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A framework for stakeholder oriented mindfulness: case of RFID implementation at YCH Group, Singapore

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Abstract

Implementation of innovative technology in organizations is often fraught with challenges. Past literature on *mindfulness* suggests that mindful implementation of innovative solutions facilitates success and enhances effectiveness for the organization. Integrating insights from the mindfulness and stakeholder perspectives, we present and analyze a longitudinal case study of Radio Frequency Identification (RFID) implementation at YCH Group, a leading logistics provider in the Asia-Pacific region. Our objectives are to examine key attributes of mindfulness as well as identify specific organizational routines that fostered mindfulness at YCH that ultimately paved the way for effective implementation of RFID technology. Important lessons can be learnt from how YCH instituted organizational routines that enabled them to mindfully implement RFID, by explicitly considering both internal and external stakeholders.

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Introduction

Adoption and implementation of innovative technologies is often of the ‘me too’ variety indicating a bandwagon phenomenon (Fichman, 2004; Swanson & Ramiller, 2004). However, recent organizational literature directs us to the concept of ‘mindfulness’ which proposes that when an organization implements an innovative technology ‘mindfully’ to the extent that it attends to the innovation taking into consideration the various organizational specifics (Swanson & Ramiller, 2004), there is a greater likelihood of making sound judgements about the adoption, implementation and assimilation processes (Fichman, 2004). However, previous applications of mindfulness framework often do not explicitly consider both internal and external stakeholders. For example, Wong *et al.* (2009) combined mindfulness framework with institutional theory to examine external stakeholders such as customers, regulatory agencies and competitors. Hence, while the concept of stakeholders may be somewhat implicit in the mindfulness perspective, stakeholder theory explicitly states that for the smooth implementation of new technologies, it is imperative that the organizations explicitly take into account concerns of important internal and external stakeholder groups.

In general, success cases of IT implementation such as Dow Corning implementation of ERP (Scott & Vessey, 2002) exhibits characteristics of mindful innovation as well as explicit consideration of concerns of various

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stakeholder groups. A primary goal of this paper is to assess and apply insights from mindfulness and stakeholder theories to understand and explain successful implementation of Radio Frequency Identification (RFID). Further, we seek to identify specific organizational routines that facilitate mindfulness which ultimately spur IT innovations such as RFID deployment. Towards these goals, we integrate the concepts propounded by the *mindfulness philosophy* (Langer, 1989; Fiol & O'Connor, 2003; Swanson & Ramiller, 2004) with the ideas from the *stakeholder theory* (Freeman, 1984; Frooman, 1999) to propose a 'stakeholder oriented mindfulness framework' which is premised on the rationale of mindfully attending to the concerns of the significant stakeholder groups for the successful implementation of an innovative technology. In doing so, the notion of stakeholders implicit in mindfulness is explicitly brought out so that the concerns of both internal and external stakeholders can be given due attention. We then use this framework to explore the case of successful implementation of RFID technology at YCH Group, Singapore. Further, using insights from the case study, we identify key organizational routines that are likely to promote mindful IT innovations.

RFID implementation has several key differences with other kinds of IT implementation. First, privacy and security issues may be more prominent issues compared to other IT implementation due to RFID signals being easily intercepted and read without authorization (Thiesse, 2007). Further, information exchanges using RFID can take place without much human intervention and implementation needs to explicitly take into account the privacy and security concerns of various stakeholders. Second, RFID as a standalone system provides much less value than when it is integrated with other organizational systems. However, such integration poses tremendous challenges as RFID requires acceptance by both internal business units such as purchasing and warehousing as well as external business partners in the supply chain. Even Wal-Mart faced some problems in implementing RFID in its supply chain despite much media publicity (Weier, 2007). Hence, an RFID implementation is typically a 'multi-firm, multi-project' effort and this makes it distinct from other IT implementation. Third, effective RFID implementation demands significant changes to inter and intra-organizational business processes to leverage the full benefits of the technology since data from multiple sources can now be more easily and accurately captured, exchanged and processed. These differences of RFID implementation with other IT implementations make it interesting and important to examine the specific issues relating to RFID.

This study contributes to existing literature in the following ways. First, the role of *mindfulness* has not been extensively explored especially in the context of implementation of RFID technologies. This research not only investigates the role of this important concept but also extends the applicability of mindfulness perspective by

identifying important organizational routines that foster mindfulness. We also integrate mindfulness with insights from the stakeholder theory. Through the case of YCH Group, we illustrate how the concept of mindfulness can be operationalized in organizations by addressing the concerns of its primary stakeholders mindfully, and by instituting specific organizational routines. Second, most previous research on RFID tends to focus on the technology. Consequently, they tend to be published in technical-oriented journals rather than in management-oriented journals (Ngai *et al.*, 2008a), barring a few exceptions (e.g., December 2009 issue of *EJIS* published a special section on managing RFID projects). As companies become increasingly concerned about the business value of RFID (Tzeng *et al.*, 2008), there is a need to examine managerial issues relating to RFID implementation. We address this need by focusing on managerial issues to add to the current literature. Third, while previous research has focused on the use of RFID in traditional goods, we focus on RFID implementation for innovative uses, for example, liquid products in a bonded warehouse environment. In doing so, we highlight some of the emergent issues and challenges in using RFID. We believe that these should be useful in helping researchers and practitioners in better understanding the potential impacts and implementation issues in RFID.

The rest of the paper is organized as follows. Initially, we present a literature review of RFID, followed by a brief understanding of the *mindfulness* and *stakeholder* theories in relation to implementation of innovative technologies. Then we argue for adopting an integrated approach to better understand the implementation of innovative technologies and present the *stakeholder oriented mindfulness framework*. This is followed by our research methodology and a detailed case study of YCH's experience with RFID implementation for liquid products in a bonded warehouse. The case analysis is used for illustrating the concept of stakeholder-oriented mindfulness and identifying key organizational routines facilitating mindful IT innovations.

The key reasons for choosing YCH to examine mindfulness are as follows. First, YCH is an established leader in innovative supply chain management (SCM) solutions in the Asia-Pacific. It has won several awards for its innovativeness and use of information technology. Success cannot occur if YCH has not been mindful of how it leverages IT in SCM. Second, Swanson & Ramiller (2004) have highlighted that innovation constitutes a critical area for organizational mindfulness since innovation initiatives are frequently a core part of mindful responses to changing conditions and emerging situations. Third, while the concept of mindfulness originated from studies on high reliability organizations (HROs) such as nuclear power plants, it can also be argued that many organizations with ubiquitous IT may share several characteristics of HROs (Valorinta, 2009). In particular, IT is a crucial part of YCH operations and failures in any IT systems can have serious consequences on the supply

chain. Given that YCH excels in innovation, deploys IT intensively and is among the first in Asia-Pacific to deploy RFID, we felt that mindfulness is an appropriate lens for examining RFID implementation. Hence, we analyze the details of the case in relation to the attributes of stakeholder oriented mindful implementation. Then, we offer implications for research and practice delineated from this case, followed by concluding remarks.

Literature review

RFID is essentially a transponder technology for contactless recognition of objects. An essential component is the RFID tag which comprises an integrated circuit with an antenna that acts as a transponder when tagged onto a surface. The tag is capable of transmitting product information wirelessly, thereby facilitating real-time tracking of inventory throughout the supply chain. Proponents of this technology believe that it will revolutionize not only how inventory is managed and tracked, but also the entire supply chain as it provides complete visibility of items flowing in manufacturing, distribution and storage. In fact, RFID has been proclaimed to be bigger than Y2K (Lundstrom, 2003) and the best thing since bar code (*Economist*, 2003). In addition, businesses that intend to deploy RFID or have deployed RFID are often reported in the press, for example, Wal-Mart, the U.S. Defense Department, and Tesco. Further, while there are some success cases of RFID usage (Loebbecke & Huyskens, 2006), there are also several challenges and difficulties faced by firms deploying RFID (Songini, 2007).

Researchers have studied RFID use in various industries and functional areas such as, retail (Gauker *et al.*, 2007; Fosso Wamba *et al.*, 2008), fashion (Loebbecke & Huyskens, 2006), logistics and SCM (Ngai *et al.*, 2007a; Kim *et al.*, 2008), library services (Pan *et al.*, 2008), healthcare (Janz *et al.*, 2005; Lee & Shim, 2007), food (Ngai *et al.*, 2008b), transportation (DeVries, 2008) and engineering (Ngai *et al.*, 2007b). Other research has examined factors affecting adoption (Shih *et al.*, 2008), benefits and pitfalls (Zipkin, 2006; Lee & Ozer, 2007), implants (Rotter *et al.*, 2008), consumer acceptance (Hossain & Prybutok, 2008), business value (Tzeng *et al.*, 2008) and privacy and security issues (Taghaboni-Dutta & Velthouse, 2006; Zipkin, 2006).

Mindfulness in innovation

Innovation (including implementation of an innovative technological solution) as an organizational activity entails a substantial amount of unforeseen emergent possibilities. Further, innovation frequently involves strategic experimentation which constitutes the highest risk/highest return category requiring unique managerial approach (Govindarajan & Trimble, 2004, 2005). Many strategic experiments in organizations are enabled by IT and fall into the realm of strategic IT experimentation (McKeen & Smith, 2007). Mindful organizations may be in a better position to manage these contingent situations effectively and hence may derive relatively

greater benefits from 'innovative actions' or 'strategic IT experiments' (Fichman, 2004; Swanson & Ramiller, 2004).

Mindfulness as a concept has its roots in psychology and defines the cognitive qualities of an individual. A mindful individual is cognizant of different situations and emergent contexts that surround him/her and is prepared to adapt to (and/or use) them for achieving the desired results. Mindfulness at an individual level is characterized by: openness to novelty, alertness to distinction, sensitivity to different contexts, awareness of multiple perspectives, and an orientation to the present (Langer, 1989; Sternberg, 2000; Swanson & Ramiller, 2004). The idea of mindfulness has been extended and applied to the organizational context where it is generally associated with the adaptive management of expectations in the presence of unexpected emergent contingencies (Weick *et al.*, 1999; Swanson & Ramiller, 2004). Mindfulness enhances an organization's innovative ability as it fosters 'creating new categories exploring multiple perspectives, and focusing on process all increase the possibility that a novel approach to a problem will be discovered' (Langer, 1989, p. 139).

Swanson & Ramiller (2004) classify an organization as mindful when it takes actions with reasoning grounded in its own facts and specifics. In the organizational context, it can be also related to the concept of 'continuous learning', where organizational actions are based on what they have learnt about themselves and their environment till the time preceding the actual 'action'. Further, mindful actions also promote learning through strategic IT experimentation (McKeen & Smith, 2007). This calls for a high degree of resilience and adaptive capability in the psyche of the organization to be able to act according to the emergent situations. Drawing upon Langer's (1989, 1997) work, Fiol & O'Connor (2003) define mindfulness as a watchful and vigilant state which is characterized by the continuous creation of new categories, openness to new information and an implicit awareness of multiple perspectives (Fichman, 2004). However, it is relevant to point out that mindfulness may not always promote innovation, more often than not it may restrain organizations from jumping on to the innovation bandwagon (Fiol & O'Connor, 2003). Thus, mindful organizations will implement innovative technological solutions only when its implementation is conducive and is in alignment with the actual requirements and specific organizational conditions.

Although we have discussed the theoretical deliberations guiding the concept of mindfulness, operationalizing the concept still remains a challenge (Fichman, 2004). However, previous research has suggested five attributes of mindfulness, namely: *a preoccupation with failure, a reluctance to simplify interpretations, a commitment to resilience, sensitivity to operations, and reliance on expertise over formal authority* (Weick *et al.*, 1999; Weick and Sutcliffe, 2001; Swanson & Ramiller, 2004). These

attributes serve as useful characteristics of mindfulness and have observable overlaps with management strategies for successful strategic IT experimentation.¹ We later use these five mindfulness attributes for analyzing the case study of YCH Group using the proposed 'stakeholder oriented mindfulness framework'. We also identify and theorize specific organizational routines that aid mindful IT innovations.

Stakeholders and mindful innovation

The stakeholder approach is about groups and individuals who can affect the organization, and focuses on managerial behavior in response to those groups and individuals (Freeman, 1984). In the context of technology implementation, stakeholders are those claimants inside and outside an organization who have a vested interest in the decision faced by the organization in utilizing the technology (Mason & Mitroff, 1981; Blyth, 1999). The implementation and adoption of technologies in organizations is dependent to a large measure on how the organization approaches the concerns of its significant stakeholder groups.

The important role of organizational stakeholders in the adoption and implementation of technology has been highlighted by past studies such as Fowler & Gilfillan (2003), Gause & Weinburg (1989) and Wiener (1993). Stakeholders have been found to be instrumental in the success or failure of technology implementation projects (Ewusi-Mensah & Przasnyski, 1991; Pan & Flynn, 2003). The multiple stakeholder groups in technology implementation may also influence managerial decisions by leveraging resource dependencies (Frooman, 1999). The control exercised may be of two types: discretion over resource allocation (withholding strategies) and discretion over resource usage (usage strategies) (Pfeffer & Salancik, 1978). Moreover, the technology implemented will be of use to the organization only if it serves the requirements of its stakeholders and is not just a fashion or a social contagion (Fichman, 2004).

Swanson & Ramiller (2004) describe organizational innovation comprising of four component processes: comprehension, adoption, implementation and assimilation. They further state that an organization is innovating mindfully 'when it attends to an innovation with reasoning grounded in its own facts and specifics' (p. 559). Despite its transformational potential, the concept of mindfulness has remained at a philosophical level because of the difficulties associated in operationalizing an abstract concept. There are very few empirical studies which have tried to test the concept (Fichman, 2004). Taking into cognizance the importance of significant stakeholders for technological implementation, we argue that it is important that organizations are 'mindful' of the concerns of the important stakeholder groups.

¹We thank one of the reviewers for highlighting this point to make the discussion richer.

Viewing from a stakeholder perspective, we extend the description of mindful innovation and define it as an *innovation that is grounded in its stakeholders' facts and specifics*. Thus, stakeholder oriented mindfulness in the context of innovative technology implementation underlines the importance of mindfully considering the significant stakeholders in relation to the implementation of the innovative technology. In most organizational contexts, two stakeholder groups are most important for venturing into innovative technological implementations: the internal organizational employees and the external customers/suppliers who use the organization's service and/or product. Hence organizations implementing innovative solutions should be mindful of the requirements of both these important stakeholder groups.

Using our conceptualization of stakeholder oriented mindfulness, we posit that for a mindful organization, its innovation must have the attributes of mindfulness in relation to all the significant stakeholder groups. Note that while the concept of stakeholders may be implicit in mindfulness, we felt that it is important to make it explicit to ensure that the concerns of both internal and external stakeholders are paid due attention. In the next section, we discuss the research method followed by details of the RFID implementation at YCH Group. Subsequently, we analyze the 'implementation' of RFID in YCH Group using the proposed stakeholder oriented mindfulness framework.

Research method

Our key objective was to examine RFID implementation and the role of mindfulness. Our study was largely exploratory in nature since RFID implementation is relatively new in Singapore. Hence, we chose the case study approach. Data were gathered through interviews with relevant personnel in YCH as well as through secondary data such as company documents, newspaper reports, websites, etc. as is commonly done in case research (e.g., Thiesse *et al.*, 2009; Wong *et al.*, 2009). The study was conducted over a period of two years, involving multiple interviews with the following: Head of Corporate Communication, Section Manager of Corporate Communications, Assistant Vice President of Product Development, Assistant Vice President of Information Technology, Senior Executive (Projects) and CIO of YCH Group. The interviewees were selected based on their knowledge about RFID implementation at YCH. Our interviewees were primarily senior and middle level executives as they are most knowledgeable about RFID and organizational issues at YCH. The interviewees came from diverse backgrounds and functions, thus providing a rich data on varied RFID implementation issues. Details of data collection procedures are shown in the Appendix.

At the end of each interview, the research team (authors excluding the CIO) transcribed the data and attempted to extract key concepts and learning points. Subsequently, we arranged further interviews to clarify

and obtain further data. Some interviewees were interviewed once and others were interviewed 2–3 times, depending on the nature of information sought. Each interview lasted for about 1 to 2 h. We also supplemented and triangulated the interview data using secondary sources from YCH Group and Y3 Technologies (a subsidiary of YCH Group) websites, company documents, media reports, etc. Further, we also made site-visits to the company warehouses to get a firsthand knowledge on RFID implementation. The site visit provided us with practical insights on logistics operations, which helped us better understand how the RFID technology was being deployed. During the site visit, we also had the opportunity to talk to a few operations personnel who helped explain the use of RFID. In addition, we also used public discourses (lectures and seminars) given by YCH senior executives at different forums to obtain additional insights into the business strategy evolution, corporate thinking and company culture, and other key initiatives. We also examined various media reports where the CEO, CIO and senior staff were interviewed. These reports also provided us with additional insights on the corporate philosophy and strategic thinking behind IT deployment at YCH. From these analyses, the research team inductively derived a set of routines that enable mindfulness, taking into consideration the key attributes of mindfulness discussed by Swanson & Ramiller (2004).

Case study – YCH Group

YCH Group is a leading logistics and SCM company that provides end-to-end SCM solutions to leading multinational firms in the Electronics (e.g., Dell, Motorola), Chemicals/Healthcare (e.g., Ciba, Pfizer), and Consumer Goods (e.g., Danone, Friesland), industries. YCH Group currently employs over 2500 employees while Y3 Technologies (YCH Group independent IT subsidiary) has about 150 employees. Further, YCH Group has more than 5 million square feet of warehouse space and serves more than 20 world class MNC customers (Chan, 2007). In 2007, YCH Group handled more than U.S.\$50 billion worth of goods for its MNC customers (Wee, 2008).

Vision and mission

YCH Group's vision is *to build the logistics superhighway in a borderless world*. This is done by integrating the three flows: physical flow (e.g., movement of cargo from one point to another), information flow (e.g., inventory numbers, data tagged to goods) and financial flow (e.g., ownership transfer of materials) in SCM. In line with this vision, YCH Group's mission is *to be the number one supply chain solutions partner in the Asia Pacific region*. A senior executive commented:

We provide integrated logistics and end-to-end SCM. Integrated logistics meaning freight, warehousing, and transportation. We like to see ourselves not just as a vendor for worldwide MNCs like Dell, Motorola, but rather as a partner; someone who actually helps to make the business

model better so that they can improve profits and when they do well, we do well as well.

Evolution of YCH Group

YCH was founded in 1955 by Mr. Yap Chwee Hock (hence the acronym YCH) as a passenger transport business. In 1977, Robert Yap (eldest son of the founding father) joined the company and made the strategic move into cargo transportation. This move is a strategic shift towards internationalizing the company and expanding the business to include freight forwarding and warehousing business. By 1988, YCH moved into the realm of providing total integrated logistics services by venturing into the Asian region and exploiting information technologies to develop proprietary applications to integrate its services.

The mid-1990s marked YCH transformation into an SCM company. The company used technology to fundamentally redefine its business and gradually developed three key IT solutions that currently drive all of its business: Intribution[®], Intrabution[®], and Retrologistics[®] (Figure 1).

Intribution[®] is essentially manufacturing logistics where YCH works with clients' global suppliers to hub raw materials and parts for clients' manufacturing operations. Intribution[®] helps manufacturers increase production flexibility and save costs since raw materials are stored in a centralized hub and provided to them on a just-in-time basis. Intrabution[®] is essentially finished goods fulfillment logistics where finished goods are fulfilled or delivered efficiently to the many destinations in the country or region, thereby minimizing stockouts and increasing market share. Retrologistics[®] stands for reverse logistics and it takes care of after-sales service logistics for manufacturers, and customers' goods, which require repairs, servicing, returns/exchanges, warranty validation, etc. Hence, Retrologistics[®] helps manufacturers or brand owners to improve after sales service, thereby enhancing customer satisfaction and loyalty.

These solutions also won the Innovation Development Award given by the Economic Development Board in Singapore. The development of these systems paved the way for a portfolio of IT-enabled solution suite that transcends the entire value chain. The newer systems in the suite exploit the power of Web services and RFID technologies. A senior executive commented:

We were one of the few logistics companies that started early using IT whereas everybody else was still dealing with paper files, etc. The reason why we use IT is that we use IT as a force multiplier. We are a local company. Much as we have gone regional, we are not global yet. We don't have that kind of manpower. The only way for us to get around our constraints is to use technology.

3PL (Logistics) + 4PL (Consulting) = 7PL™

Logistics service providers who specialize in the execution of third-party logistics (which includes transportation,

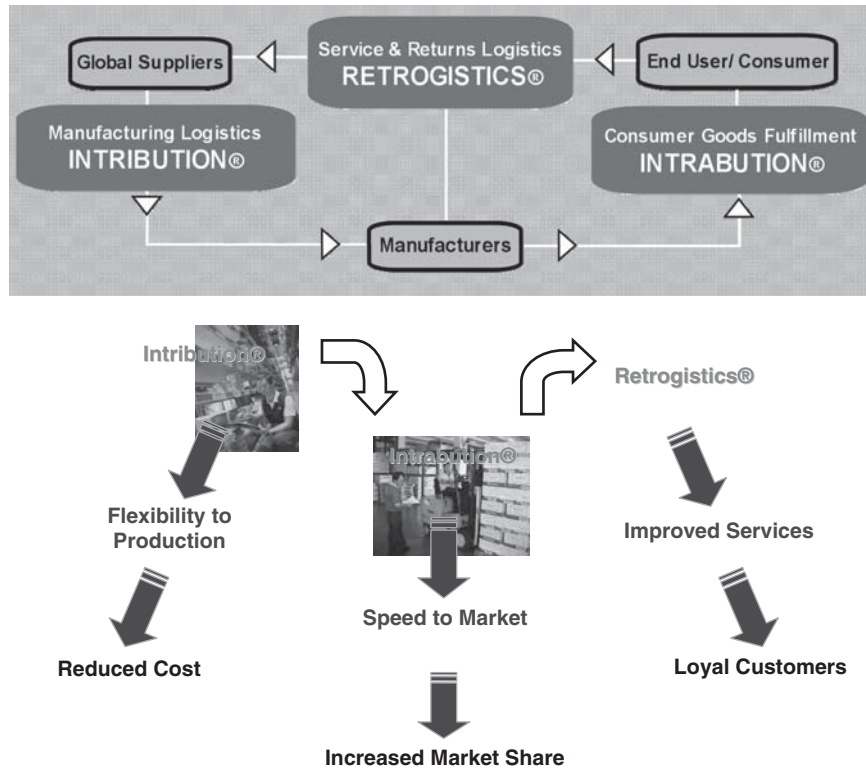


Figure 1 Intribution®, Intraduction® and Retrologistics® (providing end-to-end supply chain capabilities).

freight and warehousing) are known as 3PLs. Management and strategy consulting firms who evaluate the business models and processes, and recommend solutions but do not perform the manual and execution logistics requirements are called 4PLs. YCH provides both professional consultancy services (through its subsidiary Y3 Technologies) as well as the execution of traditional logistics operations. Hence, YCH has referred to themselves as 7PL™ and has trademarked the term 7PL™. Figure 2 summarizes the concept of 7PL. A senior executive commented:

We are not just a company where you tell us to deliver this box from point A to point B. What most clients do when they come to us is they say I have this logistics need but I am not sure which solution I want or should have and also can you give me a solution that will actually enhance my operations and hopefully my bottom line as well. So this is where our business team will sit down with them and decide which package should be offered, which kind of solutions should be tailor-made for them, is it intribution? Is it intraduction? Or is it a combination of all three. So when you add in the consulting bit to the 3PL bit, that's where we get 3PL + 4PL = 7PL.

RFID project in Singapore

Today, many of our MNC customers know that in order for us to create a true real-time supply chain for them, we will

	Specialised Integration	e2e Supply Chain Solutions	
4PL	Consulting entities that provide value added integration functions through consolidating external & internal resources/services through technology	Entities that provide end-to-end supply chain solutions, managing physical, information and financial flows with an interoperable platform	7PL™
Piece meal	Freight Forwarders, Transporters and Warehouse Operators.	Operators that provide all 3 services, either through in-house capability or strategic outsource	3PL
	Traditional	Integrated	

Figure 2 3PL + 4PL = 7PL™.

need to implement innovative RFID solutions to facilitate real-time tracking and visibility for their end-to-end supply chain needs. (YCH Group News Release, 2008)

In collaboration with Oracle, YCH launched the implementation of RFID for liquid products in a bonded warehouse environment. The pilot project which costed U.S.\$727,000 (S\$1.0 million), and lasted nine months (September 2004 to June 2005) was co-funded by the Infocomm Development Authority (IDA) of Singapore. Note that 'bonded' goods refer to controlled items

(e.g., liquor, cigarettes) that are subjected to customs duties. Hence, a bonded warehouse is an area approved by customs authorities to store controlled items for re-export or for local consumption. Operators of bonded warehouses need to adhere to stringent guidelines to ensure that the necessary duties are paid for goods meant for local consumption. For goods meant for re-export, proof of re-export documentation is necessary.

RFID technology helps to ensure 100% inventory visibility in the event of customs checks. Further, in the bonded warehouse environment, physical security (preventing pilferage), data integrity (ability to account for all bonded goods), compliance to customs requirements are critical and RFID technology helps YCH to achieve these requirements since it has the ability to track and manage the movement of controlled items. RFID technology also makes it easier for customs officials to conduct spot checks on the bonded warehouse, without the need to physically climb on the crates to do so. The importance of accuracy in stock status is emphasized by James Loo, CIO of YCH Group:

We need 100% accuracy in stock status. If we lose one or two bottles, it is as good as duty not paid. This can lead to us getting fined or losing our license to operate a bonded warehouse.

YCH is the first to implement the latest RFID UHF frequency band 923–925 MHz, allocated by IDA in November 2004, into commercial warehousing and inventory management system. The RFID system is integrated with Y-WMS™ warehouse management system, thereby enabling real-time inventory updates. Y3 Technologies developed a goods tracking system based on

RFID technology called ‘one touch strategy’. At the core of this one touch strategy is Oracle 10g infrastructure software which helps to ensure that data are clean and error-free at the point of collection and that data integrity is maintained seamlessly (hence one-touch). Another component that is crucial to ensure data integrity is the oracle Sensor edge server (part of Oracle Application Server 10g) which enables mass-read (rather than individual read) of data and ensures that the data filtered at the source are accurate.

Our ‘One-Touch’ strategy will help YCH automate and track their high-value goods in this bonded warehouse environment with minimal human intervention. Using Oracle solutions, we are able to capture the right data at the source, and manage this data through its lifecycle. ‘One-Touch’ ensures that despite multiple modifications, enhancements and process flows, the core set of data is kept secure and intact. Data remains accurate and available for appropriate users in the value chain. (James Loo, Chief Information Officer, YCH Group and Chief Operating Officer, Y3 Technologies; YCH Group News Release, 2005a)

The project team consisted of five key users from YCH and nine consultants from Y3 Technologies and Oracle. The project is the first to innovate the commercial operation processes such as inventory stocking and tracking, handling, packaging and labeling of high value and controlled inventory like liquor with RFID.

Figure 3 shows the process flow for goods in bonded warehouse. Incoming goods are received at the main distribution center. Each pallet of bonded goods is tagged with RFID tag as they arrive in the warehouse. YCH staff use handheld readers to record and receive information from these tags, for example, when a particular shipment

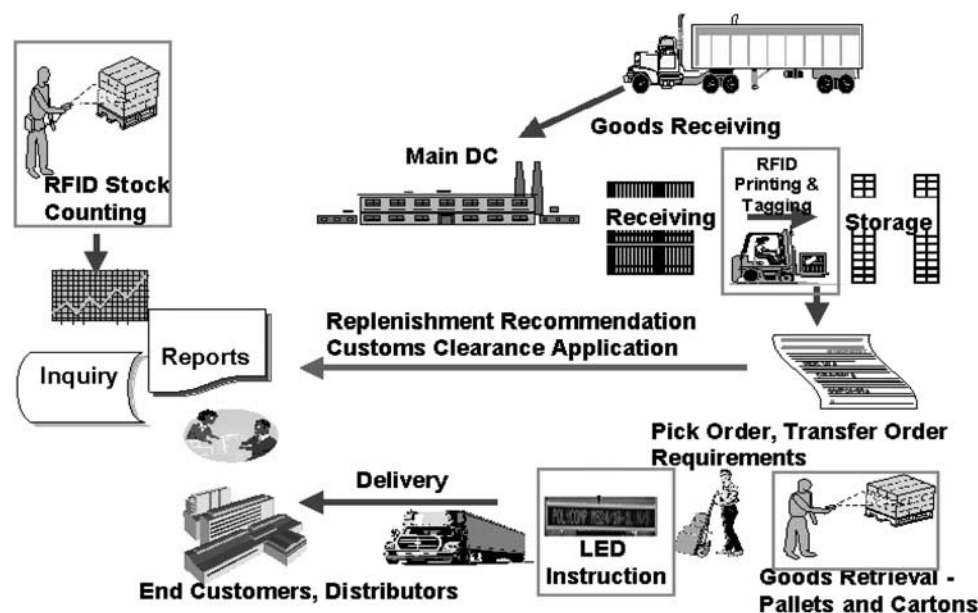


Figure 3 RFID solution for bonded warehouse.

arrived, whether it is meant for domestic consumption or for re-export. The RFID tag also contains information on the designated storage location. Forklift operators pick up the pallet and make their way to the designated storage location. The reader emits a light when this location is reached so that the operator knows exactly where to store the pallet. On receiving orders from customers, the reader is used to help YCH staff find the goods as the exact location is shown on it. This also makes it easier for customs officials to conduct spot checks; otherwise they have to walk all over the warehouse and move up the racks to find the pallet they are looking for.

The forklift driver then removes the goods from the storage area into the outbound (or staging) area. While the goods are en-route to the staging area, the RFID reader will send a signal to prompt the computer system to start printing the relevant documentation. By the time the forklift arrives at the outbound area with the goods, all the relevant documentation and destination labels are ready and the goods could be loaded onto trucks with minimal delay. Previously, staff had to wait for the goods to arrive at the outbound area before preparing the necessary documentation for dispatch.

In summary, RFID readers are used to ensure that the pallets and cartons comply with the picking and transfer order requirements as well as keep track of remaining goods in storage. The implementation also covers the area of cycle counting and ensures that stock-taking process is done quickly and any variance can be noted and resolved efficiently. Each RFID gantry has a LED

panel so that the forklift driver knows that the goods have been captured by the reader and recorded in Y-WMS™ warehouse management system. With this information, YCH is able to offer visibility of the cargo for customs purposes and to facilitate planning throughout the distribution process with the various parties involved. Custom clearance application forms and recommendations for replenishment are automatically generated.

The simple and easy-to-use system consists of RFID fixed readers with four antennae, mobile computer, RFID reader for forklift and handheld RFID readers (Figure 4) that are used during inbound, storage and outbound activities to capture cargo goods faster and more efficiently to improve the turnaround time. Note that the reading of RFID tags may be subject to interference. Consequently some trial and error on locations of readers and tags are required. The CIO commented:

We had to experiment with the position of the tags. Some tags were placed higher in some places, others lower. The angle of the readers was adjusted so that they have a certain range and can read the tags without interference from the wire fences.

In the past, without the use of RFID, staff had to input data manually, which often posed risks of data errors. Although data could be captured using bar-code readers, the process was slow since each bar-code needed to be scanned manually and data were processed in batches rather than in real time. Hence, cross-checking of inventory data was often necessary.



Figure 4 RFID equipment: (a) handheld RFID readers; (b) mobile computer; (c) RFID reader for forklift; (d) Gantry reader and antenna.

With RFID, there is better information accuracy as data are captured from source and updated automatically in real time. There is also better utilization of manpower as more than one staff can process inbound/outbound orders simultaneously resulting in shorter turnaround time to accomplish the tasks. For example, in the past, after the forklift driver had sent the goods to the outbound area, he had to constantly return to the control room to get information on the next pick-up location. With RFID, instructions are available to the driver without the need to return to the control room. In other words, the reader will tell the forklift driver 'Drop cargo off at location A and pick up goods at locations C and E, and deliver to staging area 3'. Hence, work becomes less tedious as workflow becomes more streamlined and efficient, thereby minimizing the need for overtime work. The warehouse is now paperless and the data are real time and easily accessible to the user on handheld devices as soon as the orders are created in WMS. The success of the pilot project in the complex bonded warehouse environment also means that RFID can also be easily implemented in the less-controlled traditional warehouse environment.

The impact of the RFID project is evident from comments by Dr. Robert Yap, Chairman and CEO of YCH Group:

This project is a very clear testimony to the viability and benefits of RFID technologies, especially for the logistics industry. From the pilot project, we can already see efficiency and productivity gains, with improvements of up to 40% in lead-time in the form of multiple concurrent users and activities that can be undertaken simultaneously, as well as the elimination of errors for 100% data accuracy, through streamlined data entry and tracking processes, through the various logistical functions. ...Certainly, as the RFID technologies are being deployed more pervasively over the medium term, cost of implementation for the technology will pale in comparison to the more comprehensive value-add and operational gains that will be enjoyed, such as enhanced visibility and responsiveness. As a supply chain management organization, the impact will be far more extensive for our clients and the many other related entities along the supply chain, if RFID is introduced into the processes and flows of all the end-to-end logistical operations that we manage, from manufacturing to distribution and returns. (YCH Group News Release, 2005b)

A summary of the key impacts and benefits of RFID is shown in Table 1. These benefits are classified according to Baars *et al.* (2009) typology of six benefits from RFID. Baars *et al.* divided benefits into automation effects (automation of manual procedures), information effects (data capture), and transformation effects (reengineering of business processes). These three effects can be further divided into direct benefits (obtained immediately on introduction of RFID) and indirect benefits (obtained from changes in decisions or systems enabled by RFID). Each direct and indirect benefit can be further subdivided into operational benefits and managerial benefits, though

not all potential combinations of benefits are applicable to RFID. Baars *et al.* suggested six types of RFID benefits:

- Type 1: Automation – Direct – Operational
- Type 2: Information – Direct – Operational
- Type 3: Information – Indirect – Operational
- Type 4: Information – Indirect – Managerial
- Type 5: Transformation – Indirect – Operational
- Type 6: Transformation – Indirect – Managerial

From Table 1, there is evidence that all six types of benefits are achieved by YCH.

Plans are currently underway to implement RFID extensively throughout the supply chain for storage, tracking, handling, packaging, picking, labeling, and other logistics value-add activities across various product and industry types (e.g., Electronics, Chemicals and Healthcare, Consumer Goods, etc.) which YCH manages. Recently, YCH has also successfully deployed RFID in China and Malaysia, and there are plans to deploy in other Asia-Pacific countries as well. However, in implementing RFID in other countries, YCH did encounter some challenges relating to government regulations as evident by this quote from a senior YCH executive:

Challenges of government regulations can sometimes put a stop to some deployment e.g. frequency and bandwidth restrictions in different countries. So the same equipment cannot be used in our units in countries A, B and C. Another example is the case of mobile scanning by RFID reader which is allowed in country A but not allowed in countries B and C due to security restrictions.

The overall philosophy towards RFID is best summarized by the Chairman and CEO of YCH Group:

YCH Group is firmly committed to the use of RFID technology to improve our operations and those of our customers. Over the past four years, we have gained experience through our own internal projects, proving that there are real business benefits from using RFID. Now that the technology has reached a suitable level of maturity and there are RFID standards in place in most countries, we are ready to deploy the technology across all of our operations. (YCH Group News Release, 2008)

Analyzing RFID implementation using the Stakeholder oriented mindfulness framework

Swanson & Ramiller (2004) used the five attributes identified by Weick & Sutcliffe (2001) and Weick *et al.* (1999) to describe the characteristics of mindful technological innovation. These five attributes are: *a preoccupation with failure, a reluctance to simplify interpretations, a commitment to resilience, sensitivity to operations, and reliance on expertise over formal authority.* For the case of a 'stakeholder oriented mindfulness framework', these five attributes must be evident in relation to the implementation of RFID technology for the significant stakeholder groups. In the case of RFID implementation in YCH, we have already identified internal YCH employees and external YCH customers as the two most significant

Table 1 Benefits and impact of RFID classified according to Baars *et al.* (2009) Typology

(a) Material handling and storage

- Efficiency – Multiple users are able to perform physical put away/picking at the same time thus improving the lead time by more than 40% (Type 5)
- Productivity – Data entry for put away confirmation is eliminated as the data are now captured at site of actions (when the goods are placed at the respective locations). There is also no need to re-input the location information during picking (Type 1)
- Data Accuracy – Accuracy is maintained at a very high level, due to reduction of duplicative data re-entry procedures. Errors committed during the physical put away or picking would be detected instantaneously by the RFID (Type 2)
- Cost – Cost is reduced significantly as most of the work would be completed in a shorter time. Further there is a saving of one shift (Type 5)

(b) Stock take

- Enhancement to cycle count process by improving speed and reducing physical or manual procedures (Type 1)

(c) Distribution

- RFID Gateway and integrated LED display offers real-time loading instructions to operators, improving movement accuracy and reducing dependency on verbal communication (Type 3)

(d) Value add

- RFID compliance center for shippers, maximizing investment and improving service level (Type 6)

(e) Hard expense savings

- Direct labor costs (improved productivity leads to reduction of manpower) (Type 1)
- Inventory reduction holding costs (rapid movement of inbound and outbound inventory lowers holding costs) (Type 1)
- Warehouse cost (improved turnaround implies that warehouse can be used more efficiently to handle more goods) (Type 1)
- Data entry (eliminate need for manual data entry leads to manpower savings) (Type 1)
- Order handling (streamlined order handling increases productivity) (Type 2)
- Materials utilization (JIT flow of material ensure optimal utilization) (Type 5)
- Fixed asset savings (more efficient use of existing assets reduces need to acquire new assets) (Type 1)
- Paper elimination (information automatically recorded in WMS and instructions transmitted to RFID readers eliminate need for print copy) (Type 5)
- Time-per-transaction (reduce time per transaction implies higher productivity) (Type 1)

Soft expense savings

- Inventory accuracy (ability to check inventory) (Type 2)
 - Picking accuracy (ability to ensure picking accuracy) (Type 2)
 - Shipping accuracy (ability to ensure shipping accuracy) (Type 2)
 - Indirect labor costs (streamlined work flow makes processes more efficient) (Type 5)
 - Customer retention (ability to track facilitates faster service and better decisions) (Type 3, 5)
 - Operational efficiency (improved efficiency due to streamlined work flow) (Type 5)
 - Real-time data access (improves forecasting, planning and decisions) (Type 4, 6)
 - Overall productivity (improved efficiency) (Type 1)
 - Product authentication (due to mass read and ability to track. Reduce pilferage) (Type 3)
 - Less supervisory intervention (due to streamlined workflow and automatic indication by reader, e.g., when pallet is put in wrong location) (Type 2)
-

stakeholder groups. Hence, we analyze the case in relation to the attributes of mindfulness for these two stakeholder groups. Further, we also identify the organizational routines for enhancing mindfulness. The research framework is shown in Figure 5.

Note that in analyzing each of the five attributes of mindfulness, in order to provide some contrast to what YCH did, we first provide some examples of firms innovating mindlessly which resulted in IT implementation failures. Subsequently, we analyze how YCH paid attention to each of the five attributes of mindful innovation.

Pre-occupation with failure

A pre-occupation with failure implies that the organization is forever watchful and alert for complacency that may set in resulting in irreversible failures. Hence the organization is always on the lookout for possible failures and puts an effort to plug them even before they occur (Swanson & Ramiller, 2004). The well-known case of FoxMeyer's bankruptcy as the result of ERP implementation failure serves as a poignant reminder that it is important to anticipate and plan for worst case scenario. When FoxMeyer implemented the ERP system, the system failed to work properly and was unable

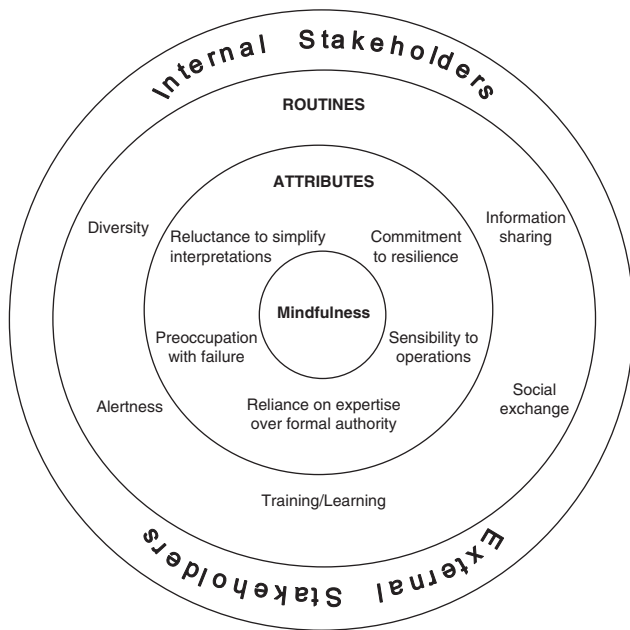


Figure 5 Stakeholder-oriented mindfulness framework.

to handle the amount of transactions. This resulted in huge losses and FoxMeyer had to file for bankruptcy. Another case of IT failure is Hershey Foods. The order management and warehouse implementation problems resulted in a failure to ship products in time for Halloween. This resulted in at least U.S.\$150 million in lost revenue and 19% drop in profit (Supply Chain Digest, 2006). These cases demonstrate that IT failures can result in huge losses and it is important to anticipate possible failure and take appropriate actions to mitigate its occurrence.

In the context of YCH, the firm implemented the RFID technology first in its bonded warehouse facility where the technology was to be tried with liquid products. Although YCH has a history of implementing innovative technological solutions that support business, the risk of failure in this case was high for two reasons. First, the technology had not been previously used for liquid products and second, in the case of bonded products, an inaccurate account of bonded products might result in inaccurate calculation of customs duty leading to serious repercussions for YCH.

YCH was not only aware of the chances of failure but also about the repercussions of such a failure such as getting fined or losing their license to operate a bonded warehouse in the event they could not accurately track bonded goods. This pre-occupation with failure enhanced the level of alertness of YCH to the implementation of the RFID technology. Another example of a pre-occupation with failure is reflected in YCH's acknowledgement of different reactions of employees in different countries to their RFID failure alarm system. An alarm will sound when the forklift is driven to the wrong loading bay. Workers in

country A² did not bother with the alarm whereas workers in country B proactively make an effort to avoid such instances. Consequently, YCH has to design different incentive system to minimize such alarms.

In addition to pre-occupation with failure related to the implementation of technology within the organization, YCH is also aware of the needs of its customers in terms of accurate account of their bonded liquid products and wants to avert this possibility from the customer's perspective. An inaccurate account of products may result in substantial losses to the customers. Currently, YCH is one of the few logistics operators that have license to operate a bonded warehouse. Bonded warehousing services are important for improving the cash flow of importers as they only pay duties when the goods are sold to end consumers. Hence, YCH wanted to plug all the possible avenues of failure so as to not only increase its own efficiency in operations but also provide better value to its customers by the use of RFID technology.

Reluctance to simplify interpretations

A reluctance to simplify interpretations implies following a generalized deductive approach with clear definition of cause and effect. In the case of FoxMeyer, the firm failed to realize that although SAP has been successfully implemented by manufacturing firms, the nature of their business as a pharmaceutical distributor is quite different from that for a manufacturer. Consequently, much customization was needed resulting in cost and schedule overruns, and subsequent IT failure when the system was implemented. FoxMeyer simplified interpretations by assuming that since ERP had been successfully implemented by manufacturing firms, it can be easily adapted to distributor firms. In another case, in the 1980s, General Motors invested billions of dollars in robots when the CEO simplified interpretations by assuming that since robots can do repetitive tasks, robots can easily replace much of the manpower required for automobile manufacturing. Billions of dollars were wasted and the project was discontinued (Supply Chain Digest, 2006).

In line with the philosophy to not simplify interpretations, YCH takes each event as independent with its own set of complex contexts that may not be generalizable in terms of reproducible heuristics (Weick, 1998; Swanson & Ramiller, 2004). For RFID implementation across its different units in the Asia Pacific region, YCH did not generalize and adopt a 'one size fits all' approach. From our analysis of the interview data, we had two indications that exhibited YCH's reluctance to simplify interpretations. First, they adopted an incremental approach for RFID implementation which has been identified by Swanson & Ramiller (2004) as one of the hallmarks of a mindful organization. Second, they adopted differential training and implementation strategy for its employees in different countries, which exhibit their context specific

²Names of countries have been disguised.

action. While designing the implementation strategy, they have also taken care of governmental regulations and available technological standards. YCH is cognizant of the existence of context specific differences and have not simplified their interpretations about the implementation of RFID technology. Rather, YCH has tried to adapt to different government regulations pertaining to frequency and bandwidth restrictions in different countries.

In a similar vein, the other important stakeholder group, that is, customers have differences in requirements. While designing technological solutions for its customers, YCH takes into consideration the unique requirements of its customers and does not offer generalized solutions. YCH works closely with their customers and customize solutions to their needs. YCH also makes an effort to anticipate customers' future needs and build partnerships with their customers.

Sensitivity to operations

Sensitivity to operations implies that a mindful organization will be aware of not only the broader aspects of management but also the seemingly small operational details affecting day-to-day working. An example of the failure to be sensitive to operations is the case of Toys R Us.com. The firm accepted orders through the Internet and failed to consider operational details in terms of fulfillment of orders. Consequently, thousands of toys could not be delivered on time for Christmas, resulting in much negative publicity (Supply Chain Digest, 2006). Another example is the case of Denver Airport Baggage Handling System. The system failed to adequately consider operational needs and was later terminated (Montealegre & Keil, 2000).

In the context of the proposed stakeholder oriented mindfulness framework, YCH should be concerned about the operational details related to employees as well as its customers. We observe from the case details, that during the course of RFID implementation, YCH displayed sensitivity to operational details. For example, YCH units implemented RFID display boards for different countries in different languages. But it realized that in doing so, some languages (e.g. Chinese) took more space and less information could be displayed on the boards. To get around this operational problem faced on the shop floor, YCH started a universal system of color codes on the display boards. For example, when the background is white, you have to input something; when it is green, the transaction is accepted, when it is red, it means that there is an error. This method of color coding was subsequently disseminated to other areas where RFID is implemented.

Further, YCH adjusted the workflow in the warehouse to take advantage of the potential of RFID. For example, there is no need for the forklift driver to go back to the control room to get instructions for the next picking job as instructions are transmitted wirelessly to his RFID reader. This saves time and increases productivity at the warehouse.

In implementing RFID outside of Singapore, YCH found that some countries have strict regulations relating to mobile scanning, which limits the real-time usefulness of RFID. In other words, the ability to roam allows employees to be more productive as the same unit of reader/scanner can be used anywhere. However, because of regulatory restrictions on the range, information captured by the scanner will only be updated on the system when the mobile unit is docked onto the cradle. Further, some of the equipment used in Singapore was not available in other countries. Consequently, YCH had to source for other equipment. In addition, some of the equipment needed to be sent back to Singapore for servicing as product support overseas was limited. YCH is sensitive to local operations requirements and does not let regulations and product support deter the use of RFID as they are convinced of the business value of RFID.

YCH also proactively educates customers on the potential of RFID to streamline the entire supply chain operation. In doing so, greater benefits could be achieved rather than just streamlining the warehousing process. They want to involve customers as partners in their technology implementation. Thus, we see that YCH has been systematically and proactively sensitive to the operations of RFID implementation both for employees as well as customers.

Commitment to resilience

A commitment to resilience implies a mindful organization recognizes that it is virtually impossible to plan for all the possible contingencies. Despite its 'pre-occupation with failure' it is not possible to predict all possible failures. An organization strategically experimenting with innovative technologies has to be prepared for possible disruptions in implementation and there is a need to creatively re-adjust the parameters as and when such a situation arises. In the case of FoxMeyer, when the firm won a contract to supply University Health System Consortium (UHC), the number of transactions to be handled by the new ERP system increased significantly. Yet, instead of adapting the implementation schedule to this change, FoxMeyer decided to bring forward its implementation schedule by 90 days, thereby making an already unrealistic implementation schedule even more unrealistic and leaving little time for testing. Consequently, the system failed as FoxMeyer did not adapt to the changes during its ERP implementation (Scott & Vessey, 2002).

From the case study of YCH, we observe that it displays a continued commitment to resilience. For example, in the past, with the use of bar code readers, there was a 'beep' sound when the barcode was scanned. However, with the use of RFID, there is no such sound. YCH discovered that some forklift drivers waited below the RFID gantry or drive the forklift to and fro under the gantry as they expected the gantry to give some indication that the goods have been read. However, this resulted in multiple readings. Consequently, YCH came

up with a contingency solution and developed an LCD panel at the gantry so that the forklift drivers knew when the goods were successfully read by the RFID gantry.

Similarly, we know that RFID is subject to interference (RF noise) from mobile phones, and wire fences, etc. (Angeles, 2005) While 100% readability/accuracy is required and desired, it is affected by tag frequencies and ranges, reader capabilities and locations, operating environment (i.e., interference from other devices, temperature, humidity, static, vibration, shock), and the types of assets being tagged (metal objects and liquid tend to have interference problems). Consequently, the orientation of readers needs to be positioned appropriately to ensure seamless reception. Further, the position of tags needs to be adjusted to facilitate reading and minimize interference. Hence, some trial and error is needed to ensure appropriate positioning of readers and tags to maximize radio signal transmission. For example, YCH found that the wire fences surrounding the bonded warehouses tend to weaken the strength of the radio signals. This issue was resolved by enhancing the transmitting capability of the tags, increasing the antenna sensitivity to overcome reception problems and adjusting the locations of tags and readers.

In addition to being resilient to issues within the organization, YCH had the onerous task of convincing its customers of the potential benefits that they will have by YCH installing an RFID-based tracking system. In future, YCH aims to move from pallet tagging to carton tagging and finally to item tagging. This means that instead of reading one tag per pallet, the system must read say, 50 tags simultaneously. Though it will result in an initial increase in costs (due to the need for large number of tags), in the long run it will prove advantageous as customers will have accurate and timely movement of their consignments. The customers are also coached by YCH to be resilient to the changes in cost over time, and to view RFID in terms of business value rather than cost.

Reliance on expertise over formal authority

Another attribute of mindfulness is the readiness to relax the formal structures so that in times of crisis, the person most suited for the job is able to execute it freely (Swanson & Ramiller, 2004). Especially in a scenario of implementation of innovative technologies the person most competent has to take charge whether it be employees or customers. An example of the importance of expertise over formal authority is the case of FoxMeyer's implementation of ERP. FoxMeyer management insisted on an unrealistic implementation schedule despite advice from experts that it is unrealistic. Consequently, when the system was implemented, many problems arose resulting in massive IT failure and the firm had to file for bankruptcy (Jesitus, 1997).

In the case of YCH, we observe that the firm has exhibited its continued reliance on expertise over formal authority. In line with this philosophy, YCH Group set

up its own technological firm called Y3 Technologies to develop customized and state-of-art solutions for YCH logistics. Since the organization structure at Y3 is more informal, this spin-off has the effect of providing the experts in Y3 technologies with more autonomy to design value-added applications while minimizing the constraints of the formal structure at YCH. Since Y3 is a part of the YCH Group, it is easier to make the two organizations work in a synergistic fashion. Moreover the formal authority structures have also been designed so as to make maximum use of the technical expertise in the operations of YCH logistics. For example, the Chief Information Officer (CIO) of YCH logistics is also the Chief Operating Officer (COO) of Y3.

The collaboration with Oracle cutting across the formal authority structures to tap into the cutting edge server technology has also been one of the key facilitators for the implementation of RFID technology. In addition to these examples from the corporate level, at the local level the managers in different units have the authority to set their own performance parameters based on the expertise level of the employees in that country unit.

In addition to relying on expertise over formal authority structures for the employees and policies within the company, YCH also has a vision of empowering its customers with the necessary technical expertise so that they are able to use the facilities offered by YCH to the fullest without the intervention of a formal authority. In the case of RFID, this is being implemented to a large extent by educating the customers about the capabilities of the technology which can be used by them without the intervention of YCH personnel.

Organizational routines that enable mindfulness

Although the stakeholder oriented mindfulness framework helps us understand IT-based innovations in organizations, it will be valuable to understand the underlying micro-processes and organizational routines that facilitate mindfulness. From our data analyses, we inductively derived a set of key organizational routines at YCH that served as building blocks for acting mindfully and thus nurtured IT innovation. These important organizational routines facilitated RFID deployment at YCH Group by enabling and relying upon the five attributes of mindfulness. We now enumerate these organizational routines.

Alertness routines

For IT-enabled innovations to happen, organizations need to identify and appreciate the opportunities presented by new developments in technology and the industry. Alertness routines will help identify new opportunities that can ultimately lead to innovation. These routines involve proactively scanning the environment and industry landscape by being plugged into information networks. Alertness routines help firms gather varied and intelligent information from a variety of sources, vicariously learn from such information and

overcome preoccupation with failure. YCH encourages its staff to attend various conferences and seminars to keep up-to-date with emerging technologies. The CIO is active in giving presentations at practitioner conferences where sharing of experiences with fellow CIOs often lead to better identification of opportunities. In addition, senior staff are key members of various industry and government sponsored groups, which helps them to keep up with technological and market developments. Information sharing among various partners also helps YCH to remain alert for opportunities as well as be cognizant of potential drawbacks of new technologies.

Diversity routines

In order to cope with dynamic and complex environmental changes, firms could be reluctant to simplify their interpretations, thereby making fewer assumptions and engage in deliberate actions to create a complete picture. For reducing its reluctance to simplify interpretations, it becomes imperative for an organization to maintain divergent perspectives and wide repertoires of action. Diversity routines help in getting diverse participation with a variety of stakeholders engaged in key organizational endeavors, thus paving way for gaining knowledge from different sources. Such diversity introduces multiple ways to view an organizational endeavor, thereby helping a firm to generate several reconfigurations of its knowledge. At YCH, project teams are cross-functional in nature, comprising business, operations and IS personnel. This diversity among team members facilitates diverse views on issues which lead to new ideas. YCH forges tight partnerships with key clients from different industries. These clients possess important industry-specific knowledge which helps YCH to tailor appropriate solutions to their supply chain issues. In addition, YCH also works closely with their vendors, such as Oracle, thereby gaining knowledge from different sources, which may give rise to innovative solutions to cater to business needs.

Information-sharing routines

In addition to gathering extensive information from diverse sources, it is important to ensure that such information is shared across different levels of the organization so that stakeholders at multiple levels of the organizational hierarchy can be sensitive to the day-to-day operational implications of the proposed organizational/IT innovation endeavor. Information-sharing routines contribute to a conducive climate for innovation where people can build a bigger picture through extensive communication and information exchange. Information sharing is facilitated by having an innovation culture where staff are encouraged to share and contribute to new ideas. Even the offices are designed to promote easy sharing of ideas by facilitating convenient interaction among staff. Further, there are discussion areas strategically located with glass panels for writing and brainstorming ideas. YCH termed these areas as 'boxing

rings' where information and ideas are shared and discussed intensively. In addition, project teams have monthly meetings with senior management to share information as well as discuss new ideas.

Social exchange routines

Related to information sharing routines, organizations also need to promote informal social exchanges between knowledgeable stakeholders rather than strictly adhering to formal structures and authority. Social exchange routines involve processes for facilitating dynamic interactions among staff, providing a way to bridge and bond with individuals who may not be directly related to their immediate job function or responsibilities. Such informal networks of practice can promote open discussion of ideas that could eventually stimulate innovative thinking. At YCH, the feedback process is 'open' in the sense that there is no need to go through different layers to get ideas heard. YCH adopts the open office concept where even the offices for senior directors are open. This enables everyone to be aware of other persons are doing, and consequently also facilitates open and informal interactions. Openness enables fruitful debate on the possibility of failures and facilitates early detection of failures. It also facilitates informal social exchanges which lead to open discussion and sharing, thereby discouraging simplifying interpretations and enabling greater sensitivity to operations. Further, social exchange routines can empower staff (reliance on expertise over formal authority) and facilitate more rapid response to crisis (commitment to resilience).

Training/learning routines

An organization's ability to cope with the invariable threat of 'surprise' or sudden changes relies on its commitment of resilience. Resilience entails the ability to absorb the change as well as utilize the change for benefits. For firms to be resilient, they have to be prepared for inevitable surprises and changes, which can be achieved through training and continuous learning. Such learning routines can facilitate organizational adaptation and managing vulnerabilities. An emphasis on training and learning entails a recognition that current levels of organizational expertise may be inadequate for future and working on updating and refreshing of skills, expertise and organizational knowledge. At YCH, staff are encouraged not only to learn from each other but also from their clients, vendors, business partners and customers. This is achieved through customer-centric alliances (to work closely with customers to understand and meet their needs) and a strong focus on staff development. In fact, at YCH, business personnel are exposed to IT and IT personnel are exposed to industry-specific knowledge as well as advanced and emerging technologies. Staff may also be sent overseas for training, when necessary. YCH's commitment to training and continuous learning is evident from the fact that training expenditure accounts for about 6% of its salary bill.

Limitations

There are three limitations of this study. First, as this paper is based on a single case study, there may be an issue of generalizability to other contexts. Nevertheless, we believe that the case study highlights several issues that are important for firms to consider when implementing RFID. Second, due to differences in infrastructure and standards, RFID implementation in other countries may encounter similar or different challenges from those highlighted in the case. Further, the use of RFID in different contexts or industries may also result in a different set of challenges highlighted in the case. Nevertheless, the stakeholder mindfulness framework should serve as a useful starting point in RFID implementation. Third, although there may be potential for some bias in retrospective interviews, we mitigated this bias by conducting interviews with different persons involved in the RFID project. This also helps to mitigate bias due to the CIO being a co-author. The researchers (excluding the CIO) coded the data, and cross-checked the interviews with secondary data. Fourth, we primarily interviewed senior and middle level managers for this study. While this could lead to potential bias, we mitigated this by talking to operations staff during our site visit. However, it should be noted that we did not interview any of the YCH customers. We use the stakeholder framework to demonstrate how YCH paid attention to the needs of internal employees and YCH customers, rather than whether customers are mindful of RFID. Future research can possibly include data collection from a diverse set of stakeholders including external customers and suppliers.

Implications for theory

There are several implications for theory that this study facilitates. First, empirical validation of mindfulness framework is still rather limited. The reason for this fact is mostly attributed to the abstract and philosophical connotations of the mindfulness concept. There can be innumerable parameters and perspectives that an organization would like to do mindfully. For operationalizing the concept so that it can be used by organizations, we take recourse in the stakeholder theory and propose that for achieving the desired ends of an innovative technology implementation, organizations must take the perspective of its significant stakeholders and address them mindfully. Hence, we propose a 'stakeholder oriented mindfulness framework' that can be used to better understand the implementation of innovative technologies. We demonstrate the applicability of the framework through the case of RFID implementation at YCH, which is an interesting and apt case as it is a firm regarded as a pioneer in innovative technology implementation (Teo *et al.*, 2007). Future research can further validate this framework by incorporating other stakeholders such as technology partners and vendors. Note that YCH's competitive advantage may also lie in the fact that it has a separate technology unit (Y3 Technologies) that develops and customizes the technical

solutions required for RFID implementation. Other firms may not have a similar structure and may need to work with a technology partner or a vendor, which then becomes an important external stakeholder. Also future research can use mindfulness for examining other technological implementations. Although this research has taken a stakeholder perspective of mindfulness, it is plausible that in different contexts, other perspectives might emerge as important.

Second, although mindfulness is a desirable quality for organizations, it remains unexplored in the mindfulness literature as to what really promotes and facilitates mindful behavior in organizations. We extend the mindfulness theory by proposing five organizational routines that firms could adopt for enabling mindfulness. Future research can examine each of these routines in greater depth as well as compare the routines practiced in different firms. While we have identified some organizational routines enabling mindfulness, it will be interesting for future researchers to examine other antecedents of mindful behavior in organizations especially in the context of implementation of innovative technological solutions. A related area of research interest would be to investigate if the returns from mindful behavior are commensurate with resources expended for inculcating it.

Third, this is the first study that examines RFID implementation in the context of mindfulness. In doing so, we demonstrate the usefulness of the mindfulness lens in examining RFID technology implementation. Though the five attributes of mindfulness have observable overlaps with management strategies for successful strategic IT experimentation, we conclude that mindfulness in organization can be a desirable state facilitating successful strategic IT experimentation leading to innovations. An agenda for future research can be to examine this link in greater detail.

Fourth, previous research on RFID tends to dwell more on technical issues rather than management issues. Past studies have shown that technology implementation may not always be dependent on the technological aspects alone (Teo *et al.*, 2009). Successful technology implementation is often heavily dependent on the softer management concerns. For example, as mentioned earlier, YCH found that forklift drivers were worried when they pass the gantry with RFID readers as there is no beep sound (unlike bar code reader). Consequently, some drivers reverse the forklift forwards and backwards to ensure that the pallets are read. However, this creates the problem of multiple reading of the same data. This problem was solved with the use of a LCD display at the gantry to indicate to forklift drivers whether a pallet has been read. Hence, our study extends the repertoire of management-oriented studies on RFID, thereby leading to a better understanding on management issues pertaining to RFID implementation. Such management issues and their resolution in RFID implementation provide rich avenues for future research.

Fifth, while the focus of our paper is on mindful behavior, future research could also examine its antithesis, namely mindless (or less mindful) behavior. It is important to note that both mindful and mindless behavior can co-exist in organizations as it is not possible for organizations to remain mindful all the time (Weick, 1998). Future research can examine the appropriate balance under differing contexts, as well as different ways to sustain mindfulness.

Implications for practice

This study also has several implications for practice. First, it empirically demonstrates the importance of having a mindful perspective with relation to the key organizational stakeholders. Practitioners should note that mindfulness requires both attentiveness to one's context as well as the capacity to respond to unanticipated cues or signals from one's context (Levinthal & Rerup, 2006). Different stakeholders can have different reactions to the same technology implementation and these must be mindfully evaluated by the organization undertaking such an implementation. Even the same stakeholder groups in different countries can react to the same technology differently. Consequently, it is important for managers to improve their state of mindfulness by paying greater extent to the five attributes of mindfulness. For example, it is important for managers to be pre-occupied with the possibility of failure as successful implementation for one site does not guarantee successful implementation in another site.

Second, in addition to paying attention to the five attributes of mindfulness in relation to the associated stakeholders, practitioners also need to foster an innovation mindset, anticipate and manage change, explore options as well as take appropriate steps to mitigate risks. In particular, organizational routines identified in this study can be directly useful to managers in enhancing mindfulness. Specifically, firms should establish routines to facilitate alertness, encourage diversity of views, promote information sharing, strengthen social interaction and bolster training and learning.

Third, although it may be common knowledge that there are likely to be salient differences in technology implementation in different countries and that these differences need to be properly managed in order to reap the benefits of RFID implementation, many organizations fail to make an effort to learn and transfer their learnings across different implementations because they are not sensitive to differences in operational details and tend to simplify interpretations by adopting a 'one size fits all' approach. Hence, it is important that lessons learned from initial implementation are transferred to subsequent implementations, and lessons learned from subsequent implementations are transferred back to the initial implementation. In this way, there is constant learning and improvement with each implementation. Such constant improvement will maintain the firm at the

forefront of technology and make it harder for competitors to catch up.

Fourth, there is a need to convince customers about the potential value benefits rather than benefits solely in terms of cost savings as the use of RFID is likely to increase costs, at least in the short term. Although costs of RFID readers and tags are on a downward trend, it is still relatively expensive. The costs of tags become a critical issue as the firm moves from pallet tagging to carton tagging to item tagging, which may require smaller tags that tend to be more expensive and less reliable. Economies of scale and lower costs of RFID readers and tags would facilitate more widespread adoption. There is also a tradeoff between using reusable tags (which are more expensive) and lifespan of the tags. In addition, there is also the cost of the software and integration issues with existing systems. Currently, most ERP and WMS systems are not designed for RFID data capture (real-time update). Hence, YCH collaborated with Oracle to develop the edge server for RFID data capture and update.

Fifth, RFID implementation can lead to massive amounts of data gathering and collection, much more than traditional systems. A firm cannot mindlessly invest in RFID as it requires careful planning for storage, retrieval and usage of the data gathered. It is also not easy to 'exit' or 'abandon' such an initiative as it involves multi-tiers of stakeholders.

Sixth, there is a need to work on standards, which will help in acceptance of technology and in the long run will bring down the cost of the technology. There is a need for appropriate frequency ranges compatible with those in U.S.A. and Europe. Firmware compatibility is also an issue. For example, YCH needed to develop firmware (software) for RFID readers as U.S. readers were not compatible. There is also a need for standards on Electronic Product Code (EPC) for RFID. The different standards for RFID hinders widespread adoption and usage, for example, ExxonMobil Speedpass system is a proprietary RFID system; hence, it cannot be used for payment at fast food restaurants. Consequently, it is important to note that local customization to suit a particular context may be necessary for successful implementation. In the case of RFID, some countries have strict regulations regarding wireless transmission, which may limit how RFID is deployed. Hence, it is important to rely on expertise over formal authority in customizing solutions creatively to address and mitigate such restrictions.

Seventh, unlike common IT implementation, RFID technologies are relatively new and being a leading edge innovation, there is a fair amount of unknown factors to deal with and learn through trial and error (e.g., positioning of RFID tags to minimize interference). Consequently, the challenges faced tend to be more dynamic and a commitment to resilience by adopting greater extent of adaptation, coordination and education of staff is required. Hence, proper change management is necessary not only within the organization but also outside the

organization. Both employees and customers need to be educated on the usage, potential and challenges of RFID.

Eighth, implementing RFID also give firms an opportunity to mindfully reflect on their current business processes and assess how RFID can be used to streamline workflow and capture data that were not easily captured before. This should result in improved business processes as RFID enables firms to track goods throughout the supply that were costly to do so in the past. As the result, RFID can also lead to better coordination among various stakeholders, leading to enhanced business value.

Concluding remarks

YCH is the first company in the world to use RFID successfully for liquid products in the bonded warehouse. The RFID project is one of many successful projects undertaken by YCH Group which has a reputation of implementing innovative technologies. The efforts of YCH have been recognized by leading industry groups and premier business associations resulting in numerous prestigious innovation and technology awards such as CIO Award (2006), Asian 3PL of the Year Award (2007) and the National Infocomm Award (2008). YCH serves as

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a role model for other companies to emulate. Recent theoretical deliberations on innovative technology implementation have stressed the importance of 'mindfulness' as a theoretical concept. But the firms are faced with a problem of operationalizing the concept for practical use. Taking a stakeholder perspective, we propose a stakeholder oriented mindfulness framework and demonstrate its appropriate use through the case of RFID implementation at YCH, where YCH mindfully addressed the concerns of its two primary stakeholder groups – employees and customers. Further, the study delineates five organizational routines that can be used by organizations for fostering mindfulness. The research integrates the theoretical concept of mindfulness with the stakeholder perspective and provides practical implications for firms contemplating innovative technology implementation in general and RFID implementation in particular.

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Appendix

Data collection procedures

Target interviewees are middle and senior level staff of YCH involved in RFID implementation.

Before interview

- Prior to the interview, collect background information from secondary sources such as YCH website, press releases, magazines, etc.
- Design interview questions and send to YCH a week before interview.

During interview

- At the start of interview, thank the interviewees for being present.
- Explain the objectives of case study.
- Ask for permission to record the interview. Allay interviewees' concerns by telling them that recorder could be switch off if they wish at any time during the interview (e.g., if they want to make some comments that they do not wish to be recorded).
- Give respondents time to answer questions and try not to interrupt their responses.
- Probe their answers and seek clarifications, whenever necessary.
- Seek views of other interviewees also. Ask them whether they have anything to add.
- Clarify questions asked to ensure interviewees understand them.

- For information not presently available, request for information to be sent via email or normal mail (e.g., organization chart, implementation schedule, annual report).

Sample questions

Background

- Can you provide a brief history of the evolution of YCH to an integrated SCM provider?
- What does YCH consider its major landmarks in the use of IT for its business?
- Please elaborate on key IT systems.
- What is your value proposition to customers?
- What is the role of CIO at YCH?
- What is the relationship between business and IT divisions of the company?
- What is the rationale for setting up Y3 technologies?
- What is the relationship between Y3 and YCH?
- What awards have you won over the years?

Innovation and mindfulness

- How does YCH gather information on technological and market developments?
- How does YCH identify information that helps them identify potential pitfalls in their new innovation journey?
- How does YCH identify and assess innovation ideas?

- What processes are in place to encourage innovation?
- How does YCH ensure multiple points of view when engaging in innovation decisions? Committees that involve varied stakeholders? Task forces with external entities or participants?
- How does YCH ensure information-sharing across different levels?
- Other mechanisms for information sharing and feedback: Town-hall meetings, technology tours, focus group, brainstorming sessions, suggestion box scheme, etc. involving operational staff etc.?
- Are there any mechanisms that YCH uses to foster collaboration across different units, departments?
- How are informal, social interactions prompted within YCH?
- How are 'open discussions' encouraged?
- How does YCH handle failures?
- What does YCH do differently from other companies in terms of bringing about IT-enabled innovation? Is it the organizational structure? Corporate culture? Some specific competency? Etc.?

RFID

- What was the key motivation for use of RFID?
- Was there a champion for RFID?
- When was the RFID project initiated?
- Please describe the RFID implementation process.
- How long did the pilot project take?

- Who was involved in RFID project? Team size?
- What is your role in RFID implementation?
- What are your views on the implementation process and the outcome?
- What information is put on RFID tags?
- What areas are RFID deployed at YCH?
- What role did other parties (e.g., Oracle) play in your RFID implementation?
- What are the key challenges and issues in RFID? How were they resolved?
- What lessons have you learned?
- What would you have done differently?
- What are the impacts of RFID on your operations?

After interview

- Transcribe interview within 24 h.
- Two authors jointly examine transcripts to identify and discuss key issues and examples related to mindfulness. This was also reviewed by a third author.
- Secondary data from YCH and Y3 websites, magazines, newspapers, press releases, company documents, etc. were collated with interview data to verify available information.
- Do a preliminary case write-up. Send to YCH for comments and validation.
- Seek further clarifications via email and/or phone.
- Set-up date and time for further interviews with key persons.