Factors that influence the implementation of collaborative RFiD programs

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Abstract
Purpose – Radio frequency identification (RFiD) programs are being mandated by many entities, such as Wal-Mart and the Department of Defense, but what factors lead to successful implementation of these programs by their business partners?
Design/methodology/approach – This paper is conceptual in nature. It briefly reviews current applications of RFiD technology and proposes a model for RFiD implementation through partners.
Findings – While some companies are quickly adopting RFiD technology, little is known regarding important factors for successful implementation. To address the interorganizational nature of RFiD, this research uses assimilation theory to provide insight as to the key factors impacting the deployment of this technology across trading partners.
Originality/value – The paper provides a theory-based framework for companies’ RFiD initiatives and identifies specific factors that enable a business partner to implement successfully an RFiD technology program initiated by a powerful supplier or customer.

Keywords Companies, Customers, Suppliers, Identification

Paper type Conceptual paper

An executive summary for managers and executive readers can be found at the end of this issue.

Introduction
Recent reports suggest that the adoption of radio frequency identification (RFiD) technology is slowing due to the lack of return on investment (Field, 2007; McWilliams, 2007; Neal, 2007). Even with mandates from Wal-Mart and the Department of Defense, the deployment of the technology in channel and other business relationships has not lived up to industry expectations. At Wal-Mart, over 600 suppliers have been mandated to adopt the technology; however, the majority are implementing the technology at the minimum levels required (Briody, 2006; Field, 2007; McWilliams, 2007). These minimum levels, also known as the “slap-and-ship” approach, utilize only the most basic aspect of the technology, the RFiD tag. The tags are applied manually to either the case or pallet just prior to leaving the warehouse. Most of the suppliers operating at this level have not invested in any of the hardware and software components necessary to scan, collect and utilize data generated from the RFiD tag technology (Briody, 2006; Field, 2007; Fish and Forrest, 2006; McWilliams, 2007; Songini, 2006; Wailgum, 2006).

Yet, the picture is mixed since there are some suppliers who have derived tremendous benefits after making the requisite investments in the hardware (i.e. RFiD readers), collaborative networking, and related software (Songini, 2006).

Because RFiD has important interorganizational requirements, when organizations such as Wal-Mart and the Department of Defense adopt RFiD in their supply chains they become dependent on the implementation behaviors of their channel partners. RFiD technologies encompass a myriad of technological components such as tags, readers, middleware, enterprise systems and collaborative networks that both channel partners must adopt. As a result, the implementation of RFiD programs across channel relationships is a complex and highly interdependent process. Collaborative RFiD programs require investments by both parties involved in the channel relationship before the benefits of the technology can be fully optimized (Hausman and Stock, 2003). One trading partner cannot effectively utilize the technology without its counterpart participating in the implementation as well. Each channel partner must invest in the various RFiD system components which may include the tags and readers, middleware and servers, enterprise applications and the EPCGlobal Network infrastructure, all of which may or may not be adopted at the same time (RFiD Journal, 2006). The adoption of RFiD technology in a channel relationship begins with one trading partner’s decision to adopt the technology; this partner is the initiator.
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and may be the supplier or retailer. After the initiator decides to adopt the technology, they must then deploy it across their channel partners by convincing them to implement the technology. Often this is done through coercive tactics, such as mandates requiring the channel partner to adopt the technology or face the termination of the relationship. The channel partners who are required by the initiator to adopt the technology are called followers.

When an initiator adopts and subsequently implements an interorganizational technology, they often have little direct control over the assimilation behaviors of follower firms and, consequently, little control in realizing benefits from the technology (Bello et al., 2004). For this reason, it becomes necessary to understand the factors that enable the follower to successfully implement an RFID program. This is especially crucial as major retailers and governments attempt to encourage RFID technology adoption and deployment through mandates.

As called for by Ngai et al. (2008), the goal of this research is to identify specific factors that are likely to enable the follower firm to have a successful RFID implementation that results in increased organizational efficiency. While innovation theory is the predominant paradigm for analyzing adoption and implementation behaviors, other research suggests that the technological characteristics are not the only forces that work within this phenomenon (Attewell, 1992). The major argument is that innovation theory only considers knowledge about the technology and ignores the implications of knowing how to implement and use the technology (Attewell, 1992; Fichman and Kemerer, 1997). As such, we propose a conceptual model based on the theory of assimilation; our approach suggests follower organizations are more apt to have successful implementations when conditions are conducive to organizational learning.

The conceptual model we propose recognizes that the successful implementation of RFID programs is dependent on both the internal and external implementation climates experienced by the follower organization. The internal implementation environment may create conditions conducive to organizational learning, while the external implementation environment may increase the follower's commitment to the program. RFID programs require specific knowledge and skills and, as such, the model considers specific organizational factors leading to successful implementation practices.

This article proceeds with discussions of the theoretical framework and conceptual model. Three propositions are developed to summarize the theory presented and to serve as a guide for future research. The article concludes with a discussion of the research implications.

Theoretical framework

In situations where the adoption of RFID technologies is mandated to followers, some argue that learning about the characteristics of the technology becomes less important than learning how to implement and utilize the technology (Attewell, 1992). Classical innovation and diffusion theories examine how communication influences the adoption of technology. These theories assume that technologies are more likely to be adopted when the potential adopter is aware of the technology and convinced that the technology is superior to and compatible with current systems, easy to understand, easy to try and test, and has highly observable results (Rogers, 2003). One limitation of these theories is that they do not differentiate between the cognitive (i.e. beliefs, perceptions, mental models) and technical dimensions (i.e. know-how, technical knowledge and skills) of tacit knowledge. Some researchers suggest that the latter is the critical knowledge component related to the implementation of technologies and that the persuasion-based drivers of adoption in the classical theories do little to explain the degree to which follower organizations deploy technologies (Attewell, 1992).

In response to this criticism of classical diffusion models, Attewell (1992) introduced a framework suggesting that know-how or technical knowledge impacts an organization’s ability to adopt and implement complex technologies. Importantly, Attewell suggests complex technologies create knowledge barriers for organizations possessing limited know-how, negatively impacting their ability to adopt and implement technologies. The assimilation framework suggests knowledge barriers are created when organizational resources are insufficient to the extent they place burdens on organizational learning (Attewell, 1992; Fichman and Kemerer, 1997). As will be shown, organizations are less susceptible to knowledge barriers when they have an internal environment that encourages organizational learning (Fichman and Kemerer, 1997). Similar to innovation theory, technology assimilation is based on processes, beginning with an organization’s awareness of the technology. Next, the organization evaluates the technology, resulting in a decision to commit or not to utilizing the technology within the organization (Fichman and Kemerer, 1997). The actual implementation of the technology (implementation stage) refers to all events that follow the decision to commit to a technology (Pullig et al., 2002). In this stage, the organization purchases the technological components, changes relevant business processes, and routinely utilizes the information created by the technology (Fichman and Kemerer, 1997).

Empirical evidence suggests that organizations can easily purchase the technological components necessary for a new technology system; however, the implementation phase is wrought with difficulty stemming from the learning burden (Attewell, 1992). Some research even suggests that certain technologies can destroy firm competencies when they require new skills and knowledge (Tushman and Anderson, 1986). Additionally, researchers have found that firms with more prior knowledge and diverse knowledge are more likely to sustain the implementation of a technology (Fichman and Kemerer, 1997).

Conceptual model

As shown in Figure 1, effective implementations of RFID programs for follower firms are the result of commitment and internal firm conditions that are conducive to the implementation (Pullig et al., 2002; Klein and Sorra, 1996). With RFID implementations, considering the external environment is important due to the dependencies associated with the collaborative adoption by both the initiator and follower. The successful implementation of the RFID program can be viewed as the routinized utilization of the capabilities of the RFID technology effectively in their business activities (Armstrong and Sambamurthy, 1999). Internally, environments that are conducive to the creation of technical knowledge will be better equipped to implement and utilize the RFID technologies in a successful manner.
Externally, the collaborative environment created by the relationship with the initiator motivates the follower to implement and utilize the technology. In the following sections, internal and external factors that are likely to increase the likelihood of successful implementation are examined.

**Internal implementation environment**

An internal implementation environment is the internal culture of the follower organization (Albino et al., 1999). It represents both the learning and transmission abilities of the firm (Albino et al., 1999; Cohen and Levinthal, 1990). The internal implementation environment encompasses the resource endowments specific to the firm that encourage organizational learning (Cohen and Levinthal, 1990). Organizations vary in the degree of resource endowments, which enable the implementation and utilization of complex technologies. For those lacking these resources, cost disadvantages and knowledge burdens make implementing technologies difficult (Mata et al., 1995). According to assimilation theory, it is knowledge burdens that have the greatest impact on an organization’s ability to implement and utilize technology.

Previous research suggests specific resource endowments that might create the conditions necessary for the successful implementation of an RFiD program. These variables include: top management support (Chwelos et al., 2001), the cross-functional teams dedicated to the program (Hausman et al., 2005) and prior technical knowledge (Fichman and Kemerer, 1997).

Empirical evidence suggests that top-management support is key to a firm’s adoption and implementation behaviors (Chwelos et al., 2001; Iacovou et al., 1995; Premkumar et al., 1997; Ramamurthy and Premkumar, 1995; Ramamurthy et al., 1999). Support and involvement from senior management serves to drive the adoption by signaling the importance of the RFiD program (Ramamurthy et al., 1999). Additionally, the interorganizational component of the technology requires the cooperation between the follower and initiator, which is often best done at the senior levels of management (Premkumar et al., 1997). Several studies find that top-management support is a factor key to the implementation of interorganizational technologies such as EDI (Chwelos et al., 2001; Iacovou et al., 1995; Premkumar et al., 1997; Ramamurthy and Premkumar, 1995; Ramamurthy et al., 1999).

The existence of cross-functional teams is also likely to enable the successful implementation of RFiD programs. The underlying mechanism that drives interfunctional coordination is the communication across functional units, which drives knowledge sharing, builds social capital and builds consensus (Hausman et al., 2005). Knowledge is transferred across functional boundaries increasing the firm’s ability to utilize the technology. Cavusgil et al. (2003) found that collaborative experiences increase an organization’s ability to transfer knowledge. In a meta-analysis of innovation determinants, Damanpour (1991) found that internal communication facilitates the adoption of radical technologies. Corsten and Kumar (2005) found that the utilization of cross-functional teams increased the degree of ECR adoption.

The degree of existing technical knowledge within an organization as it relates to RFiD technology may also have an impact on the success of RFiD implementation (Fichman and Kemerer, 1997). While some of the technical knowledge is explicit, in that the ability to implement a new technology is based on the codified knowledge within the firm, it can be argued that the majority of the knowledge is tacit in that it has been learned through experience. Research suggests that tacit knowledge increases a firm’s ability to innovate (Cavusgil et al., 2003). Related technical knowledge increases a firm’s ability to acquire and retain new knowledge because the knowledge foundation provides a mental schema that assists and bridges the gap between the old and new knowledge (Fichman and Kemerer, 1997). The gap between what they know and what they need to know is lessened because they have to acquire less knowledge.

An implementation environment that is conducive to the transference of technical know-how is posited to create conditions that enable the follower to have a successful
implementation. When these elements are low or nonexistent, the firm will have high knowledge barriers that will impede its ability to implement and utilize the technology. Zahra and George (2002) suggest that firms with realized absorptive capacity are more innovative due to their enhanced abilities to transfer and exploit knowledge. They suggest that firms high in absorptive capacity are better equipped to change current processes and find innovative ways to increase organizational performance. Studies also indicate that organizations with high learning abilities are more likely to successfully reengineer their business processes to participate in electronic markets (Grewal et al., 2001).

Thus we put forward the following proposition:

**P1.** An internal implementation environment will create conditions that lead to an effective implementation of the RFID program when an organization has: cross-functional teams dedicated to the RFID implementation; top management support for the program; and existing technical knowledge related to RFID technology.

**External implementation environment**

An external implementation environment encompasses the elements of the relationship between the follower and initiator that serve to motivate the follower to implement the technology. Morgan and Hunt (1994) suggest that follower's are more likely to acquiesce to the initiator's requests and work together towards mutual goals when the follower believes that the relationship is important enough to ensure that it continues into the future. The relationship is strengthened when the follower perceives that they share values with the initiating firm (Morgan and Hunt, 1994). Shared values describe the extent to which channel partners have common values, goals and behaviors (Morgan and Hunt, 1994). They serve as a mechanism for managing the relationship and ensuring appropriate behavior (Bercovitz et al., 2006; Heide and John, 1992). The literature suggests that the shared values associated with the exchange relationship will increase relationship commitment and hence, commitment to implementing the RFID program (Morgan and Hunt, 1994).

Heide and John (1992) suggest three relational norms-flexibility, information exchange and solidarity- reflect shared values within the channel relationship (Morgan and Hunt, 1994). Flexibility represents the ability of each partner to adapt to changing conditions through the modification of agreements (Bercovitz et al., 2006; Heide and John, 1992). It is a bilateral expectation that changes will be made to agreements when warranted by circumstances that are detrimental to either partner (Heide and John, 1992). In the context of the follower's adoption of RFID programs, flexibility is manifested when the initiator reevaluates its mandate and rescinds requirements that are detrimental to the relationship.

Information exchange is the expectation that each party will share information that is useful to the partner (Heide and John, 1992). Frequent information exchange is critical in initiating/follower relationships, not only does it allow the initiator to have dialogue as to the status of the implementation, but it also allows for feedback from the follower as to any issues or problems they are having with the implementation (Cavusgil et al., 2003). Additionally, tacit knowledge is transferred across organizational boundaries when the frequency of interactions increases (Cavusgil et al., 2003).

Solidarity is the expectation that each party values the welfare of the other (Bercovitz et al., 2006; Heide and John, 1992). Relationships high in solidarity relish their interdependence and work together to solve problems within the relationship (Bercovitz et al., 2006). In successful implementations of RFID technology, solidarity becomes key to resolving issues faced by the follower. This is especially important to organizations experiencing difficulties adopting the technology because characteristics of the product interfere with the ability to read the RFID tags. For example, several firms are having problems obtaining the appropriate read rates necessary for their initiating partners due to the water content of their product. In these cases, when the initiator works with the follower to help remedy the problem by either sourcing technological providers or providing additional time for the follower to meet the mandate, the initiator will remain committed to implementing the program.

Thus we put forward the following proposition:

**P2.** An external implementation environment will increase the follower firm's commitment to implementing the RFID program when the follower's relationship with the initiating partner exhibits: flexibility, information exchange; and solidarity.

**Successful implementation of the RFID program**

The successful implementation of the RFID program encompasses much more than the purchase of the technology. The implementation includes the acquisition of the technology, the reorganization of business processes, and the utilization of the data created by the system. With RFID systems, the technological components are the physical hardware and software components that are required to run the network, such as readers, tags and internal data mining software. Current mandates only require the application of the RFID tag at the pallet level; for those followers who only adopt at this level, the costs of implementing the program often exceed the benefits derived. It is only when the follower firm adopts all of the components necessary to enable the exchange of real-time data across the channel relationship that the true benefits of the system can be derived. This level of implementation requires the follower to change business processes, activities and procedures in such a way that the data can be collected and distributed across the organization and channel relationship (Clark and Stoddard, 1996). The final requirement for a successful implementation is that the follower must have the ability to utilize the data in such a way that they can derive value from the information. RFID programs enhance information visibility across the supply chain, increasing the efficiency of both demand management and order fulfillment activities (Tajima, 2007).

Demand management includes all activities related to forecasting and managing demand in production and distribution (Lambert and Cooper, 2000). RFID data improves the accuracy of the data collection as the products move from the production line to the consumer (Delen et al., 2007). More accurate point-of-sale data results in reduced uncertainty and more efficient flows of goods through the supply chain (Lambert and Cooper, 2000). With increased information visibility, demand can be more accurately forecasted and managed, reducing inventory-holding costs.

Order fulfillment includes all activities associated with meeting customer requirements and includes the integration of manufacturing, distribution and transportation strategies.
Conclusion

In conclusion, with major retailers and governments mandating the use of RFiD technology by their business partners, it is essential to understand the factors that will lead to successful implementation of RFiD programs. Our model suggests that successful implementation is a result of an internal implementation environment, which is conducive to organizational learning by the following partner. It also is a result of a positive external implementation environment which will increase a follower firm’s commitment to the program. RFiD programs require specific knowledge and skills; therefore, our model takes into account the specific organizational factors leading to successful implementation and resulting in greater efficiency for the organization. This model lends itself to many future research streams and it also has many potential practical implications for firms. We propose, first, that companies must have strong top management support for the new RFiD programs, as well as high-quality cross-functional teams that can assist in the knowledge transfer across company areas. Second, firms also will be successful in implementing RFiD programs if they have prior technical knowledge regarding RFiD in general. Finally, if the initiator firm reaches out and collaborates with the follower firm, then the follower firm will have a stronger commitment to implement a successful RFiD program.

Managerial implications

Our conceptual model leads to some very practical implications. First, an organization’s ability to successfully implement RFiD technologies requires a commitment to the program as well as conditions that enable the implementation. Conditions that enable the relationship are those that reduce knowledge barriers and increase the transfer of technical know-how across the organization. One basic implication is that top management must be involved and support the implementation of the RFiD program. This suggests they must have a strong understanding of the technology and the performance implications for the firm. Additionally, executive level support enables the transfer of knowledge by opening up the capital resources necessary for the firm to build the technical knowledge through training, educational seminars and conference attendance. Cross-functional teams are also suggested to help with the implementation. Cross-functional teams help transfer knowledge regarding the benefits and problems associated with an implementation across the functional areas. The implementation often requires that other functional units understand the benefits of the program and how to utilize the data to create value for the firm. The framework also suggests that firms with more prior technical knowledge will be more likely to have the conditions necessary for a successful implementation. Firms with a history of successful implementations or experience with RFiD technology in other applications have the ability and confidence to tackle a complex implementation.

Another implication for managers is the role that the external relationship has on the follower’s likelihood of having a successful RFiD implementation. The social norms that surround the exchange relationship between the follower and the initiator will influence their levels of commitment to the program. Interorganizational relationships that are highly collaborative are more conducive to motivating the follower to adopt the technology. Collaborative relationships provide the follower with the expectation that there will be a fair distribution of profits and burdens associated with the implementation. Overall, the research suggests that initiating firms can encourage successful adoptions through collaborative behaviors.

References


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Further reading


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