become a complex marketplace of ideas, products, and services. If you don't know the detailed ins and outs of integral online business processes such as accounting, e-commerce, reporting, order processing, and customer support, you may want to check out Net Ledger, a powerful small business software application from Oracle, the industry leader in business database technology.

A POWERFUL, POPULAR WEB-BASED SOLUTION

Many websites devoted to business management seem to be clusters of various third-party services slapped together into one package. Others are simply well disguised portals to more expensive, sometimes esoteric services. But one popular business management service used widely today was clearly built from the ground up with the primary objective of providing businesses with tools to leverage the Web for business success, and it just keeps getting better.

The Oracle Small Business Suite, powered by Net Ledger, is a Web-based application that provides multi-user capability, online collaborations, access to your accounting system from any location via the Internet, and seamless connections to employees, customers, and suppliers. Because the suite is Internet-based, it is automatically compatible with different operating systems. You don't need to pay for hardware or software, and upgrades and backups are managed for you. It integrates complete front-office and back-office application functionality, thereby allowing companies to run their entire enterprise on a single hosted service. Although it is simple to learn, it is secure, reliable, and scalable to grow as your business grows.

NET LEDGER MAKES THEIR SMALL BUSINESS SERVICE SWEETER

Because of its Oracle Small Business Suite, Net Ledger reigns as the leading provider of integrated customer relationship management (CRM) application services, and now the company has boldly entered an even more impressive

frontier. In September 2004, Net Ledger announced the launch of NetCRM, built on the CRM functionality found in the Oracle Small Business Suite. NetCRM is the first online CRM application that automates the entire sales process, from marketing to lead generation, to prospect management, to sales orders and support.

In addition, NetCRM adds important new features not found in any other online CRM solution. Customizable "Dashboards," unique to NetCRM, highlight key information related to the roles of individual users within an enterprise. Graphical snapshots provide sales personnel and management with performance comparisons, and saved searches highlight the latest results of marketing campaigns. Shortcuts and quick searches keep customer information readily available, and reminders within a Dashboard make it easy to keep track of problems that must be solved and tasks that must be completed.

Selling is made easier and forecasting more accurate by NetCRM's integrated lead capturing and order processing capabilities, which allow businesses to track sales as they actually occur. An online form captures each lead, sends a personalized email auto reply, and then routes the lead to the correct person for follow-up within your sales pipeline according to customizable territory assignment rules.

Sales representatives create sales quotes or orders within NetCRM by selecting from product or service catalogues, and then sales managers receive notification on their Dashboards when sales orders require approval before

closing. This close monitoring of sales transactions helps provide managers and executives with a complete and accurate view of current and future forecasts.

Because NetCRM seamlessly integrates purchase history, you can create tailored campaigns to target specific customer segments of your market. End-to-end campaign management includes system-provided templates, email campaign creation and distribution, and results measurement and analysis—all in one application. With this terrific customer intelligence built in, NetCRM allows businesses to deliver the right message in marketing campaigns much more effectively, since marketing efforts are personalized with customers' names and information they have proven their interest in. After the campaign is executed, NetCRM tracks the results and provides accurate cost-of-acquisition statistics for the entire sales cycle.

NetCRM's knowledge management technology, Net Answers, can provide huge cost savings and increase service capabilities by allowing customers to search an online database for answers to their questions without calling customer support. Companies can track frequently asked questions, standard problem resolutions, and known issues, and organize information into different levels of topics and solutions based on individual experience as well as collective knowledge.

NetCRM also provides a complete compliment of task management tools, partner relationship management features, XML server-to-server integration capabilities,

various configurable user security levels, complete document management functionality, and intranet content publishing capabilities. Its numerous powerful features far outperform those provided by competing CRM products.

E-SERVICES

e-Services or "eServices" is a highly general/generic term usually referring to the provision of services via the Internet (the prefix 'e' standing for "electronic", as it does in many other uses). It is true Web jargon, meaning just about anything done online. This page, for example, is an e-Service.

It can cause confusion when used in conjunction with "Support," as who knows the difference between "eServices" and online Support. It is often best to be avoided for this reason, especially in Website navigation.

e-Services include "e-commerce," although they may also include non-commercial services.

Non-ecommerce e-services include (at least some) "eGovernment" services.

ELECTRONIC COMMERCE

Electronic commerce, commonly known as (electronic marketing) e-commerce or eCommerce, consists of the buying and selling of products or services over electronic systems such as the Internet and other computer networks.

The amount of trade conducted electronically has grown extraordinarily with widespread Internet usage. The use of

commerce is conducted in this way, spurring and drawing on innovations in electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management systems, and automated data collection systems. Modern electronic commerce typically uses the World Wide Web at least at some point in the transaction's life cycle, although it can encompass a wider range of technologies such as email as well.

A large percentage of electronic commerce is conducted entirely electronically for virtual items such as access to premium content on a website, but most electronic commerce involves the transportation of physical items in some way. Online retailers are sometimes known as e-tailers and online retail is sometimes known as e-tail. Almost all big retailers have electronic commerce presence on the World Wide Web.

Electronic commerce that is conducted between businesses is referred to as business-to-business or B2B. B2B can be open to all interested parties (e.g. commodity exchange) or limited to specific, pre-qualified participants (private electronic market). Electronic commerce that is conducted between businesses and consumers, on the other hand, is referred to as business-to-consumer or B2C. This is the type of electronic commerce conducted by companies such as Amazon.com. Electronic commerce is generally considered to be the sales aspect of e-business. It also consists of the exchange of data to facilitate the financing and payment aspects of the business transactions.

TECHNOLOGY INVESTORS REFLECT SIMILAR CONCERNS

SPAMMING AND COMPUTER VIRUSES

The usefulness of email is being threatened by four phenomena: email bombardment, spamming, phishing, and email worms.

Spamming is unsolicited commercial (or bulk) email. Because of the very low cost of sending email, spammers can send hundreds of millions of email messages each day over an inexpensive Internet connection. Hundreds of active spammers sending this volume of mail results in information overload for many computer users who receive voluminous unsolicited email each day. Email worms use email as a way of replicating themselves into vulnerable computers. Although the first email worm affected UNIX computers, the problem is most common today on the more popular Microsoft Windows operating system. The combination of spam and worm programs results in users receiving a constant drizzle of junk email, which reduces the usefulness of email as a practical tool.

A number of anti-spam techniques mitigate the impact of spam. In the United States, U.S. Congress has also passed a law, the Can Spam Act of 2003, attempting to regulate such email. Australia also has very strict spam laws restricting the sending of spam from an Australian ISP, but its impact has been minimal since most spam comes from regimes that seem reluctant to regulate the sending of spam.

EMAIL SPOOFING

Email spoofing occurs when the header information of an email is altered to make the message appear to come from a known or trusted source. It is often used as a ruse to collect personal information.

EMAIL BOMBING

Email bombing is the intentional sending of large volumes of messages to a target address. The overloading of the target email address can render it unusable and can even cause the mail server to crash.

PRIVACY CONCERNS

Email privacy, without some security precautions, can be compromised because:

- email messages are generally not encrypted;
- email messages have to go through intermediate computers before reaching their destination, meaning it is relatively easy for others to intercept and read messages;
- many Internet Service Providers (ISP) store copies of email messages on their mail servers before they are delivered. The backups of these can remain for up to several months on their server, despite deletion from the mailbox;
- the Received: fields and other information in the email can often identify the sender, preventing anonymous communication.

There are cryptography applications that can serve as a remedy to one or more of the above. For example, Virtual Private Networks or the Tor anonymity network can be used to encrypt traffic from the user machine to a safer network while GPG, PGP, SMEmail, or S/MIME can be used for end-to-end message encryption, and SMTP STARTTLS or SMTP over Transport Layer Security/Secure Sockets Layer can be used to encrypt communications for a single mail hop between the SMTP client and the SMTP server.

Additionally, many mail user agents do not protect logins and passwords, making them easy to intercept by an attacker. Encrypted authentication schemes such as SASL prevent this.

Finally, attached files share many of the same hazards as those found in peer-to-peer file sharing. Attached files may contain trojans or viruses.

TRACKING OF SENT MAIL

The original SMTP mail service provides limited mechanisms for tracking a transmitted message, and none for verifying that it has been delivered or read. It requires that each mail server must either deliver it onward or return a failure notice (bounce message), but both software bugs and system failures can cause messages to be lost. To remedy this, the IETF introduced Delivery Status Notifications (delivery receipts) and Message Disposition Notifications (return receipts); however, these are not universally deployed in production.

COMPONENTS OF AN ENTERPRISE CONTENT MANAGEMENT SYSTEM

Enterprise content management systems combine a wide variety of technologies and components, some of which can also be used as stand-alone systems without being incorporated into an enterprise-wide system.

The five ECM components and technologies of the ECM model were first defined by AIIM as follows:

- capture
- manage
- store
- preserve
- deliver.

The model includes in the "Manage" category five traditional application areas:

- document management (DM),
- collaboration (or collaborative software, groupware),
- web content management (WCM) (including web portals),
- records management (RM) (archive and filing management systems on long-term storage media), and
- workflow/business process management (BPM).

These "Manage" components connect capture, store, deliver and preserve and can be used in combination or separately. While document management, web content management, collaboration, workflow and business process

management are more for the dynamic part of the life cycle of information, records management takes care of information which will no longer be changed.

The utilization of the information is paramount throughout, whether through independent clients of the ECM system components, or by enabling existing applications that access the functionality of ECM services and the stored information. The integration of existing technologies makes it clear that ECM is not a new product category, but an integrative force. The individual categories and their components will be examined in the following.

CAPTURE

The "Capture" category contains functionalities and components for generating, capturing, preparing and processing analog and electronic information. There are several levels and technologies, from simple information capture to complex information preparation using automatic classification. Capture components are often also called "Input" components.

MANUALLY GENERATED AND CAPTURED INFORMATION

Manual capture can involve all forms of information, from paper documents to electronic office documents, e-mails, forms, multimedia objects, digitized speech and video, and microfilm. Automatic or semiautomatic capture can use EDI or XML documents, business and ERP applications or existing specialist application systems as sources.

TECHNOLOGIES FOR PROCESSING CAPTURED INFORMATION

Various recognition technologies are used to process scanned documents and digital faxes, among them:

OPTICAL CHARACTER RECOGNITION (OCR)

This converts image information into machine-readable characters; OCR is used for type;

HANDPRINT CHARACTER RECOGNITION (HCR)

This refinement of OCR converts handwriting or lettering into machine characters, but does not yet give satisfactory results for running text; however, for defined field content, it has become very reliable;

OPTICAL MARK RECOGNITION (OMR)

OMR, as used for checkboxes for example, reads special markings in predefined fields with very high accuracy; it has proven its value in questionnaires and other forms;

BARCODE

Barcodes on mailed forms allow for the automatic recognition and filing of returns.

DOCUMENT IMAGING

Document Imaging processing techniques are used to capture, improve the quality of and to view images. Functions and features include rotation, zooming, aligning, separation of pages, annotations, despeckling and other.

FORMS PROCESSING

In forms capture, there are two groups of technologies, although the information content and character of the documents may be identical.

PAPER FORMS

Forms processing means the capture of industrially or individually printed forms via scanning; recognition technologies are often used here, since well-designed forms enable largely automatic processing;

E-FORMS/WEB-FORMS

Automatic processing can be used to capture electronic forms as long as the layout, structure, logic and contents are known to the capture system.

COLD

COLD/ERM are technologies for the automatic processing of structured entry data. COLD stands for computer output to laser disk and is still in use although laser disks have not been on the market for years.

The acronym ERM here stands for enterprise report management. For both, supplied output data is processed based on existing structure information in such a way that it can be indexed independently of the origination system, and transferred to a storage component that can be dynamic ("Store") or an archive ("Preserve").

AGGREGATION

Is a process of combining data entries from different creation, capture, and delivery applications. The goal is to

combine and unify data from different sources, in order to pass them on to storage and processing systems with a uniform structure and format.

COMPONENTS FOR SUBJECT INDEXING OF CAPTURED INFORMATION

Systems incorporate further components for subject indexing and getting captured digital information to the appropriate recipients. These include:

INDEXING (MANUAL)

In English parlance, indexing refers to the manual assignment of index attributes used in the database of a "manage" component for administration and access;

INPUT DESIGNS (PROFILES)

Both automatic and manual attributing can be made easier and better with preset profiles; these can describe document classes that limit the number of possible index values, or automatically assign certain criteria; input designs also include entry masks and their logic in manual indexing;

CATEGORIZATION (AUTOMATIC CLASSIFICATION OR CATEGORIZING)

Based on the information contained in electronic information objects, whether OCR-converted faxes, office files or output files, automatic classification programs can extract index, category, and transfer data autonomously; these systems can evaluate information based on predefined criteria or in a self-learning process.

The objective of all "Capture" components is the provision of information to the "Manage" components for further processing or archiving.

MANAGE

The "Manage" components are for the management, processing, and use of information. They incorporate:

- databases for administration and retrieval, and
- access authorization systems.

The goal of a closed ECM system is to provide these two components just once as services for all "Manage" solutions such as document management, collaboration, web content management, records management and workflow/business process management. To link the various "Manage" components, they should have standardized interfaces and secure transaction processes for inter-component communication.

DOCUMENT MANAGEMENT

Document management (DM) in this context does not refer to the industry known in Europe as DMS, but to document management systems in the narrower "classical" sense. These systems control documents from their creation through to long-term archiving. Document management includes functions like:

- check in/check out for checking stored information for consistency;
- version management to keep track of different versions of the same information with their revisions and

renditions (same information in a different format);

- search and navigation for finding information and its associated contexts, and
- visualizing for showing information in structures like virtual files, folders, and overviews.

However, the functions or document management increasingly overlap with those of the other "Manage" components, the ever-expanding functionalities of office applications like Outlook/Exchange or Notes/Domino, and the characteristics of "library services" for administering information storage.

COLLABORATION (COLLABORATIVE SYSTEMS, GROUPWARE)

Collaboration simply means "working together." However, these solutions, which developed from conventional groupware, now go much further and include elements of knowledge management. Collaboration includes the following functions:

- jointly usable information databases;
- joint, simultaneous, controlled information processing;
- knowledge based on skills, resources and background data for joint information processing;
- administration components such as whiteboards for brainstorming, appointment scheduling, project management, etc.;
- communication application such as video conferencing, and

- integration of information from other applications in the context of joint information processing.

WEB CONTENT MANAGEMENT

Enterprise content management claims to integrate web content management (WCM). However, information presented on the Internet and Extranet or on a portal should only be data that is already present in the company, whose delivery is controlled by access authorization and storage. Web content management includes the following functions, among others:

- creation of new or editing of existing information in a controlled generation and publishing process;
- delivery and administration of information for the web presentation;
- automatic conversion for various display formats, personalized display and versions;
- secure separation of access to public and non-public information, and
- visualization for Internet presentation (browser, HTML, XML, etc.).

It is, however, worth noting that many in the industry do not consider WCM as an integral component to an ECM system. There are very few examples of successful implementations whereby a shared repository for documents (the core purpose of ECM) and web content are managed together. Indeed very different techniques and philosophies to structure and organize content are utilized for external facing web content than for internal facing document content.

RECORDS MANAGEMENT (FILE AND ARCHIVE MANAGEMENT)

Unlike with traditional electronic archival systems, records management (RM; electronic records management or ERM) refers to the pure administration of records, important information and data that companies are required to archive. Records management is independent of storage media, and can also manage information stored otherwise than in electronic systems. The following are only some of the functions of records management:

- visualisation of file plans and other structured indexes for the orderly storage of information;
- unambiguous indexing of information, supported by thesauri or controlled wordlists;
- management of record retention schedules and deletion schedules;
- protection of information in accordance with its characteristics, sometimes down to individual content components in documents, and
- use of international, industry-specific or at least company-wide standardized meta-data for the unambiguous identification and description of stored information.