

Integrating Knowledge Management Technologies in Organizational Business Processes: Getting Real Time Enterprises to Deliver *Real* Business Performance

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Abstract: Recent industry case studies provide illustrative examples of successes and failures in integrating knowledge management technologies for enabling organizational business processes and new business models. Based upon insights from selected case studies, this article identifies three key paradigms that have characterized the implementation of KM systems, technologies, and techniques in organizational business processes. Taking a critical view of the mainstream characterization of KM technologies, this article highlights the 'critical gaps' between technology inputs, related knowledge processes, and business performance outcomes. Drawing upon the above issues, the article develops pragmatic understanding for leveraging the power of *disruptive technologies* through *disruptive business value propositions and customer value propositions* embedded in organizational business processes and enterprise business models¹.

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¹ Technologies that may possibly transform the competitive structure of industries as well as market positions of the players are often described as *disruptive technologies*. A number of examples of such technologies are discussed in this article as well as in the illustrative case studies. However, the article's key emphasis is on *uniquely interesting and specific business value propositions and customer value propositions* embedded in business models of best performing corporations that truly underlie the power realized through technologies characterized as disruptive *or* otherwise. This is illustrated by examples of companies that spectacularly failed despite deploying the technologies identified as 'disruptive' during any specific era as well as companies that succeeded despite being laggards in terms of adoption of the technologies hyped as 'disruptive' by industry analysts during the same era.

Introduction

“Technologists never evangelize without a disclaimer: “Technology is just an enabler.” True enough -- and the disclaimer discloses part of the problem: Enabling what? One flaw in knowledge management is that it often neglects to ask what knowledge to manage and toward what end. Knowledge management activities are all over the map: Building databases, measuring intellectual capital, establishing corporate libraries, building intranets, sharing best practices, installing groupware, leading training programs, leading cultural change, fostering collaboration, creating virtual organizations -- all of these are knowledge management, and every functional and staff leader can lay claim to it. But no one claims the big question: Why?”

-- Tom Stewart in *The Case Against Knowledge Management, Business 2.0*, February 2002

The recent summit on Knowledge Management (KM) at the pre-eminent *ASIST* conference opened on a rather upbeat note. The preface noted that KM has evolved into a mature reality from what was merely a blip on the ‘good idea’ radar only a few years ago. Growing pervasiveness of KM in worldwide industries, organizations, and institutions marks a watershed event for what was called a *fad* just a few years ago. KM has become embedded in the policy, strategy, and implementation processes of worldwide corporations, governments, and institutions. Doubling in size from 2001, the global KM market is projected to reach US\$8.8 billion in 2004. Likewise, the market for KM business application capabilities such as CRM is expected to grow to \$148 billion by 2005. KM is also expected to help save \$31 billion in annual re-invention costs at *Fortune 500* companies. The broader application context of KM, which includes learning, education, and training industries, offers similarly sanguine forecasts. Annual public K-12 education is estimated at \$373 billion dollars in United States alone, with higher education accounting for \$247 billion dollars. In addition, the annual corporate and government training expenditures in United States alone are projected at over \$70 billion dollars.

One can see the impact of knowledge management everywhere but in the KM technology-performance statistics (Malhotra 2003). This seems like a contradiction of sorts given the pervasive role of information and communication technologies in most KM applications. Some industry estimates have pegged the failure rate of technology implementations for business process reengineering efforts at 70%. Recent industry data suggest a similar failure rate of KM related technology implementations and related applications (Darrell et al., 2002). Significant failure rates persist despite tremendous improvements in sophistication of technologies and major gains in related price-performance ratios. At the time of writing, technology executives are facing a renewed credibility crisis resulting from cost overruns and performance problems for major implementations (Anthes and Hoffman, 2003). In a recent survey by Hackett Group, 45% CIOs attribute these problems to technology implementations being too slow and too expensive. Interestingly, just a few months ago, some research studies had found *negative* correlation between tech investments and business performance (Alinen, 2002; Hoffman, 2002). Financial performance analysis of 7,500 companies relative to their IT spending and individual surveys of more than 200 companies had revealed that:

- Companies with best-performing IT investments are often most frugal IT spenders.
- Top 25 performers invested 0.8% of their revenues on IT in contrast to overall average of 3.7%.
- Highest IT spenders typically under-performed by up to 50% compared with best-in-class peers.

Based upon multi-year macroeconomic analysis of hundreds of corporations, Strassmann (1997) had emphasized that it is not computers but what people do with them that matters. He had further

emphasized the role of users' motivation and commitment in IT performance.² Relatively recent research on implementation of enterprise level KMS (Malhotra 1998, Malhotra and Galletta 1999, Malhotra and Galletta 2003, Malhotra and Galletta *in press*) has found empirical support for such socio-psychological factors in determining IT and KMS performance. An earlier study by Forrester had similarly determined that the top-performing companies in terms of revenue, return on assets, and cash-flow growth spend less on IT on average than other companies. Surprisingly, some of these high performance 'benchmark' companies have *lowest* tech investments and are recognized *laggards* in adoption of leading-edge technologies. Research on best performing U.S. companies over the last 30 years (Collins, 2001) has discovered similar 'findings'. The above findings may seem *contrarian* given persistent and long-term depiction of technology as *enabler* of business productivity (cf: Brynjolfsson 1993; Brynjolfsson and Hitt 1996; Brynjolfsson and Hitt 1998; Kraemer 2001).

Despite increasing sophistication of KM technologies, we are observing increasing failures of KM technology implementations (Malhotra 2002a). The following sections discuss how such failures result from the knowledge gaps between technology inputs, knowledge processes, and business performance. Drawing upon theory, prior research, and industry case studies, we also explain why some companies that spend *less* on technology and are *not* leaders in adoption of most hyped RTE technologies succeed where others fail. The specific focus of our analyses is on the application of KM technologies in organizational business processes for enabling real time enterprise business models. The RTE enterprise is considered the epitome of the agile adaptive and responsive enterprise capable of anticipating surprise; hence our attempt to reconcile its sense making and information processing capabilities is all the more interesting. However, our theoretical generalizations and their practical implications are relevant to IT and KM systems in most enterprises traversing through changing business environments.

Disconnects Between Disruptive Information Technologies and *Relevant* Knowledge

Organizations have managed knowledge for centuries. However, the popular interest in digitizing business enterprises and knowledge embedded in business processes dates back to 1993.³ Around this time, the *Business Week* cover story on virtual corporations (Byrne 1993) heralded the emergence of the new model of the business enterprise. The new enterprise business model was expected to make it possible to deliver anything, anytime, and, anywhere to potential customers. It would be realized by digitally connecting distributed capabilities across organizational and

² Strassmann's research has primarily focused on macro-economic analysis of industry IT investments data and has not empirically studied the behavioral and strategic disconnects related to IT and KM performance discussed in this paper. Author's seminal research in this context – referenced in this article – specifically focuses on these disconnects between IT, information, actions, and performance at individual, organizational, and national levels. Therefore, author's research on behavioral-strategic disconnects between IT- and KM- performance complements research by others that has focused primarily on macro-economic aspects. An interesting focus for future practice and research is in terms of reconciling existing gaps between economic, sociological, and behavioral aspects of IT- and KM- performance as recommended in Malhotra (2003).

³ Some may argue that the interest in digitizing knowledge of business enterprises pre-dates 1990s as prior AI and expert systems have focused on such processes. Our focus in this article is on the "real-time enterprise" logic in which inter-connected value-chains can respond in real-time to supply and demand changes almost in real time. As the commercialization of the Web occurred much later than the invention of the first browser version of Mosaic, such real-time capabilities of networking across enterprises were not available and as affordable in the post-1995 era. However, there are fundamental problems characterizing the AI and expert systems based focus on KM systems that is discussed in greater depth in the contrast between 'sense making' and 'information processing' capabilities explained in the *Expert Systems With Applications* journal special issue on Knowledge Management (Malhotra, 2001b).

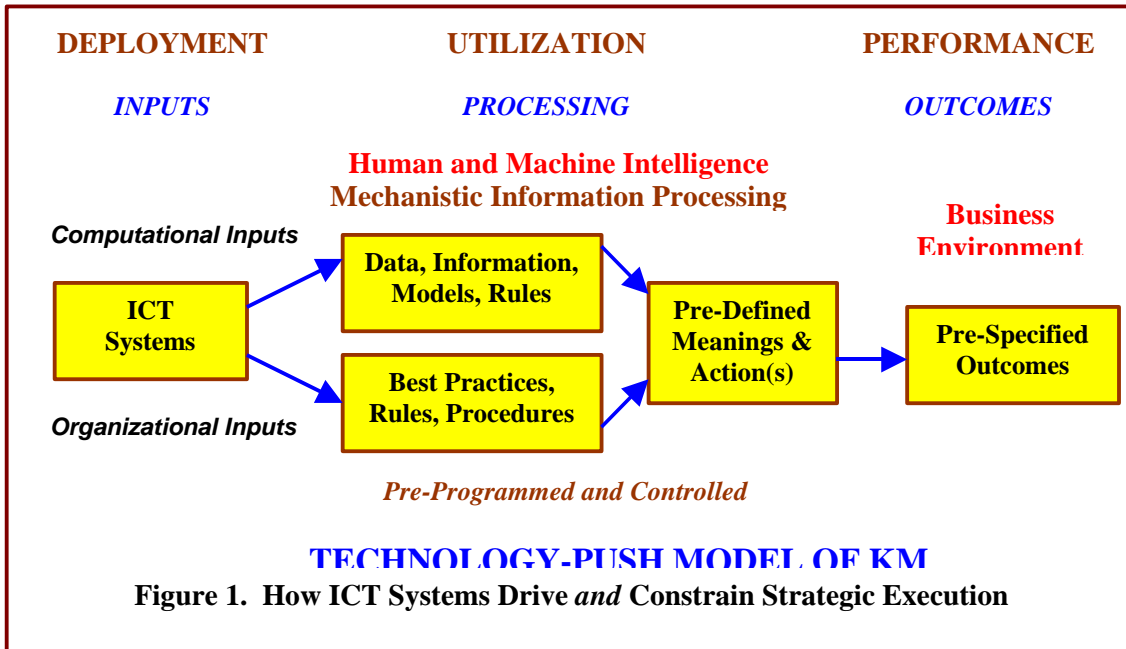
geographical boundaries. Subsequently, the vision of the virtual, distributed, and digitized business enterprise became a pragmatic reality with the mainstream adoption of the Internet and Web. Incidentally, the distribution and digitization of enterprise business processes was expedited by the evolution of technology architectures beyond mainframe *to* client-server *to* Internet and Web and more recently *to* Web services. Simultaneously, the software and hardware paradigms have evolved to integrated hosted services and more recently to *utility computing* and *on demand* computing (Greenemeier, 2003a, 2003b; Hapgood, 2003; Sawhney, 2003; Thickins, 2003) models. Organizations with legacy enterprise business applications trying to catch up with the business technology shifts have ended up with disparate islands of diverse technologies.

Decreasing Utility of the *Technology-Push Model*

Management and coordination of diverse technology architectures, data architectures, and system architectures poses obvious knowledge management challenges (Malhotra 1996; Malhotra 2001a; Malhotra 2002a). Such challenges result from the need for integrating diverse technologies, computer programs, and data sources across *internal* business processes. These challenges are compounded manifold by the concurrent need for *simultaneously* adapting enterprise architectures to keep up with changes in the *external* business environment. Often such adaptation requires upgrades and changes in existing technologies or their replacement with newer technologies. Going business enterprises often have *too much* [unprocessed] data and [processed] information and *too many* technologies. However, for most high-risk and high-return strategic decisions, timely information is often unavailable as more and more of such information is *external* in nature (Drucker, 1994; Malhotra, 1993; Terreberry 1968; Emery & Trist 1965). Also, *internal* information may often be hopelessly out of date with respect to evolving strategic needs. Cycles of restructuring and downsizing often leave little time or attention to ensure that the dominant business logic is kept in tune with changing competitive and strategic needs.

As a result, most organizations of any size and scope are caught in a double whammy of sorts. They *do not know what they know*. In simple terms, they have incomplete knowledge of explicit and tacit data, information, and decision models available within the enterprise. Also, their very *survival may sometimes hinge on obsolescing what they know* (see for instance, Yuva 2002, Malhotra 2002a, Malhotra 2002b). In other words, often they may not know if the *available* data, information, and decision models are indeed up to speed with the radical discontinuous changes in the business environment (Arthur 1996, Malhotra 2000a, Nadler and Shaw 1995). In this model, incomplete and often outdated data, information, and, decision models *drive* the realization of the strategic execution, but with diminishing effectiveness. The model may include *reactive* and *corrective* feedback loops. The logic for processing specific information and respective responses are all pre-programmed, pre-configured, and pre-determined. The mechanistic information-processing orientation of the model generally does not encourage diverse interpretations of information or possibility of multiple responses to same information. As depicted in **Figure 1**, this model of KM is often *driven* by technological systems that are out-of-alignment with strategic execution and may be characterized as the *Technology-Push Model*. This model has served the needs of business performance given more manageable volumes of information and lesser variety of systems within relatively certain business environment. However, with recent unprecedented growth in volumes of data and information, the continuously evolving variety of technology architectures, and the radically changing business environment, this model has outlasted its utility. The limitations of the *Technology-Push* model are evident in the following depiction of IT architectures as described in *Information Week* by LeClaire and Cooper (2000):

"The infrastructure issue is affecting all businesses... E-business is forcing companies to rearchitect all or part of their IT infrastructures--and to do it quickly. For better or worse, the classic timeline of total business-process reengineering--where consultants are brought in, models are drawn up, and plans are implemented gradually over months or years--just isn't fast enough to give companies the E-commerce-ready IT infrastructures they need... Many companies can't afford to go back to the drawing board and completely rearchitect critical systems such as order fulfillment and product databases from the bottom up because they greatly depend on existing infrastructure. More often, business-process reengineering is done reactively. Beyond its disruptive effect on business operations, most IT managers and executives don't feel there's enough time to take a holistic approach to the problem, so they attack tactical issues one-by-one. Many companies tackle a specific problem with a definitive solution rather than completely overhaul the workflow that spans from a customer query to online catalogs to order processing."



Strategic Execution: The Real Driver of Business Performance

The *gap* between IT and business performance has grown with the shifting focus of business technology strategists and executives. Over the past two decades, their emphasis has shifted from IT (Porter and Millar 1985, Hammer 1990) to information (Evans and Wurster 2000; Rayport and Sviokla 1995; Hopper, 1990; Huber, 1993; Malhotra, 1995) to knowledge (Holsapple and Singh 2001, Holsapple 2002; Koenig and Srikantaiah 2000; Malhotra 2000b, Malhotra 1998b) as the lever of competitive advantage. At the time of the writing, technology sales forecasts are gloomy because of the distrust of business executives who were previously oversold on the capabilities of technologies to address *real* business threats and opportunities. This follows on the heels of the on-and-off love-hate relationship of the *old economy* enterprises and media analysts with the *new economy* business models over the past decade. We first saw unwarranted wholesale adulation and subsequently wholesale decimation of technology stocks. All the while, many industry executives and most analysts have *incorrectly* presumed or pitched technology as the *primary* enabler of business performance (Collins 2001, Schrage 2002)¹.

**Table 1. Strategic Execution As Driver of Technology Deployment and Utilization
Lessons from Companies That Achieved High Business Performance**

Lessons learned from some of the most successful business enterprises that distinguished themselves by making the leap from 'good to great' (Collins, 2001).

Lessons About Outcomes:

Strategic Execution, The Primary Enabler

- [1] How a company reacts to technological change is a good indicator of its inner drive for greatness versus mediocrity. Great companies respond with thoughtfulness and creativity, driven by a compulsion to turn unrealized potential into results; mediocre companies react and lurch about, motivated by fear of being left behind.
- [2] Any decision about technology needs to fit directly with three key non-technological questions: What you are deeply passionate about? What you can be the best in the world at? What drives your economic engine? If a technology does not fit squarely within the execution of these three core business issues, the good-to-great companies ignore all hype and fear and just go about their business with a remarkable degree of equanimity.
- [3] The good-to-great companies understood that doing what you are good at will only make you good; focusing solely on what you can potentially do better than any other organization is the only path to greatness.

Lessons About Processing:

How Strategic Execution Drives Technology Utilization

- [1] Thoughtless reliance on technology is a *liability*, not an asset. When used right - when linked to a simple, clear, and coherent concept rooted in deep understanding - technology is an essential driver in accelerating forward momentum. But when used wrong - when grasped as an easy solution, without deep understanding of how it links to a clear and coherent concept - technology simply accelerates your own self-created demise.
- [2] No evidence was found that good-to-great companies had more or better information than the comparison companies. In fact both sets of companies had identical access to good information. The key, then, lies not in better information, but in turning information into information *that cannot be ignored*.
- [3] 80% of the good-to-great executives didn't even mention technology as one of the top five factors in their transition from good-to-great. Certainly not because they ignored technology: They were technologically sophisticated and vastly superior to their comparisons.
- [4] A number of the good-to-great companies received extensive media coverage and awards for their pioneering use of technology. Yet the executives hardly talked about technology. It's as if the media articles and the executives were discussing two totally different sets of companies!

Lessons About Technology Inputs:

How Strategic Execution Drives Technology Deployment

- [1] Technology-induced change is nothing new. The real question is not, What is the role of technology? Rather, the real question is, How do good-to-great organizations *think differently* about technology?
- [2] It was never technology per se, but the pioneering *application of carefully selected* technologies. Every good-to-great company became a pioneer in the application of technology, but the technologies themselves varied greatly.
- [3] When used right, technology becomes an *accelerator* of momentum, *not* a creator of it. The good-to-great companies *never* began their transitions with pioneering technology, for the simple reason that you cannot make good use of technology until you know which technologies are relevant.
- [4] You could have taken the exact same leading-edge technologies pioneered at the good-to-great companies and handed them to their direct comparisons for free, and the comparisons still would have failed to produce anywhere near the same results.

The findings from the research (Collins 2001) on best performing companies over the last three decades are summarized in **Table 1**. These findings are presented in terms of the Inputs-Processing-Outcomes framework used for contrasting the *Technology-Push* model with the *Strategy-Pull* model of KM implementation.⁴ Subsequent discussion will further explain the relative advantages of the latter in terms of strategic execution and business performance. Given latest advances in Web services, the strategic framework of KM discussed here presents a viable alternative for delivering business performance as well as enterprise agility and adaptability (Strassmann 2003).

Will the *Real Knowledge Management Please Stand Up?*

The technology evangelists, criticized by Stewart (2002), have endowed the KM technologies with intrinsic and infallible capability of getting the *right information to the right person at the right time*. Similar critiques (cf: Malhotra 2000a, Hildebrand 1999) have further unraveled and explained the 'myths' associated such proclamations made by the technology evangelists. Specifically, it has been underscored that in *wicked* business environments (Churchman 1971) characterized by radical discontinuous change (Malhotra 2000a), the deterministic and reductionist logic (Odom and Starns 2003) of the evangelists does not hold. Incidentally, most high potential business opportunities and threats are often embedded within such environments (Arthur 1996, Malhotra 2000c, Malhotra 2000d). Such environments are characterized by fundamental and ongoing changes in technologies as well as the strategic composition of market forces. Increasing failures rates of KM technologies often result from their rapid obsolescence given changing business needs and technology architectures. Popular re-labeling by vendors of many information technologies as KM technologies has not helped the situation. Skeptics of technology have observed that *real knowledge* is created and applied in the processes of socialization, externalization, combination, and internalization (Nonaka and Takeuchi 1995) and outside the realm of KM technologies. Practitioners' inability to harness relevant knowledge despite KM technologies and offices of the CKOs caused the backlash and KM was temporarily branded as a *fad*. Scholarly research on latest information systems and technologies, or lack thereof, has further contributed to the confusion between data management, information management, and knowledge management.

Recent reviews of theory and research on information systems and KM (Alavi and Leidner 2001; Schultze and Leidner 2002) seem to confirm Stewart's (2002) observation about the key *flaw* of knowledge management: "*Knowledge management activities are all over the map... But no one claims the big question: Why?*" Hence, it is critical that a robust distinction between technology management and knowledge management should be based on theoretical arguments that have been tested empirically in the "real world messes" (Ackoff 1979) and the "world of re-everything" (Arthur 1996). We are observing diminishing credibility of information technologists (Anthes and Hoffman 2003; Hoffman 2003; Carr 2003). A key reason for this is an urgent need for understanding how technologies, people, and processes *together* influence business performance

⁴ The *Technology-Push* model and the *Strategy-Pull* model of KM implementation are discussed as contrasting 'archetypes' for business environments ranging from highly routine and predictable environments to radically changing and discontinuous environments. It is, however, recognized that most real world business environments as well as most real world business contexts would fall between the two polar contrasts. Hence most such RTE models would effectively combine the two models for balancing new knowledge creation and commercial exploitation of existing knowledge. Balancing the two processes is discussed in author's interview with the Institute for Supply Management featured in the Knowledge Management cover story of *Inside Supply Management* (Yuva 2002). Additional discussion on balancing the apparently paradoxical processes is available in Malhotra (2000a, 2001a, 2002a).

(Murphy 2003). Explicit focus on strategic execution as the driver of technology configurations in the *Strategy-Pull* KM framework reconciles many of the above problems. The evolving paradigm of technology architectures to *on demand* plug-and-play inter-enterprise business process networks (Levitt 2001) is expected to facilitate future realization of KM value networks. Growing popularity of the Web services architecture (based upon XML, UDDI, SOAP, WSDL) is expected to support the realization of *real-time deployment* of business performance driven systems based upon the proposed model (Kirkpatrick 2003, Zetie 2003, Murphy 2003).

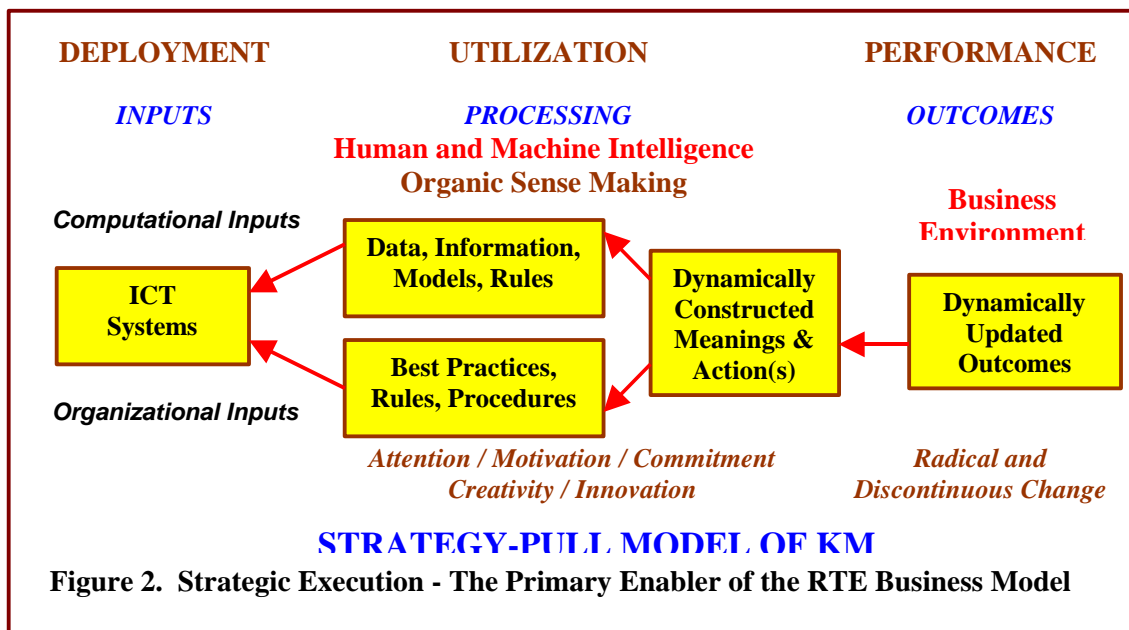
The *Technology-Push* model is attributable for the *inputs-* and *processing-* driven KM implementations with emphasis on *pushing* data, information, and decisions. In contrast, the *Strategy-Pull* model recognizes that getting *pre-programmed* information to *pre-determined* persons at the *pre-specified* time may *not* by itself ensure business performance. Even if pre-programmed information does not become out-dated, the recipient's attention and engagement with that information is at least equally important. Equally important is the reflective capability of the recipient to determine if novel interpretation of the information is necessary or if consideration of novel responses is in order given external changes in the business environment. The *Technology-Push* model relies upon *single-loop* automated and unquestioned automatic and pre-programmed response to received stimulus. In contrast, the *Strategy-Pull* model has built in *double-loop* process that can enable a true sense-and-respond paradigm of KM.² The focus of the *Technology-Push* model is on *mechanistic information processing* while the *Strategy-Pull* model facilitates *organic sense making* (Malhotra 2001b). The distinctive models of knowledge management have been embedded in KM implementations of most organizations since KM became fashionable. For instance, the contrast between the models can be illustrated by comparing the fundamental paradigm of KM guiding the two organizations, a U.S. global communications company and a U.S. global pharmaceutical firm. The telecommunications company adopted the mechanistic *information-* and *processing-* driven paradigm of KM (Stewart & Kaufman 1995): "What's important is to find useful knowledge, bottle it, and pass it around." In contrast, given their emphasis on insights, innovation, and creativity, the pharmaceutical company adopted the organic sense-making model of KM (Dragoon 1995, p. 52): "There's a great big river of data out there. Rather than building dams to try and bottle it all up into discrete little entities, we just give people canoes and compasses." The former model enforces top-down compliance and control through delivery of institutionalized information and decision models. In contrast, the latter model encourages discovery and exploration for questioning given assumptions and surfacing new insights (Nonaka and Takeuchi 1995).

Real Time Strategic Execution: The *Real* Enabler of the RTE

The issues of *technology deployment*, *technology utilization*, and *business performance* need to be addressed *together* to ensure that technology can deliver upon the promise of business performance. Interestingly, most implementations of KM systems motivated by the *Technology-Push* model have inadvertently treated business performance a *residual*: what remains after issues of technology deployment and utilization are addressed.³ This perhaps explains the current malaise of IT executives and IT management in not being able to connect with business performance needs (Hoffman 2003). A sense-and-respond KM system that can respond in real time would need to consider the holistic and collective effect of:

- *Real-time deployment* in terms of tech and human infrastructure (inputs).
- *Real-time utilization* in terms of what is done about or with information (processing).
- *Real-time performance* in terms of how it delivers business performance (outcomes).

Deployment of intranets, extranets, or, groupware cannot *of itself* deliver business performance. These technologies would need to be adopted and appropriated by the human users, integrated within their respective work-contexts, and effectively utilized while being *driven by* the performance outcomes of the enterprise. To deliver real-time response, business performance would need to *drive* the information needs and technology deployment needs. This is in congruence with the knowledge management logic of the top performing companies discussed earlier. These enterprises may not have created the buzz about the latest technologies. However, it is unquestionable that these best performing organizations harnessed organizational and inter-organizational knowledge embedded in business processes most effectively to deliver top-of-the-line results. The old model of technology deployment spanning months or often years often resulted in increasing misalignment with changing business needs. *Interestingly, the proposed model turns the Technology-Push model on its head.* The *Strategy-Pull* model illustrated in **Figure 2** treats business performance not as the *residual* but as the *prime driver* of information utilization as well as IT-deployment.



The contrast between the Inputs-Processing-Output paradigms of KM implementations is further explained in the following section to bridge the existing gaps in KM research and practice.

Gaps in KM Implementation Research and Practice

The 'knowledge application gap' that is characteristic of the *inputs-* and *processing-* driven *Technology-Push* model have also been the subject of criticism in scholarly research on KM (Alavi and Leidner 2001, Zack 2001). However, these gaps seem to persist across most of theoretical research and industry practices related to information systems *and* knowledge management as shown in **Table 2**. As discussed in Malhotra (2000a), such gaps have persisted over the past decade despite advances in understanding of KM and sophistication of technology architectures.

**Table 2. Driving KM *with* Business Performance
From Inputs- and Processing- Driven KM to Outcomes-Driven KM**

Additional theoretical and applied definitions of KM are discussed in Malhotra (2000a).

TECHNOLOGY-PUSH MODELS OF KM

[Depicted in Figure 1]

Inputs-Driven Paradigm of KM

- "Knowledge management systems (KMS) refer to a class of information systems applied to managing organizational knowledge. That is, they are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application." (Alavi and Leidner, 2001)
- "Knowledge management is the generation, representation, storage, transfer, transformation, application, embedding, and protecting of organizational knowledge." (Schultze & Leidner 2002)
- "For the most part, knowledge management efforts have focused on developing new applications of information technology to support the capture, storage, retrieval, and distribution of explicit knowledge." (Grover and Davenport, 2001)
- "Knowledge has the highest value, the most human contribution, the greatest relevance to decisions and actions, and the greatest dependence on a specific situation or context. It is also the most difficult of content types to manage, because it originates and is applied in the minds of human beings." (Grover and Davenport, 2001)
- "Knowledge management uses complex networks of information technology to leverage human capital. The integration of user-friendly electronic formats facilitates inter-employee and customer communication; a central requirement for successful KM programs." (eMarketer 2001)
- "In companies that sell relatively standardized products that fill common needs, knowledge is carefully codified and stored in databases, where it can be accessed and used--over and over again--by anyone in the organization." (Hansen and Nohria, 1999)

Processing-Driven Paradigm of KM

- "KM entails helping people share and put knowledge into action by creating access, context, infrastructure, and simultaneously reducing learning cycles." 7,8,25 . (Massey et al., 2001)
- "Knowledge management is a function of the generation and dissemination of information, developing a shared understanding of the information, filtering shared understandings into degrees of potential value, and storing valuable knowledge within the confines of an accessible organizational mechanism." (CFP for *Decision Sciences* special issue on Knowledge Management, 2002)
- "In companies that provide highly customized solutions to unique problems, knowledge is shared mainly through person-to-person contacts; the chief purpose of computers is to help people communicate." (Hansen and Nohria, 1999)

STRATEGY-PULL MODEL OF KM

[Depicted in Figure 2]

Outcomes-Driven Paradigm of KM

- "Knowledge Management refers to the critical issues of organizational adaptation, survival and competence against discontinuous environmental change. Essentially it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings." (Malhotra 1998a, 2002)

The sample of 'definitions' of KM listed in this table is not exhaustive but illustrative. However, it gets the point across about the missing link between KM and business performance in research and practice literatures. Despite lack of agreement on what is KM, most such interpretations share common emphasis on the *inputs- and processing- driven Technology-Push model*. Review of most such 'definitions' also leaves one begging for a response to Stewart's pointed question to technologists' evangelism about KM: "Why?" In contrast, the *Strategy-Pull* model with its *outcomes-driven* paradigm seems to offer a more meaningful and pragmatic foundation for KM. At least as far as real world outcomes are concerned, this paradigm measures up to the expectations about KM policy and its implementation in worldwide organizations⁴. Better understanding of the gaps that we are trying to reconcile is possible by appreciating the contrast between the three paradigms of KM implementation that have characterized the *Technology-Push* and *Strategy-Pull* models of KM depicted in **Figures 1 and 2**. This contrast is explained in terms of their primary and differential focus on the *inputs, processing, and outcomes*.

The *inputs-driven paradigm* considers information technology and KM as synonymous. The *inputs-driven* paradigm with its primary focuses on technologies such as digital repositories, databases, intranets, and, groupware systems has been the mainstay of many KM implementation projects. Specific choices of technologies drive the KM equation with primary emphasis on getting the *right* information technologies in place. However, the availability of such technologies does not ensure that they positively influence business performance. For instance, installing a collaborative community platform may *neither* result in collaboration *nor* community (Barth, 2000; Charles, 2002; Verton, 2002). The practitioners influenced by this paradigm need to review the 'Lessons About Technology Inputs' listed earlier in **Table 1**.

The *processing-driven paradigm* of KM has its focus on best practices, training and learning programs, cultural change, collaboration, and virtual organizations. This paradigm considers KM primarily as means of processing information for various business activities. Most proponents of RTE belong to this paradigm given their credo of getting the *right information to the right person at the right time*. Specific focus is on the activities associated with information processing such as process redesign, workflow optimization, or, automation of manual processes. Emphasis on processes ensures that relevant technologies are adopted and possibly utilized in service of the processes. However, technology is often depicted as an *easy solution* to achieve some type of information processing with tenuous if any link to strategic execution needed for business performance. Implementation failures and cost- and time- overruns that characterize many large-scale technology projects are directly attributable to this paradigm (Anthes and Hoffman 2003, Strassmann, 2003). Often the missing link between technologies and business performance is attributable to choice of technologies *intended* to *fix* broken processes, business models, or, organizational cultures. The practitioners influenced by this paradigm need to review the 'Lessons About Processing' listed earlier in **Table 1**.

The *outcomes-driven paradigm* of KM has its *primary* focus on business performance. Key emphasis is on strategic execution for driving selection and adaptation of processes and activities, and carefully selected technologies. For instance, if collaborative community activities do not contribute to the key customer value propositions or business value propositions of the enterprise, such activities are replaced with others that are more directly relevant to business performance. If these activities are indeed relevant to business performance, then appropriate business models, processes, and culture are *grown* (Brooks 1987) as a *precursor* to acceleration of their performance with the aid of KM technologies. Accordingly, emphasis on business performance outcomes as the

key *driver* ensures that relevant processes and activities, *as well as*, related technologies are adopted, modified, rejected, replaced, or enhanced in service of business performance. The practitioners interested in this paradigm need to review the 'Lessons About Outcomes ' listed earlier in **Table 1**.

The contrast between the outcomes-driven *Strategy-Pull* model and the input- and processing-driven *Technology-Push* model is even evident in the latest incarnation of KM under the moniker of RTE. Given the confusion between KM and KM technologies that resulted in the backlash against technology vendors, it is germane to point out a similar future for the proponents of RTE. There is an imperative need for making a clear distinction between the business performance capabilities afforded by the *RTE business model* and the technologies that are labeled as *RTE technologies*. As discussed earlier, success in strategic execution of a business process or business model may be accelerated with carefully chosen technologies. However, in absence of good business processes and business model, even the most sophisticated technologies cannot ensure corporate survival.

Coming of the Real Time Enterprise: The New Knowledge Management

The RTE enterprise is based upon the premise of getting the *right information* to the *right people* at the *right time* (Gartner Group 2002) in 'real time', i.e., without latency or delay (cf: Lindorff 2002, Lindquist 2003, Margulius 2002, Meyer 2002, Siegele 2002, Stewart 1999). Enabling the RTE should lead to faster and better decisions, and, enhanced agility and adaptability. RTE represents the future of knowledge enabled business processes: wherein digitized organizations interact with increasing and relentless speed and any specific 'event' results in a real-time 'response'. For instance, businesses such as Gillette and Wal-Mart are trying to minimize the delay between a customer order, its shipment and the restocking of inventory with the help of RFID (radio-frequency detection) tags, also known as smart tags (Cuneo 2003). The proponents of RTE technologies suggest that these technologies would help companies to learn to adapt, evolve, and survive within increasingly uncertain business environments. Their rationale still seems to be based on the *Technology-Push* model of KM and may perhaps benefit from recognizing the *Strategy-Pull* model as a complement. One such perspective of RTE (Khosla and Pal, 2002) that yet does not address Stewart's (2002) big question: "Why?" and may benefit from focus proposed above is listed below:

"Real Time Enterprises are organizations that enable automation of processes spanning different systems, media, and enterprise boundaries. Real Time Enterprises provide real time information to employees, customers, suppliers, and partners and implement processes to ensure that all information is current and consistent across all systems, minimizing batch and manual processes related to information. To achieve this, systems for a Real Time Enterprise must be "adaptable" to change and accept "change as the process"."

The RTE will be able to operate at speeds with split-second reaction times that may far exceed human speeds of gathering and processing of information, analysis, and response (Meyer 2002). At least, that is what the proponents of 'RTE technologies' such as Khosla and Pal (2002) claim. Examples of increase of business process velocity that are often attributed to information technology include the following examples (Gartner Research cited in *CIOInsight*, Nov 2002):

- Trading analytics: from 30 minutes to 5 seconds
- Airline operations: from 20 minutes to 30 seconds
- Call center inquires: from 8 hours to 10 seconds
- Tracking finances: from 1 day to 5 minutes
- Supply chain updates: from 1 day to 15 minutes

- Phone activation: from 3 days to 1 hour
- Document transfer: from 3 days to 45 seconds
- Trade settlement: from 5 days to 1 day
- Build-to-order PCs: from 6 weeks to 1 day

RTE enterprises would harness everything from radio frequency sensors and *smart dust* to global positioning satellites and worker-monitoring software to monitor and control all processes and activities. There are obvious benefits of the automated event-driven architectures (Sliwa 2003) for repetitive, structured, and routine decisions (Malhotra, 2002a). Well-tested business processes may be suitable candidates for acceleration with automation of manual activities and workflows (Malhotra, 2000d). However, the more critical problem can be understood in terms of the contrast between the Technology-Push model and the Strategy-Pull model. The programmed logic of the RTE may yield diminishing returns if environmental change outpaces the assumptions and logic embedded in its computerized networks. Split-second decisions based upon pre-determined 'rules' are *efficient* as they follow the single-loop logic and are well suited to repetitive, structured, and routine decisions. However when such decisions are made regardless of the obsolescing business process or business model, the price is paid in terms of *effectiveness* (Drucker, 1994; Yuva 2002). High-risk or high-return situations require reflection, and re-thinking as *meaning of information* could change and previously non-existent responses become feasible. This is all particularly applicable in contexts within which creativity and innovation facilitate emergence of new meaning, insights, and actions. Such complex meaning making and sense making capabilities for *anticipating the unforeseen* are yet unavailable in existing technologies (cf: Wolpert 2001)⁵.

RTE Business Models: *Function* Should Drive the Choice of *Form*

Successful RTE enterprises focus primarily on the *function* of the business model that guides the choice of the infrastructure *form* for accelerating strategic execution. Unsuccessful RTE enterprises, in contrast, often meet their fate because of the misplaced belief that *form* could somehow compensate for the inadequacy of the *function*. Successful RTE business models may be apparent in *virtual* companies such as e-Bay that owe most of their functioning to *social capital* embedded in their users, buyers, and, sellers. Successful RTE business models may also be apparent in companies with brick-and-mortar stores such as Wal-Mart. Regardless of the variations in *form*, most such companies share a similar but distinctive focus on their higher purpose, which guides their strategy and its execution. This observation perhaps explains how some companies achieved most sustained business performance with *lesser* investments in related technologies. Often their success was attributable to a differentiated business model based on strong ties with customers and suppliers rather than most recent investments in CRM and SCM systems. Strategic execution of the business models was *accelerated* with the help of technologies. However, successful companies had superior business models and a consistent track record of strategic execution as a precursor. Smart and selective investments in technologies afforded them the ability to *do more with less* by accelerating their business capabilities. Also, strong ties with suppliers and customers enabled them to spread the risk of investing, deploying, and utilizing the technologies with their partners and customers.⁶

⁵ Additional discussion on how existing 'information processing' focus of technology on semantics (meaning) has yet to address the 'sense making' capacities of human beings within the context of the new paradigm of self-regulation and self-control is available in Malhotra (2001b, 2001c, 2002b).

⁶ It is understandable that WS-I and related web service based experiments (such as RosettaNet) provide hope for technological feasibility of real-time information exchange. However, despite the exploitation of most sophisticated

Enabling the RTE: *Ends* Should Drive the Choice of *Means*

The misplaced emphasis of *Technology-Push* models arose from their primary focus on the *means* rather than the *ends* as explained in this section. Most such KM implementations often happened to be caught in the convoluted complexities of technology deployment and processing without making a *real difference* in business performance. Given the state of technology and the long time spans necessary for getting business systems in place, an obvious question is relevant about the superior business performers: How did the top performing companies manage to produce stellar business results despite having to choose same or similar technologies as their competitors? It may be argued that the top performers always kept their key focus on business performance. They adopted new technologies and adapted old technologies without compromising on that primary focus. Their technologies were used for pushing data, information, and decision models *just like* their competitors. However, unlike the competitors they vanquished, their choices of business processes and technologies were *still* driven by their primary focus on strategic execution. They may not have *planned* to be laggards in adopting new technologies or in spending less on such tech investments. Rather their slow but steady progress in selecting, eliminating, modifying, adapting, and integrating old and new technologies in service of their business models and business processes seemed to pay off. As they *accelerated* their *already superior business models* and business processes with new technologies, they realized greater returns in business performance. It may also be argued that many of their competitors *imitated* their choices of specific technologies often based upon 'best practice' studies and 'benchmarks.' Mistakenly treated as easy and assured solutions for fixing broken business processes and business models, new technologies further escalated the 'knowledge application gap'. Some of these comparison companies saw a spate of fickle and frequent technology and tech personnel changes, but their *business* problems persisted eventually leading to corporate failures or bankruptcies. In contrast, top performing companies have grown their business models around *carefully thought out customer value propositions and business value propositions* in spite of their adoption, or lack thereof, of latest technologies. Knowledge becomes the accelerator of business performance *when* identified with execution of business strategy rather than with the choices of tools and technologies that keep changing with time. In the eyes of the wise, *knowledge and action are one* (Beer, 1994).

Why do Some RTE Businesses Succeed (Where Others Fail)?

The following cases were selected after reviewing the industry case studies of companies that were often described as benchmarks in terms of their RTE business models. Specific companies were chosen based on their visibility in the business technology press and popular media. The reviews of industry cases studies were guided by our interest in understanding the link between investments in advanced technologies and resulting business performance.

technical standards, information exchange within and between enterprises remain more of a sociological and cultural issue than a technical issue. Hence, despite availability of technical standards that may ensure perfect real time communication, sociological and cultural artifacts impose a major burden. Conversely, concerns that tend well to such sociological and cultural concerns, as discussed in this article, *accelerate* their RTE business models through adoption of facilitating technologies. More in-depth discussion on this theme is available in the author's Intel Corporation's e-Strategy research paper (Malhotra 2001a).

Wal-Mart: RTE Business Model where Technology Matters Less

Some IT analysts have attributed Wal-Mart's success to its investment in RTE technologies. However, Wal-Mart has emerged as a company that has set the benchmark of doing *more with less*. Wal-Mart did not build its competitive advantage by investing heavily or by investing in latest technologies (Schrage 2002). A McKinsey Global Institute reports, "The technology that went into what Wal-Mart did was not brand new and not especially at the technological frontiers, but when it was combined with the firm's managerial and organizational innovations, the impact was huge." More recently, Collins (2003) has predicted that Wal-Mart may become the first company to achieve trillion-dollar valuation within next ten years following the performance-driven model delineated in **Table 1** and discussed earlier. In contrast to its competitors, Wal-Mart systematically and rigorously deployed its technologies with clear focus on its core value proposition of lowest prices for mass consumers. With that singular focus, it went about setting up its supply chains and inventory management systems to accelerate business performance. Long before anyone had heard about the RTE technologies, Wal-Mart was perfecting its logistic prowess based on the hub-and-spoke model of truck routes and warehouses underlying its inventory management systems. It was much later in the process when for its \$4 billion investment in its supply chain systems its suppliers invested *ten times* that amount to accelerate its RTE business model underlying its supply chain network (Schrage 2002). The business model created the strong linkages with suppliers, which not only heavily subsidized the costs of technology investments but also pre-committed the partners to the success of the shared systems. Simultaneously, given its retail channels, distribution network, and proximity to customers through market scanner data, it has preempted its suppliers from directly competing against it.

Dell: RTE Business Model that Does More With Less

Dell has developed and perfected its business model by developing strong ties with its customer base over the past 17 years. It perfected its business model over several years before *accelerating* its business performance with the aid of carefully selected technologies. It has cultivated outstanding relationships with its virtual supply chain partners including outsourcing providers [such as Solectron] and technology vendors [such as HP, Sony, and EMC]. Dell also leverages its customer reach and range and market penetration for deriving commercial benefits from technologies developed by its technology partners. It has been developing and extending the real time logic over the past several years first for selling and servicing desktop computers, and later to aggregation and distribution of value-added products and services servers, storage, networking, printers, switches, and handheld computers. According to a survey of 7,500 companies conducted by Alinean (2002), Dell is a thrifty IT spender. Dell is equally frugal in its R&D spending (1.5% of revenues), according to a recent *Business Week* report, despite its continuing forays into new products and services. Through its alliances with partners such as EMC, Dell is able to leverage their research on product innovation while itself concentrating on perfecting the linkages with customers as well as suppliers. Dell's early innovations in *passionate pursuit* for being the low cost 'build on demand' leader for consumer computing products has yielded it the advantage of real time business performance. More recently, it has been able to accelerate the performance of its business model with the aid of carefully chosen technologies.

GE: RTE Automation for Operational Efficiencies

GE views the real time movement as an extension of GE's renowned emphasis on Six Sigma quality drive. The business model defined for maintaining quality standards has been extended to control costs by minimizing response time to problems affecting products purchased by its customers. GE's CIO Gary Reiner tracks once every 15 minutes what he considers to be the few most critical variables including sales, daily order rates, inventory levels, and savings from automation across the company's 13 worldwide businesses. He acknowledges that it is neither feasible nor desirable to track all kinds of information in real time even with the aid of digital dashboards. Most operational information is tracked on daily or weekly basis while other kinds of information is tracked on an exception-reporting basis. The company claims operational savings of 35% to 60% in costs involved in customer response, customer service, and sales. Most of these savings are attributable more to management control rather than to technologies that are used to enforce pre-negotiated contracts on its buyers who deal with its various suppliers. Operational automation that is executed in terms of command and control logic seeking compliance has not been without its adverse ramifications. GE has encountered labor management disputes resulting from the workers who are not accustomed to minute-by-minute electronic surveillance.

Cisco: Real Time Enterprise Technology Troubles

Cisco has been lauded for its RTE technologies since three years ago when its market cap was 850% of its recent market capitalization during this year. The company prided itself about the RTE technologies that offered apparently seamless integration of real time data within and across its supply chain and customer ordering systems. The company had legendary faith in its technologies for predictive modeling and decision-making (Carter 2001). In a Harvard Business Review article, the company's CFO [of that time] claimed that: "We can literally close our books within hours... the decision makers who need to achieve sales targets, manage expenses and make daily tactical operating decisions now have real-time access to detailed operating data." Unfortunately, real-time access to data could not be of much help when, buoyed by its unparalleled growth over several quarters⁵, Cisco made some fundamentally incorrect assumptions about the future. Cisco ignored a key lesson of KM that is often ignored by many others: the past may not be an accurate predictor of the future. While other networking companies with less sophisticated technologies had cut back on production schedules months earlier seeing impending downturn in demand, Cisco stuck to the forecasts of their 'virtual close' system that they considered invincible. As Cisco [or, rather, its technology-driven forecasting systems] had *never* been proven wrong before, their business partners saw little merit in trying to question their *proven* wisdom. As a result of misplaced faith in the power of the forecasting systems, Cisco ended up writing off \$2.2 billion in inventories and sacking 8,500 employees. Industry experts and analysts suggest that Cisco's write-off resulted from its blindsided over-reliance on its much vaunted "virtual close" systems. Cisco's case demonstrates that even the best technology offers no protection against bad management decisions, especially when the assumptions embedded in the dominant logic are taken for granted. Some Cisco executives do maintain that in absence of the RTE "virtual close", the outcome could have been worse. Cisco retains its optimism in perfecting its RTE systems hoping they would eventually provide high certitude in the face of increasingly uncertain business environment.

Enron: Destroyed in Real Time

Given the dominant and intensive role of real-time information, many of the technologies associated with real-time response were initially adopted by financial services firms on the Wall Street. Given Enron Online's primary business of exchanging and trading financial data, the real-time response model seemed like a match made in heaven. Enron planned to leverage its online exchange for facilitating direct real time instantaneous transactions in the online trading of energy market commodities. In its communiqué submitted to the Federal Trade Commission, Enron had emphasized that, "Efficiency gains made possible by dynamic pricing and trading are especially well suited to Enron's on-line business because electronic trading can match the speed with which commodity pricing changes. Transactions that used to take up to three minutes to complete over the phone now take just a second or two, including complex processes such as credit checks." The company deployed Tibco's vaunted 'RTE platform', sought out new technology wherever possible, and planned to spend hundreds of millions of dollars on technology infrastructure. The management control and oversight vagaries of Enron's management as well its insider- and self-dealings with fictitious entities are well documented in the records of the US Senate hearings as well as the public records of print and broadcast media. Post-hoc analysis of Enron's RTE technologies confirms prior observations about the Technology-Push model (Berinato 2002):

"If these [accounting irregularities] hadn't come up, the IT inefficiency might well have come up to bite Enron... Enron IT was as cutting edge as it was Byzantine. There were plenty of great tools, but there was precious little planning... The core systems supporting the main revenue-generating activities were very disjointed... There were major disconnects from deal capture to risk management to logistics to accounting. They all worked from different data sources... They had teams and teams of people who had to comb through the data and massage it so that it made sense... There was a lot of magic, transforming apples into oranges and oranges into apples. Preparing annual reports was a joke... The breakneck deployment of state-of-the-art technology was done with little regard for a management plan."

When the cover about the collusion between Enron insiders and its auditing firm blew open, the RTE system triggered the freefall of Enron as it was also covering the risk exposure related to its instantaneous transactions. Unfounded and overly optimistic belief in *technology as the means for generating profits despite an inadequate business model* led to Enron's downfall resulting in one of the largest corporate bankruptcies in U.S. history.⁷

Conclusion

This article opened with the observation that although KM activities are "all over the map" in terms of technology implementations, however, no one has asked the "big question": Why? Despite diverse propositions about "getting the right information to the right person at the right time," almost everyone neglects to ask what knowledge to manage and toward what end. A review of the industry case studies of companies characterized in the recent years as RTE business enterprises surfaced some interesting insights. Recent industry analyses that have demonstrated inverse correlations between IT investments and business performance provided some motivation

⁷ One news story had the following remarks about Enron's business model: "In the aftermath of the collapse, there have been suggestions that a few directors had mishandled the partnerships to siphon off funds to their own accounts. However, it is clear that the more than 3,000 partnerships, more than 800 of which were in tax havens like the Cayman Islands, played a far more purposeful role in Enron's business model." Despite real time availability of information, the corporate crisis in this case pertains to sociological and cultural issues such as senior management's corruption and auditors' dishonesty that led to 'real time' cover-ups despite access to best technology.

for this analyses. Additional impetus was provided by the contrast between the hype about 'RTE technologies' propagated by some IT analysts and our in-depth analysis of companies that achieved success as RTE benchmarks. To some extent the search for the 'next big thing' and the 'killer app' is to blame for its narrow focus on IT and innovation as *ends* rather than *means* for achieving sustainable business performance (Business Week 2003). The big question "Why?" should drive tactical and operational aspects of technology and process related innovations in an organizational KM implementation. As contrasted with the inputs- and processing- focused Technology-Push model, explicit and specific performance outcomes oriented focus of the Strategy-Push model, further emphasized the focus on the 'big question.'

The contrast between the three archetypes of inputs-, processing-, and outputs-driven paradigms of KM explained in Table 1 and Table 2 further aided deconstruction of the existing conceptualizations and practices of KM. One such conceptualization of KM that has been applied in diverse worldwide governmental and corporate practices was then discussed to motivate subsequent discussion on the RTE business models. The contrast between information-processing capabilities of latest technologies and needed sense-making capabilities was then explained. Additionally, the mechanistic emphasis of technology-based linkages was contrasted with appreciation for organic and socio-psychological relationships needed for nurturing knowledge processes. Two propositions were offered based on prior discussion – one pertaining to the form and function of the RTE, and the second relevant to the contrast between ends and means of achieving performance outcomes. Based upon original analyses, review of prior research, and review of industry case studies we made specific managerial recommendations about realizing the real time performance of enterprise business models. Specifically, we recommended that: a) organizational function should drive the choice of organizational form; b) ends should drive the choice of means.

The above propositions were then illustrated with the aid of RTE industry case studies that have been used by IT analysts to hype the benefits of RTE technologies. Based upon our analyses, we counter-argued that the benefits attributed to the RTE technologies should indeed be attributable to the RTE business model. We further contended that in absence of an effective RTE business model, even the most expensive and sophisticated technology couldn't ensure corporate survival in the short or long term. The RTE case studies lent support to the primary role of strategic execution as the lever for sustained business performance. As discussed, the successful RTE enterprises achieved their success by staying a step ahead of competition and by offering value propositions that inspired customers' imagination instead of playing the "me too" game in an already crowded market. These companies also selected and integrated ICT capabilities that fit directly with what they were deeply passionate about, what they believed they could be the best at, and what directly drove their steady economic growth. The successful RTE businesses did not adopt new technologies motivated by fear of getting behind. Rather, they thought differently about technology as an *accelerator* of business momentum and *not* its creator. Unlike the successful models of RTE enterprises, the failures were characterized by thoughtless reliance on technology often grasped as an easy solution, without coherent understanding of how it links to strategic execution for business performance.

Background Readings and Research

KMNetwork <http://www.kmnetwork.com/>

The above portal provides unrestricted access to several full-text articles and research papers by the author that have preceded this milestone in fathoming the ongoing evolution and progress in the field of knowledge management.

There are several excellent reviews of various types of information and communication technologies (ICTs) that are used within the realms of KM applications. The focus of this article is on the strategic and overarching framework of real time enterprises and business performance within which specific ICTs are used. For more specifics on technologies that are relevant to the Input- and Processing- aspects of both KM models discussed herein, the reader is advised to peruse Tsui (2002), O'Leary (2002), Conway (2002), Gray and Tehrani (2002), Gray and Tehrani (2002), Susarla et al. (2002), Wei et al. (2002), and, Jackson (2001).

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NOTES

¹ This argument is supported by examples of technology pioneers of yesteryears that have faded into oblivion . For instance, Visicalc, the company that pioneered the spreadsheet lost out to Lotus 1-2-3 which itself lot out to Ms-Excel. The first portable computers came from Osborne, a company that ceased to exist long before portables became adopted by the mainstream.

² For more details on single-loop and double-loop learning, the reader is advised to see seminal writings of Chris Argyris such as Argyris (1990) and Argyris (1994).

³ In some cases of technology implementation such as ERP, the issues of technology deployment and utilization could never get addressed, resulting in snowballing downslide of business performance. See for instance, Strassmann (2003).

⁴ Such as the U.S. Federal Government, United States Army, European Commission, U.S. Agency for International Development, Government of UK, Government of South Africa, Parliament of Victoria (Australia), Government of New Zealand, Government of Argentina, SAP North America, Microsoft Europe, Verisign, Telecom Italia, Organization of Islamic Capitals and Cities (Saudi Arabia), and United Nations and its worldwide agencies. More details accessible at: <http://www.brint.com/casestudies.html>.

⁵ 40 quarters of straight growth and three immediate quarters of extreme growth to the tune of 66%.