ABSTRACT

Interorganizational systems (IOS) adoption requires cooperation and collaboration between trading partners and, therefore, is reliant on the nature of their relationships. There has been some research that investigates relationships and how organizations progress from one level to the next level of adoption. However, these studies do not adequately justify the exclusion of other variables and are not theoretically based. This research extends the Kurnia and Johnston (2000) process model of IOS adoption by incorporating the notion of IOS adoption maturity and also modifies it from a supply chain to a dyadic level so better evaluations of progression can be performed. With this model, the dynamics of IOS adoption maturity can be better examined empirically.

Keywords: Interorganizational systems (IOS), B2B e-commerce, Interorganizational relationships, IOS adoption, IOS maturity, IOS sophistication

INTRODUCTION

Interorganizational systems (IOS) are automated information systems, such as electronic data interchange (EDI) and collaborative planning, forecasting, and replenishment (CPFR), that are shared by two or more companies (Cash & Konsynski, 1985). IOS offers trading organizations substantial benefits such as reduced inventory costs; elimination of redundant handling of data entries; improved scheduling, processing, and distribution of goods; and improved information accuracy, to name a few (Mentzer, 2004; Premkumar & Ramamurthy, 1995). IOS has become a strategic weapon for some organizations to obtain competitive advantage and has shifted competition from single firms competing individually to supply chains competing against other supply chains (Birou, Fawcett, & Magnan, 1998; Lambert & Cooper, 2000).

Despite these benefits, many companies face difficulties in adopting these systems
because such implementations are highly reliant on trading partners’ existing relationships, which often are not favorable (Kurnia & Johnston, 2003). IOS adoption requires credible commitment of participating firms to work collaboratively to achieve common objectives and goals. Because of the inherent complexity in IOS adoption, there have been many attempts in the literature to study various aspects of IOS adoption by organizations (Damsgaard & Lyytinen, 1998; Kumar & Van Dissel, 1996; Saeed, Malhotra, & Grover, 2005). Some studies (e.g., Ham & Johnston, 2007; Kumar & Van Dissel; Meier, 1995; Saeed et al.; Webster, 1992) indicate that unfavorable relationships often exist among trading partners, which makes IOS adoption difficult.

Realizing the importance of relationships in IOS adoption, there have been an increasing number of researchers investigating interorganizational (IO) relationships. For example, some studies examine IO relationship factors or aspects that contribute to adoption failures or success (Hart & Saunders, 1997; Ibrahim & Ribbers, 2006; Nagy, 2006). Others classify relationship types based on relationship intimacy and IOS types based on integration, and then match levels of relationship intimacy with the levels of IOS integration (Choudhury, 1997; Shah, Goldstein, & Ward, 2002). More recently, researchers not only examined the interaction between relationship types and IOS types, but also investigated how organizations move from lower levels to higher levels of intimacy in relationships and the integration of IOS types (Ham & Johnston, 2007).

While there are some studies that shed light on how organizations can move or progress from a less sophisticated to a more sophisticated IOS based on relationships, it is difficult to base an empirical investigation on this work. This is because these studies are not theoretically strong and do not include, or justify the exclusion of, other factors such as organizational capabilities to investigate maturity or progression of IOS adoption.

Over the years, various frameworks have been developed within the IOS adoption field. For example, Damsgaard and Lyytinen (1998) examine IOS using micro, meso, and macro levels of analysis; Kumar, Van Dissel, and Bielli (1998) classify IOS studies as technical, economical, or sociopolitical; and Ramanathan and Rose (2003) explain IOS adoption research using stages. While these frameworks help us obtain a general understanding of the field, they do not emphasize the importance of time in the study of IOS adoption.

Kurnia and Johnston (2000), using IOS adoption of efficient consumer response (ECR) as an example, present a process model of IOS adoption that includes a set of factors and also considers the role of time in IOS adoption. Their model has the potential to complement other studies that examine IOS adoption maturity. Their process model suggests that through dynamic interactions among industry and supply chain players, organizations modify their capabilities and technology vision in the course of adoption of a particular IOS. The model suggests broadening the scope of study to include both an individual organization and its interorganizational environment (supply chain and/or industry), and extends the period of study in order to better capture the dynamic interaction among the industry players that occurs during the IOS adoption.

The Kurnia and Johnston process model could be extended to include the notion of progression because IOS adoption maturity is intended to take place over time. However, it would pose a challenge for empirical research since the model proposes the inclusion of an organization and its interorganizational environment as the unit of analysis, which is practically difficult to achieve, and the data produced would be difficult to interpret due to the complexity involved (Kurnia & Johnston, 2000). Therefore, in this article, we modify the Kurnia and Johnston model by reducing its scope from a supply chain to a pair of organizations (dyadic level), and also refine the model to incorporate the idea of maturity of IOS adoption, which is necessary to obtain a complete picture of IOS adoption. It is important to note that even though our model is dyadic, we still consider
the industry influence in our model because IOS implementations cannot be completely understood without including industry variables in the analysis.

We will show that during the course of IOS adoption, organizational capabilities and the nature of technologies can improve over time through better relationships between the two organizations. This, in turn, will result in the ability of the two organizations to adopt a more sophisticated IOS, which will further improve the relationships. Then we argue that over time, this IOS adoption progression phenomenon occurs because of the reciprocal influences between the nature of the trading partner relationship and the IOS adopted. Based on our model, we finally outline a number of propositions to be tested for further empirical studies.

In the next section, we present a summary of the Kurnia and Johnston study and highlight its limitations. We then discuss a dyadic model of IOS adoption maturity. Next we justify the exclusion of some factors identified in previous studies. Finally, we propose two propositions in relation to our model and conclude the article.

THE KURNIA AND JOHNSTON IOS ADOPTION MODELS

Based on the taxonomy of Markus and Robey (1998), Kurnia and Johnston (2000) classify IOS studies according to the factor approach and process approach. This classification is useful not only because it highlights the theoretical inadequacies of the factor approach, but also shows the importance of expanding the unit of analysis and the role of time in studying IOS adoption. The factors-based studies assume that IOS adoption is determined by a number of predicting variables identified at a particular point of time. These studies examine (a) the nature of technology, (b) characteristics of the organization, and (c) some conditions in the environment of the adopting organization in order to predict adoption.

The first group of factor studies that have investigated the nature of technology has relied on Roger’s (1995) innovation theory as a foundation (O’Callaghan, Kauffman, & Konsynski, 1992; Premkumar, Ramamurthy, & Nilakanta, 1994; Teo, Wei, & Benbasat, 2003). The individual factors include relative advantage, trialability, ease of use (Bouchard, 1993; Premkumar & Ramamurthy, 1995; Premkumar et al.), and perceived risk (O’Callaghan et al.). These studies argue that the more favorable the perceived characteristics of the nature of technology, the more likely the organizations are to adopt (or intend to adopt) the technology. The second factor group, characteristics of the organization, includes top-management support, availability of the technological infrastructure, size, and structure. These factors have been commonly regarded to predict adoption or intent to adopt (Chwelos, Benbasat, & Dexter, 2001; Premkumar & Ramamurthy; Premkumar, Ramamurthy, & Crum, 1997). The last factor group suggests that certain conditions that exist in the external environment of the focal organization may affect the decision to adopt an IOS (Grover, 1993; Premkumar & Ramamurthy; Segars & Grover, 1995). These factors include industry concentration (Grover; Segars & Grover), power (Hart & Saunders, 1998), and competitiveness (Premkumar et al., 1997).

The factor-based studies (refer to Figure 1) adopt a firm-centric perspective, which suggests that organizations do not have a strong influence over their environment, and these studies do not account adequately for the fact that the action of firms changes their conditions over time (Kurnia & Johnston, 2000).

On the other hand, the process approach suggests that an organization’s implementation decision is an ongoing process of assessment and reassessment of adoption aspects. The processual approach posits that the factors alone are insufficient to explain adoption without understanding the processes that are undertaken by the adopting organizations (Kurnia & Johnston, 2000). The Kurnia and Johnston process model represents a transition from the factor approach and is based on empirical evidence from the
Australian grocery industry. The authors argue that the complex interaction between supply chain members in the process of adopting the IOS occurs over time and it is necessary to include the industry players as part of the unit of analysis. Thus, because organizations have an influence over their environment, they are able to change their conditions over time.

As illustrated in Figure 2, the Kurnia and Johnston process model proposes the existence of two-way causal links (processes) among actions of organizations, the interorganizational environment (supply chain structure), the nature of technology, and the capability of the organizations. External factors are beyond the control of the organization and include unpredicted demand, declining competitiveness, and the political environment. Kurnia and Johnston argue that the actions of the focal firm are not only influenced by the nature of technology, capability of organizations, and environmental factors, but also modified by mutual interactions of the focal firm with its supply chain structure. The supply chain structure consists of the players, power relations, economic relations, communication relations, trust, and partnerships (Gregor & Johnston, 2001). This approach provides a better understanding of the way organizations adopt an IOS by investigating their industry structure, and capturing the changes of technology and the role of the organization in the process (for example, Damsgaard & Lyttinen, 1998). While the Kurnia and Johnston IOS process model has advantages, it is unsuitable to use for empirical investigation because the model suggests the inclusion of all the industry players as part of the unit of analysis, which is in practice difficult to achieve, and the complexity involved may create barriers to the interpretations of the findings.

We propose to create a new model by incorporating the notion of IOS progression and reducing the scope of the Kurnia and Johnston process model from a supply chain level to a dyadic level. It is important to note that even though we refer to the model as dyadic, we do not completely eliminate the industry structure from the proposed model. In other words, organizations are not independent from industry forces, which have to be included to understand how the industry affects organizations’ decisions to adopt a particular system. The dyadic level is justifiable because (a) our main objective is to conduct future case studies that investigate the maturity concept in IOS adoption, and by reducing the scope to a dyadic level, we believe that we will be able to better show how pairs of organizations move from one level of IOS adoption to the next level, (b) the adoption decision is fundamentally an activity between two organizations in a supply chain or a network (Nagy, 2006), for example, CPFR is generally being implemented by pairs of organizations (VICS, 2006), (c) focusing on the dyadic level

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Figure 1. A typical factor model (Kurnia & Johnston, 2000)

![Diagram](attachment:factor_model.png)

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Figure 2. The Kurnia and Johnston process model
permits researchers to advance further and faster (Iacobucci & Hopkins, 1992) in understanding complex IOS adoption phenomena, and (d) by considering a dyadic level, we can also incorporate the industry influence in our study.

Therefore, using the theoretical concepts of Kurnia and Johnston, we propose a dyadic IOS adoption maturity model that retains the richness of their model while making empirical research into IOS adoption progression more feasible.

### A DYADIC MODEL OF IOS ADOPTION MATURITY

The dyadic model is based on the concept that IOS adoption is reliant on two organizations agreeing to use an IOS. Therefore, instead of studying one focal organization and its arbitrary trading partners, we look at two particular organizations: Organization A and its trading partner B. As shown in Figure 3, Organizations A and B have their own capabilities, their own perceptions of the nature of technology, and their own actions. The part of the industry structure consisting of the dyad is now viewed as consisting of two elements: (a) relationships between the two organizations and (b) other relationships amongst the rest of the supply chain players that are now viewed as external factors. The perceptions of Organizations A and B of the nature of technology (Arrows b) and their capabilities (Arrows h) may enable or inhibit organizations’ actions to use the IOS (Arrows f) and alter the dyadic relationship (Arrows c). The two organizations’ actions may modify their perceptions (Arrows a) and improve their capabilities (Arrows g) through various interactions with each other, their relationships, their external environment, and the IOS sophistication. Furthermore, the dyadic relationship (Arrows d) and external environment (Arrows p) mediate organization actions to use the IOS (Arrows f). IOS sophistication also affects the two organizations’ dyadic relationships mediated by organization actions (Arrows c) because of routinized, structured communication facilitated by the IOS sophistication (Cannon & Perreault, 1999). The new constructs of the simplified dyadic model are explained below.

### Dyadic Relationships

The nature of dyadic relationships is defined in terms of common relational variables (Heide, 1994; Rinehart, Eckert, Handfield, Page, & Atkin, 2004) identified from the interorganizational relationship and IOS literature. The three defining relational variables that are the most frequently cited and investigated in the literature are trust, goal congruence, and dependence. These are explained below.
**Trust**

Interpersonal relationship and negotiation theory includes trust as a predictor of improved relations between organizations (Ring & Van de Ven, 1992). From a relationship theory perspective (Anderson & Narus, 1990), trust is defined as “the firm’s belief that another company will perform actions that will result in positive outcomes for the firm, as well as not taking unexpected actions that would result in negative outcomes for the firm” (p. 45). The importance of interorganizational trust has also been emphasized in the IOS adoption literature (Hart & Saunders, 1997; Ibbott & Keefe, 2004; Ibrahim & Ribbers, 2006; Karahannas & Jones, 1999; Nagy, 2006; Ratansingam, 2000). Trust is measured by the reliability, competence, and openness of trading partners (Ibrahim & Ribbers).

**Dependence (Power)**

Organizations are limited in their ability to obtain or produce all resources, making them dependent on their partners and others in the environment to acquire some resources (Pfeffer & Salancik, 1978). Dependency is an important characteristic of a relationship and influences a party’s degree of long-term orientation (Anderson & Narus, 1990). The nature of dependency is closely related to the issue of power, which has been commonly investigated in IOS adoption (Lusch & Brown, 1996). In a dyadic relationship, power relation imbalance exists when one of the organizations is more powerful in terms of resources such as facilities, manpower, or sales, which are not easily replaced (Emerson, 1962).

In an asymmetric relationship, when there is a powerful party, the dominant party can easily influence the less powerful party to abide by its terms and conditions and force it to adopt the system. When there is a balanced power relationship and one of the parties is unwilling to implement the IOS, the initiating organization may implement the system with the reluctant organizations’ rivals. This may put competitive pressure on the unwilling organization and force it to implement the system. In the literature, this type of pressure is commonly referred to as mimetic pressure (DiMaggio &

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**Figure 3. A dyadic IOS adoption maturity model**

![Figure 3](image-url)
Powell, 1983). More specifically, mimetic pressure occurs when an organization is forced to change its action over time in order to become similar to its rivals (DiMaggio & Powell). Teo et al. (2003) found empirical evidence of a link between organizations’ IOS adoption decisions and mimetic pressure. Power is measured in terms of how costly a firm finds it to switch to other organizations’ implementations, the criticality of sales or purchase volume, the importance of maintaining social association, and the need to maintain good relationships with its partners (Heide, 1994; Kumar & Van Dissel, 1996; Kumar et al., 1998; Teo et al.).

**Goal Congruence**

Goal congruence refers to alignment of the goals of different components of an organization. In a dyadic or supply chain context, goal congruence is achieved when a firm’s goals coincide with the goals of its trading partners. Goal congruence is regarded as a key component in establishing successful trading-partner relationships (Jap, 2001; Lejeune & Yakova, 2005). IOS studies also recognize the importance of congruence in establishing partnerships by considering the alignment of organizational cultures and size (Chen & Williams, 1998), goal compatibility (Bensaou, 1998; Ham & Johnston, 2007), and IT compatibility (Hendon, Nath, & Basu, 1995; Kearns & Lederer, 2001; Lu, Huang, & Heng, 2006). In this study, we define goal congruence as the extent to which the goals of two trading partners are aligned with each other; in other words, goal congruence is determined by the extent to which two organizations support each other’s goals, and the compatibility and similarity of the goals (Jap, 1999; Jap & Anderson, 2003).

The level of dyadic relationship is based on the degrees of trust, dependency, and goal congruence. In other words, the higher the degrees of trust, goal congruence, and dependence, the higher the intimacy level of the dyadic relationship of the two organizations.

**IOS Sophistication**

In the Kurnia and Johnston model, the outcome construct is called IOS adoption, which implies that the IOS system may or may not be used. As such, this definition will not serve the purpose of this study because maturity of IOS adoption is based on prior experiences with IOS use. Therefore, in this study, we rename this construct IOS sophistication, which refers to the actual use of a particular IOS and not intention to use. To define the level of IOS sophistication, we apply the extent of business practice alignment between the two organizations and the level of organizational involvement as measurement variables, as explained below.

**Extent of Alignment of the Two Organizations’ Business Practices**

This variable assesses the extent to which the system aligns the two (or more) organizations’ business-related working practices. For example, EDI aligns procurement practices including ordering and receiving, whereas CPFR aligns more business practices such as planning, forecasting, and replenishment (including ordering and receiving) practices. As two organizations progress from one level of sophistication to the next, the extent of alignment accumulates from the lower level to the higher level because a more sophisticated IOS generally depends on the existence of a more basic IOS. Therefore, we can differentiate between different types of IOS by examining the extent of interoperation between the two organizations.

**Level of Organizational Involvement**

We define organizational involvement as the extent to which senior hierarchical management functions (operational, tactical, and strategic) are involved in the day-to-day functioning of the IOS. In other words, the deeper the organizational involvement required by the system, the more sophisticated the system employed. For example, EDI involves operational staff from the two organizations who are typically the
personnel that use the information for conducting the procurement function. CPFR involves the tactical staff who are involved in planning and forecasting in the two organizations as well as those operational staff who are involved in replenishment.

Thus, the above two variables are actually related. The more the business practices of the two organizations are aligned by the IOS, the more the functional levels of management are involved, as illustrated above with EDI and CPFR.

A DYADIC IOS ADOPTION MATURITY MODEL WITH TIME AND PERFORMANCE DIMENSIONS

The dyadic IOS adoption model in Figure 3 depicts that over time two organizations would adopt a particular IOS (Arrow f in Figure 3) that is compatible with their capabilities, perception of the IOS, dyadic relationships, and some external factors (Arrows b, d, h, and p in Figure 3). The IOS adopted (Arrow e in Figure 3) will then improve their own performance and in turn lead to advancements in their capabilities, perception of the IOS, and dyadic relationships (Arrows a, c, and g). These modifications will enable them to progress to adoption of a more sophisticated IOS. Thus, the different types of IOS adopted are a result of the various events from the interactions of the two organizations’ actions over time.

To further illustrate the IOS adoption progression and maturity suggested in Figure 3, we explicitly show the time and performance dimensions involved in the model in Figure 4a. The IOS sophistication at different time intervals (t1, t2, and t3) is an outcome of the influence of all the variables, perceptions, capabilities, dyadic relationships, initial IOS uses, and some external factors. The model is also driven by performance, which is the result of using the IOS and is regarded as a key factor for organizations to adopt an IOS (Choudhury, Hartzel, & Konsynski, 1998; Frohlich & Westbrook, 2001; Kumar & Van Dissel, 1996; Lee & Lim, 2005; Subramani, 2004). In simple terms, organizations will not progress to the next level of adoption maturity if the current systems do not provide the expected benefits. Performance includes tangible benefits such as return on investment (ROI) resulting from reduction in paper flow, manpower, and inventory-storage and out-of-stock situations, and from higher sales and improved service levels. Intangible benefits include improved trading-partner relationships and customer satisfaction (Lee & Lim; VICS, 2006).

The model in Figure 4a illustrates that the actions of the two organizations are triggered by the levels of these variables, but organizations can also modify these variables because of the IOS use, which enables them to adopt the next level of IOS (Arrows b, d, f, h, and p). This process continues incrementally over time due to better performance experienced by the two organizations as a result of IOS use (Arrows e). In other words, the changes in the two organizations’ current dyadic relationship, their perceptions of the nature of the technology, and their capabilities (Arrows a, c and g) take place over time (at the individual organizational level). The different time intervals (times t1, t2, and t3) are extended snapshots of the alterations in the two organizations’ variables that have to be consistent with each other and that are mediated by their actions (Arrows b, d, h and p) to facilitate the next level of IOS adoption (Arrow f). For example, at time t1, the actions of the two organizations are influenced by their perceptions of the nature of technology, their relationships, and their capabilities to adopt and implement a particular IOS system such as EDI (Arrows b, d, f, h, and p). After time t1, the two organizations’ experience from system use will influence their actions (organization action time t1+) to modify their perceptions of the nature of technology, their dyadic relationship, and their own capabilities. It is important to note that because each organization has its own variables, this alteration process is not an absolute step but may occur incrementally at
different time intervals until the two organizations’ variables are consistent with the nature of adoption. Therefore, the two organizations will reach a higher level of IOS adoption at some later time, t2, when their capabilities, perceptions, and dyadic relationships are compatible with the next IOS adoption, which may be a CPFR system. This process will continue until the two organizations reach the highest level of IOS sophistication, which is at time tn.

Simplifying the Dyadic IOS Adoption Maturity Model

Thus far, we have argued that for two organizations to move from one level of IOS sophistication to the next (IOS adoption maturity t1 to t2), their perceptions of the nature of the technology, their capabilities, their dyadic relationship, and their IOS experiences are modified through the two organizations’ actions. However, there is a problem with including all these variables in an empirical investigation of progression of IOS because some of the variables overlap with each other when the two organizations progress from time t1 to t2. The interactions between the dyadic relationship and IOS sophistication of the two organizations indirectly capture their perceptions of the nature of the technology, their capabilities, and some aspects of industry structure. As explained earlier, the level of dyadic relationship of the two organizations is defined by the degrees of trust, dependence, and goal congruence. These three variables affect perceptions of the nature of technology. For instance, when one of the organizations shows its intentions to adopt the next IOS, their perceptions of the nature of technology is shaped by their dyadic relationship, which is characterized by some level of trust (Hart & Saunders, 1997; Ibbott & Keefe, 2004; Karahananas & Jones, 1999; Kumar & Van Dissen, 1996; Kumar et al., 1998), dependence (Chwelos et al., 2001; Nagy, 2006; Teo et al., 2003), and goal congruence (Ham & Johnston, 2007). In addition, the last two defining variables, goal congruence and dependency, relate to partners’ capabilities. For example, partners would not likely be dependent on each other if they were not capable, and they would not likely have compatible goals if some degree of a common goal was not present. In such a case, parties may be pressured by their partners to have the required IT capabilities (Wang, Heng, & Ho, 2007) to facilitate the IOS sophistication or they may look for other partners.

Furthermore, as explained earlier, unwilling organizations may also be pressured to implement the IOS out of competitive necessity (Teo et al., 2003). They tend to imitate their rivals to maintain their social status in the industry and particularly with their partners. This mimetic pressure is related to industry structure. Therefore, by investigating dependency as one of the variables, we also examine some aspects of the two organizations’ industry structure.

The initial use of IOS affects the two organizations’ perceptions of the nature of technology and their capabilities for further adoption. For example, the adopted IOS creates the infrastructure for subsequent IOS implementations (Corsten & Nirmalaya, 2005; Ham & Johnston, 2007; Inkpen, 1996; Li & Williams, 1999). When the two organizations adopt an IOS, they are aware of each other’s internal IT infrastructure (Hendon et al., 1995; Kearns & Lederer, 2001) and they also create the initial joint capabilities such as training, defined roles, and the existing IOS infrastructure for further implementations. Thus, this suggests that the various interactions among the variables in the model shown in Figure 4a can be well captured and represented entirely by the two new constructs in the model (dyadic relationship and IOS sophistication) and with two-way interactions between them over time. This simplification is summarized in Figure 4b.

The model in Figure 4b illustrates that progression of IOS adoption can be adequately explained in terms of the interactions between the dyadic relationship and IOS sophistication over time. Thus, we “black-box” other variables because all the complex interactions between the two organizations involving their own capabilities, their perceptions of technologies, and some aspects of the external factors
**Figure 4. Transition from a) IOS adoption model with overlapping variables to b) IOS adoption maturity model that reduces overlap of variables along time and performance dimensions**
can be summarized in the two-way causal links between dyadic relationship and IOS sophistication (Arrows a, b, c, d, e, f, g, and h). During IOS adoption maturity at time $t_n$, the dyadic relationship results in the highest level of IOS sophistication and no further progression takes place.

**The Proposed Dyadic IOS Adoption Maturity Model**

In this section, we explicitly show the two-way causal relationship between the dyadic relationship and IOS sophistication derived from the model in Figure 4b and present a set of propositions for future work. We simplify our dyadic IOS adoption model by summarizing the various interactions among actions of capability of organizations, perception of technologies, and the external factors in the two-way causal links between the dyadic relationship and IOS sophistication constructs. In this way, our final model (Figure 5) is based on dyadic-level variables. In addition, in this section we focus on the progression in maturity of IOS rather than events over time as represented by the model in Figure 4b. In other words, we are underlining the actual major alterations that take place over an extended period because of better performance. Therefore, we transition from a model that includes organizational-level concepts developing along a time dimension to a model that is based on dyadic-level variables that develop along an IOS adoption maturity dimension. The model depicted in Figure 5 has three main constructs: dyadic relationship, IOS sophistication, and IOS adoption maturity. As explained earlier, the dyadic relationship is qualified in terms of the level of the dyadic relationship (intimacy) that is based on the degrees of trust, goal congruence, and dependence; the IOS sophistication is qualified in terms of level of sophistication, which is composed of the extent to which the system aligns the two (or more) organizations’ business-related working practices and organizational involvement in the IOS use. We define the level of IOS adoption maturity as the highest level to which the dyad has progressed in *both* the dyadic relationship and IOS sophistication.

In addition, Figure 5 illustrates how trading partners progress from one level of IOS adoption maturity to the next level. For instance, IOS adoption maturity at Level 1 is achieved when the dyadic relationship reaches Level 1 (Level 1 dyadic relationship) and the IOS sophistication reaches Level 1 (Level 1 IOS sophistication). Therefore, to achieve a particular level of IOS adoption maturity, a particular level of dyadic relationship and a particular level of IOS must be achieved first. It is important to note that the level of IOS adoption maturity is the alignment between the two constructs: dyadic relationship and IOS sophistication. In other words, any two organizations will not reach a level of IOS adoption maturity if the system is not fully used. When two organizations are in the process of adoption and their relationship is not favorable, they will not progress to the next level and will be in between the levels until their relationships improve or they are likely to abandon the initiative and therefore stay at the previous adoption maturity level.

As shown by the arrows in Figure 5, the level of IOS sophistication depends on the level of the dyadic relationship, and the level of the dyadic relationship is also influenced by the level of IOS sophistication. In particular, a certain level of dyadic relationship is a prerequisite to adoption of an IOS at the level of sophistication that is in line with the level of the dyadic relationship. The adoption of IOS at a particular level of sophistication, in turn, affects the level of dyadic relationship, positively leading to the achievement of the next level of dyadic relationship, which again feeds back and facilitates the adoption of an IOS at a higher level of sophistication and so on. Thus, with the model we can illustrate how two organizations progress from one level to a higher level of IOS adoption maturity.

Based on the above discussion we postulate the following three propositions regarding the progression in IOS adoption. $X$ denotes the maturity level and can range from 1 to $n$ (refer to Figure 5).
Proposition 1: Level X dyadic relationship is a prerequisite for achieving Level X IOS sophistication. In other words, Level X IOS sophistication will not be achieved until the dyadic relationship is built to Level X and so on for the other levels.

Proposition 2: Level X IOS sophistication is a prerequisite for Level X+1 dyadic relationship. Therefore, Level X+1 dyadic relationship will not be reached until Level X IOS sophistication is achieved and so on for the other levels.

Proposition 3: Both the dyadic relationship and IOS sophistication need to mature progressively to achieve any level of IOS adoption maturity, and if either one stalls, no further progression can take place.

We now illustrate the propositions with a hypothetical example. A Level 1 dyadic relationship may be characterized by reliability-based trust, moderate goal congruence, and some degree of dependency. This could result in IOS sophistication such as an EDI type of system. This level of IOS sophistication is characterized by its ability to automate the process of the exchange of business documents such as invoices, purchase orders, purchase order changes, sales, and so forth. This system involves participants from the operational levels. To progress to the next level of IOS adoption maturity, the organizations’ experiences from the use of the EDI system improves their dyadic relationship at Level 2. The dyadic relationship at this level may be characterized by an improvement in their trust and goal congruence while the parties are more dependent on each other. Level 2 dyadic relationship again facilitates the adoption of an IOS with a higher level of sophistication. The IOS sophistication at Level 2 could be the adoption and use of a CPFR system. In terms of the extent of business work practice, such a system is characterized by synchronizing the trading organizations’ planning functions and assisting the development of promotion and sales forecasts, while also providing replenishment plans and facilitating the distribution of products based on joint demands. In terms of the level of organizational involvement, such a
system requires the involvement of personnel such as category managers, logistic planners, demand forecasting managers, and key account managers. This system requires involvement of personnel not only at the floor level, but also at the middle-management level such as the logistics manager, logistics planning manager, and so on, who are involved with the distribution and logistic functions. Depending on their performance from IOS use and their dyadic relationships, Level 2 or Level 1 could be the highest level of IOS adoption maturity that the two organizations can achieve. In such a case, there may be no further progression.

To further illustrate the adoption progression model, we now provide an industry example as shown in Table 1. Wal-Mart and Procter & Gamble (P&G) provide a good illustration of how companies mature from one level of IOS adoption maturity to the next (Clark & Lee, 2000; Grean & Shaw, 2002; Seifert, 2003).

In 1985, when Wal-Mart had P&G online with its EDI solution, their relationship was characterized as being adversarial. Each company was focusing on pushing its own agenda and there was a low level of trust. Eventually by 1988, these two companies decided that if they were going to fully benefit from information technology, they would have to collaborate and improve their relationship.

During this period, they initiated a joint Wal-Mart/P&G team to lay long-term plans to achieve mutual goals for themselves. After various ramifications of both IT and business processes and after years of joint planning and discussions, these two partners realized the best way to improve supply chain activities is to share information to reduce inventory and deliver goods more efficiently (Clark & Lee, 2000).

In 1992, their improved relationship paid off when they fully implemented vendor-managed inventory, also known as the continuous replenishment process (CRP) because this system requires the disclosure and sharing of information and therefore trust. The function of this system was to allow P&G to control inventory based on the data from Wal-Mart’s

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**Table 1. IOS adoption maturity between Wal-Mart and P&G**

<table>
<thead>
<tr>
<th>Level of IOS adoption maturity</th>
<th>Level of dyadic relationship</th>
<th>Level of IOS sophistication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 IOS adoption maturity (1985)</td>
<td>The relationship was characterized as arms length, where each company was looking after its own benefits, having a short-term focus, and there was no form of collaborative goals.</td>
<td>The two companies implemented an EDI solution that automated the procurement cycle.</td>
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<td>Level 2 IOS adoption maturity (1992)</td>
<td>P&amp;G and Wal-Mart developed a common vision to improve their efficiency and effectiveness. With this vision in mind, they wanted to build stronger collaborative initiatives to attain the highest benefits, leading to the introduction of vendor-managed inventory (VMI).</td>
<td>P&amp;G and Wal-Mart adopted VMI. VMI allows P&amp;G to access Wal-Mart’s inventory, monitor its inventory flow, and make decisions on order quantities and shipping. In other words, P&amp;G is responsible for the entire replenishment of Wal-Mart.</td>
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<td>Level 3 IOS adoption maturity (1996)</td>
<td>With improved working relationships and because of the increasing benefits of VMI, Wal-Mart was the first to introduce and implement CPFR.</td>
<td>Wal-Mart and P&amp;G extended their VMI to implement CPFR, which includes the sharing of point-of-sale (POS) data for joint planning and forecasting for better replenishment. This system also includes processes to monitor supply chain performance.</td>
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distribution centre (DC). This improved the flow of P&G products into Wal-Mart’s stores, which resulted in the reduction of stockouts, improved customer levels, and reduced lead times.

Having realized the benefits of VMI, Wal-Mart and P&G moved to the next level of sophistication. In 1998, they progressed to CPFR, which is an extension of VMI. This system is based on exchanging POS data, and joint planning and forecasting. The system synchronizes both their planning and forecasting data and then assists with replenishment decisions. Wal-Mart has implemented CRP and CPFR with its critical customers such as P&G, whereas EDI is used with most of its supplier base—EDI compliance being a prerequisite for Wal-Mart suppliers (Wal-Mart, 2008).

**CONCLUSION**

In this article, we modify the Kurnia and Johnston (2000) IOS adoption process model by reducing its scope to a dyadic level and also extending it by introducing the concept of progression of IOS adoption. We introduced and defined three new constructs: dyadic relationship, IOS sophistication, and IOS adoption maturity. With the IOS sophistication construct, we can differentiate between different types of IOS and it can serve as a measuring tool for future IOS studies. This is an essential step because most IOS adoption studies assume that IOS technologies are one general type of system and do not highlight the distinctive characteristics of different systems. For example, IOS studies that have investigated EDI systems often assume that the same results apply to other types of IOS. Moreover, by distinguishing different IOS technologies and assessing the link with the previous adoption of a less sophisticated IOS, we can also better understand and investigate IOS adoption maturity that evolves over time.

In addition, reducing the scope of the Kurnia and Johnston model has many research benefits: (a) We are able to better understand the notion of IOS adoption maturity because we focus research on the interaction of two organizations compared to the whole supply chain or industry, (b) we can justify that the two-way causal effect of the dyadic relationship and IOS sophistication captures the concept of IOS progression, and (c) by investigating these two constructs (dyadic relationship and IOS sophistication), we can prevent or reduce the overlap of variables (such as capabilities of parties), which would create problems in empirical research, especially if the dyadic relationship construct is not clearly defined (see, for instance, Ham & Johnston, 2007). Furthermore, in testing the propositions, the complex interactions behind the two-way causal link between dyadic relationship and IOS use will also be examined indirectly to enrich the understanding of how relationships and IOS sophistication progress over time. Moreover, researchers can adopt the dyadic relationship and IOS sophistication, defining variables to categorize relationships into types that can then match the IOS types.

Practitioners can also benefit from the model. IOS sophistication should not be treated as a single dependent variable, and practitioners should not base their implementation decisions on a single time assessment but rather on a continuous evaluation process that is also related to performance measures. Hence, continuous assessment of the relationship and IOS sophistication should be done at different points of time to identify patterns and see if the organizations are able to reach the maturity adoption level required. This can help practitioners form new or evaluate existing strategies to facilitate future IOS use.

Here we have illustrated the model using a literature case example of Wal-Mart and P&G, showing how they progressed from one level to the next level of IOS adoption maturity. However, future research is needed to empirically validate the model of this study. We are in the process of testing the three propositions of the model with dyadic pairs of organizations using case studies. In that study, we focus on observing how two organizations can progress from one level of IOS sophistication to the next based on their dyadic relationships. However,
depending on the case availability, it would also be valuable to investigate whether two organizations might regress to a lower level of maturity if their dyadic relationship becomes unfavorable.

ACKNOWLEDGEMENT

The authors would like to thank the four anonymous reviewers for their valuable suggestions for improvement on a previous version of this article. The authors also thank their colleague, Associate Professor Peter Seddon, for his critical comments that helped clarify some ambiguities in the article.

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