Taking the Fear out of Adopting IT in Construction Project Management

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INTRODUCTION
The construction industry is clearly one of the major industries in Hong Kong and the world. In our daily life, we use various services from various industries, including the airline industry, automobiles, railways, manufacturing, and the construction industry, which produces the facilities in which we live and do business. Many of these industries generally exhibit high-quality products, timeliness of service delivery, reasonable cost of service, and low failure rates. The construction industry, on the other hand, is generally the opposite [Hegazy (2002)]. Most projects exhibit cost overruns, time extensions, and conflicts among parties. According to UK Department of Trade and Industry key performance indicator, [DTI (2002)]

- 50% of all construction projects finish over budget
- 54% finish behind schedule
- 24% of construction projects are completed unsatisfactorily, 48% of those having a significant negative impact on business operations

It has become painfully obvious during the past several years that many other industries have outpaced the construction community when it comes to adopting technology tools. While our construction industry was one of the first to embrace the cell phone, we have proven to be laggards when it comes to adopting IT overall.
In fact, Gartner, Stamford, Conn., a research and advisory firm, reports that companies across all industries spent an average of 3.54% of revenues on IT in 2001. The same study shows the construction industry, far behind most of these industries, spends only 0.84% [Stark and Smedley (2002)].

Firstly what do we mean by IT – or Information Technology? Essentially it is a combination of computer hardware and software that is used in order to process data in some way to generate information that we can use to do our job.

We all know construction project management attempts to achieve project mission objectives within specific constraints. It needs information to make decisions. Managers do not need loads of input data generated in the control process. It is the information extracted from the data that helps the managers in performing their functions efficiently and effectively. The world’s richest man, Bill Gates (1999), said, “How you gather, manage, and use information will determine whether you win or lose.”

So what is IT in construction project management? Basically, I’m talking about an integrated computer system that provides information to support operations, management and decision-making functions relating to planning and control of project objectives.

Today, the ubiquity of the Internet has enabled the construction project management system to operate in World Wide Web (“web”) or just using the web browser. The term web-based or Electronic Project Management System (“EPMS”) is commonly called and will be used in the following part of this paper.

It is important to note that EPMS is a broad concept rather than a rigid system. Its offers a wide variety of functions, features as well as the benefits. Moreover, we can distinguish EPMS in two contexts: internal to an organization, or between two or more organizations. When used internally, the tool-set is called Intranet; when deployed between organizations, it is called an Extranet. Actually, the same tools are part of both [WPL Publishing (2000)].

SPECTRUM OF IT ADOPTION
IT can promote various degrees of organizational change ranging from incremental to far-reaching. Three kinds of structural organizational change that are enabled by IT: (1) automation, (2) rationalization, (3) reengineering. Each carries different rewards and risks.
The most common form of IT-enabled organizational change or the first phase of IT adoption is automation. This has allowed employees to automate a number of time-consuming and error-prone activities and gain benefits in cycle-time, productivity, and accuracy. For example, a main contractor makes use of standalone software to keep track all Request For Information (RFI) in a project.

A deeper form of organization change or the second phase of IT adoption is rationalization of procedures. Automation frequently reveals bottlenecks in production and makes the existing arrangement of procedures and structures painfully cumbersome. Rationalization of procedures involves the streamlining of standard operating procedures, which eliminates obvious bottlenecks, so that operating procedures become more efficient. For example, the main contractor implements an intranet and standardizes the data in RFI across all projects in the enterprise.

A more powerful type of organizational change or the third phase of IT adoption is business process reengineering, in which business processes are analyzed, simplified, and redesigned. Reengineering involves radically rethinking the flow of work and the construction business processes with the intention to radically reducing the costs of businesses. Using IT, organizations can rethink and streamline their business processes to improve speed, service, and quality. Business process reengineering reorganizes workflows, combining steps to cut waste and eliminating repetitive, paper-intensive tasks. It is much more ambitious than rationalization of procedures because it requires a new vision of how the process is to be organized. For example, the main contractor sets up an extranet to online collaborate with the architect for the RFI process.

IT CAPAbILITIES AND THEIR ORGANIZATIONAL IMPACTS
Not many construction industry players have moved beyond the first phase of automation. However, there are some companies have committed to a continuing investment in technological advancement and organizational change. By changing how they are organized and do business, they have achieved far greater benefits than available through automation alone. Companies like this have succeeded in staying ahead of their competitors not merely by automating but by changing their organization as well. Their strategic advantage has been their preparedness and ability to continually innovative, and to manage the change necessary to gain substantial business benefits.

The IT capabilities and their organizational impacts can be summarized in the following table [Davenport and Short (1990)].
## Capability | Organizational Impact/Benefit
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Transactional | IT can transform unstructured processes into routinized transactions
Geographical | IT can transfer information with rapidity and ease across great distances, making processes independent of geography.
Automational | IT can replace or reduce human labor in a process.
Analytical | IT can bring complex analytical methods to bear on a process.
Informational | IT can bring vast amounts of detailed information into a process.
Sequential | IT can enable changes in the sequence of tasks in a process, often allowing multiple tasks to be worked on simultaneously.
Knowledge management | IT allows the capture and dissemination of knowledge and expertise to improve the process.
Tracking | IT allows the detailed tracking of task status, inputs, and outputs.
Disintermediation | IT can be used to connect two parties within a process who would otherwise communicate through an intermediary (internal or external).

### CONSTRUCTION IT ADOPTION LIFE CYCLE

According to the thesis in “Crossing the Chasm” [Moore (1991)], the high-tech market adoption will anyhow follow this picture:

![Technology Adoption Life Cycle](image)

Technology adoption is supposed to go from left to right. The innovators fiddle with a
technology to discover if it's real. If it is, they tell the early adopters. The early adopters are less belonged to exploration, more to exploitation. The early adopters then will pass the good word on to the early majority. The early majority want a product that works. Late majority buy products because they really have no choice. They want products that are cheap and do their job as unobtrusively as possible. Laggards are not going to buy, though they may talk other people out of buying.

The common problem is that the early adopters aren’t in good reference for the early majority. They provide tales of heroics – not stories of smooth, predictable adoption. Early majority want references from other early adopters. Early majority want a safe buy from the market leader – but there isn’t one yet. Crossing the chasm is about getting the first toehold in the Mainstream Market.

Is construction IT following this curve? My personal viewpoint is yes!!! The greatest challenge facing construction IT is to make the transition from an early market dominated by a few visionaries to a mainstream market dominated by a large block of pragmatists.

We can see that the uses of accounting software, CAD, scheduling software and E-mail are now almost the industry standard and have been successfully transited to mainstream market. The EPMS Intranet has already crossed the chasm but still in the early stage of mainstream. EPMS Extranet is now crossing the chasm while e-procurement is still remaining in early market.

In order for me to explain the slow movement of EPMS in crossing the chasm, it would be better to correlate with the universal laws of inertia, motion and friction, that I learned in my secondary school physics lesson. In the following sections, I would identify the outside force pushing and pulling the EPMS adoption from left to right. I would also highlight why the construction IT adoption is so ‘heavy’ to move. Then, some causes of ‘friction’ in the EPMS adoption including resistance and counter-implementation would be discussed.

TECHNOLOGICAL PUSH
The advent of various new technologies like the Internet and wireless network, with the potential to address some of the limitations facing current construction project management practices has created a major impact on the industry. The role that technology plays in the construction industry has been gradually changing the way companies conduct everyday business. What used to be a paper-and-pen world will become a monitor-and-keyboard world in the foreseeable future.
Some technologies and advancements pushing the EPMS adoption change include:

- Application software packages meeting the specific construction industry needs including project management, scheduling, document management, estimating, job costing, accounting, field administration, etc;
- Web-based technologies enabling for the sharing and transmitting of information, including drawings, photos, voice, print and computer data. The Internet merges perfectly the time-honored adage that a picture’s worth a thousand words, with the contract-mandated assertion that time is of the essence, to produce an on-line, visual construction management system.
- Wireless technologies, including WAP, that enable the transfer of information to remote sites without the requirement for, or restrictions of, hard infrastructure such as cabling or wires and that are accessible via mobile phones and other hand held devices [Bulmer and Brewer (2000)]; and
- Interoperability, or seamless information exchange via integrated technologies and based on object modeling, allowing all participants in the process to access and value add to the information in a form suitable for their needs. This allows all disciplines and project partners to share information thus avoiding duplicating effort and encouraging collaborative working processes [Bulmer and Brewer (2000)].

Innovators and early adopters believe they are on the ‘leading edge’ of technology, as opposed to the ‘bleeding edge’ [Guinta and Smedley (2003)]. They confess that in order to do business today, especially in construction, employees must be able to communicate wherever and whenever. Thus, IT has proven to be the answer. Early adopters of the new and integrated technologies can reap benefits for their own business and processes, and often influence their project partners to use the technologies.

BUSINESS ENVIRONMENT PULL

The following five business environment changes have altered the construction business environment. This pace of change is introducing new climate, which have highlighted the limitation of the current project management practices in meeting the new requirements.

Firstly, globalization of the world’s industrial economies greatly enhances the value of information to the firm and offers new opportunities to businesses. The challenges we now face are different from the previous era. [Kotter (1996)] A globalized economy is creating both more hazards and more opportunities for everyone, forcing firms to make dramatic improvements not only to compete and prosper but also to merely survive. No one is immune to these forces. We cannot stand still. Instead, we are being forced to try
to improve as driven by this international economic integration.

Secondly, the knowledge and information revolution began at the turn of the twentieth century and has gradually accelerated. In a knowledge- and information-based economy, knowledge and information are key ingredients in creating wealth. Clearly, the proportion of knowledge worker keeps on increasing in our construction industry. New kinds of knowledge- and information-intense organizations like project management companies or environmental engineering firms, have emerged that are devoted entirely to the production, processing, and distribution of information. Information systems are needed to optimize the flow of information and knowledge within the organization and to help management maximize the firm’s knowledge resources.

Thirdly, it has been a transformation of the business enterprise from traditional hierarchical, centralized, structured arrangement of specialists to new style of flattened, decentralized, flexible arrangement of generalists. The new manager relies on nearly instant information, a flexible arrangement of teams and individuals working in task forces [Laudon and Laudon (2001)], and a customer orientation to achieve coordination among employees. The new manager appeals to professionalism and knowledge to ensure proper operation of the firm. Once again, IT makes this style of management possible.

The fourth major change has been in perception of the client/contractor relationship from confrontation to collaboration. This cultural trend pull on the uptake of IT is evidenced by more collaborative working practices, the utilization of shared objectives and partnerships, especially with clients, and an alignment of IT usage with business objectives. Real benefits will flow from IT enabled business process re-engineering, not simply from the automation of manual tasks [Alshawi and Ingrige (2001)].

Finally, never before have owners felt so much pressure to do more with less. To ensure that the property development meets the budget and remain profitable, developers must monitor tightly the project throughout the lifecycle. The imperative pressure from the top hierarchy to build cheaper, faster and better will force the whole project team for seeking enduring improvement in construction project management, and IT should be definitely considered.

INDUSTRY INERTIA
The Construction Industry Review Committee Report [CIRC (2001)] has identified a number of macro level factors that have inhibited a higher IT take-up in construction. This industry’s great inertia made it hard to push or pull in the IT adoption change.
The fragmented nature of the industry which impedes the wider adoption of common IT tools across disciplines. Small to medium sized enterprises (SME) are often the slowest to engage IT and, by numbers, comprise the majority of the construction industry participants. Several market key players have expressed to me their frustration with the fact that the slowness of sub-contractors IT engagement is increasingly affecting the way they conduct business.

The second major inertia is the absence of a conducive environment due to the lack of common standards and a common data infrastructure. Technology has been revolutionizing the construction industry, but there is a clear disconnect between traditional manual practices and new automation developments, whether LAN-based (local-area network) or Internet-based. The Internet platform further perpetuates the industry’s tradition of fragmented processes with new applications that only offer standalone solutions. Enabling systems to transcend platforms and communicate and operate without significant human intervention or costly system integration is therefore critical.

The third major inertia is the low awareness at management levels of the potential benefits of IT as well as the low IT literacy among construction personnel. Management’s lack of knowledge of existing and emerging technologies, and how they can be incorporated at both project and corporate level, is a factor in the organization’s ability to change. Tight profit margins and a tradition of undercapitalization deter investment in skills and awareness particularly among small & medium enterprises (SMEs). Together these deficiencies limit adoption of the technology and its further exploitation.

PEOPLE RESISTANCE
Resistance to change, like the frictional force, is one of the most significant inhibitions for movement. It is normal for individuals, teams or even organizations to react adversely when faced with something different or unexpected. People will especially feel the emotions of denial, defense and discard where the change process affects their self-esteem or position in an organization.

One main cause of resistance in relation to IT take-up is that data are not merely an intellectual commodity but a political resource, whose redistribution through new information systems affects the interests of particular individuals or groups. Project data like a central political resource [Keen (1981)]. Many agents and units in organizations get their influence and autonomy form their control over information. During my consulting experience, some managers are concerned that trends in computer networking and
database administration may similarly encourage their superiors to ‘snoop’.

For example, with collaborative project management sites, there is no way for contractors or architects to hide any project delays – all-correspondence records are plainly documented on the site. Although accountability is a big benefit to owners, it concerns contractors and design firms. Maybe the number one reason for reluctance around using web-based project management site is due to accountability.

The other main cause of resistance is that some construction personnel challenge the value of EPMS. Information is usually regarded only a small component of decision processes. Traditionally, decision processes are remarkably simple; what has worked in the past is most likely to be repeated. The self-assumed experienced construction personnel would tell you that negotiations, habit, rules of thumb, and ‘muddling through’ have far more force than digital information. The point is not that managers are stupid or information systems irrelevant but that decision making is multifaceted, emotive, conservative, and only partially cognitive. It is the fact that formalized information technologies are not sometimes as self-evidently beneficial as vendors or technicians presume.

All in all, IT implementation threaten the interests of individuals and groups by intruding on their territory, limiting their autonomy, reducing their influence, or adding to their workload. While all people may try to act in the “corporate” interest, they often have very different definitions of exactly what it is [Keen (1981)].

Obviously there is a fine line between honest resistance to an implementation one feels is misguided and selfish sabotage of a necessary innovation. The difference is a matter for conscience and self-scrutiny. In both cases, the response is political, whether “clean” or “dirty” politics.

CHANGE MANAGEMENT FRAMEWORK AND METHODOLOGY
Kotter’s study of a hundred top management-driven corporate transformations concluded that more than half did not survive the initial phase [Kotter (1999)]. To my experience, the root causes of EPMS implementation failure will most likely include: inwardly focused cultures, paralyzing bureaucracy, parochial politics, a low level of trust, lack of teamwork, arrogant attitudes, shortage of buy-in, a lack of leadership in middle management, and the general human fear of the unknown, rather than the pleaded superficial reasons: costs too high, software not good, or user requirements not being adequately addressed. Therefore, a proper change management framework and methodology must address these
barriers and address them well.

It is very important to deeply understand that EPMS implementation projects are about business process change in which IT plays a significant part. It is better to stop thinking in terms of ‘IT Projects’, but to think ‘Business Process Change’, ‘Organizational Change’ or ‘Cultural Change’, brought about by the introduction of new IT. For example, once we have some transaction or process data that has been collected more consistently than is typical today we will have the basis to redesign the existing processes to create process synergies, improve drawing and information coordination, improve workflow, etc.

It is too lengthy to elaborate the change management framework and methodology here. Nevertheless, no formal effective strategic model exists. If it did, one might expect to find it in political science! Counter-implementation is most likely to occur when outsiders bring in threatening new technologies [Munson and Hancock (1977)]. EPMS is exactly that in many cases.

CONCLUSION
Building owners and developers are discovering that IT in construction project management is the key to successful construction projects. The challenge they face is persuading other project team members to embrace the technology. The resistance to change, no matter actively or passively, at the micro or macro levels of the industry, contributes to the major impediment of IT take-up in the construction industry. The simple, central argument presented here is that EPMS implementation is political as well as, sometimes far more so than, technical in nature. When that is understood and accepted, politics are then the process of getting commitment, or building support, or creating momentum for change.

In today’s world, people are talking about the real-time enterprise. Decisions have to be made in a split second. It could be in a day or two days, but it could not be in three weeks. Without right information that is shared by everyone collaboratively, at the right time, you can’t make those decisions and you will lose money. Any company that is not looking to become a real-time enterprise – in the sense of making the decision-making process swift – is not going to be able to compete or even survive.

I foresee that, sooner or later, leading edge innovators and early adopters in the construction industry will transform their organizations with IT-based strategies which add value for their clients. They will automate or re-engineer many of their business processes, which lead to cost advantages. These cost reductions will then absorb into
the industry cost structures, and the benefits passed along to clients. The late adopters of IT will find it hard to survive the competitive cost pressures. Sure, jumping in early can cost some money, time and frustration, but often as not, jumping in late is also costly because you're playing a game of catch-up. I would suggest that being among the earlier adopters of IT is better than being among the late-comers.

Depending on the investment time horizon, the specific challenges and tools available may change, but the overall direction is unmistakable. The construction industry is about to experience a profound change: leaner organizations, more consistent and rigorous performance metrics, and relentless productivity improvements. The net result of these changes should also be increased profitability for those who are successful at mastering the new IT tools with the promise to enable these changes.
REFERENCES

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