The need for a processual view of inter-organizational systems adoption

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Abstract

In order to sustain competitiveness, companies need to adopt electronic commerce (EC) enabled inter-organizational systems (IOS) to improve the efficiencies of entire supply chains. Adoption of IOS by companies, however, has proved difficult since such systems span organizational boundaries. Understanding IOS adoption is hampered by a lack of theory that can capture the complexity involved in IOS adoption since previous studies mostly employ the factor approach. In this paper, using Efficient Consumer Response as an example of an EC-enabled IOS, we demonstrate that the acknowledgement of the inter-organizational context of these systems naturally introduces the need for the processual approach and different notions of causality. We also show how the factor and the processual approaches to theorizing IOS adoption can be used in a complementary way. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Electronic commerce; Efficient Consumer Response; Inter-organizational system; Adoption; Case study

1. Introduction

Adoption of electronic commerce (EC) enabled inter-organizational systems (IOS) has become increasingly important for organizations to remain competitive in this era of globalization. Many organizations have established partnerships to develop new strategies jointly (for example Just-in-Time, Quick Response, and Efficient Consumer Response) based on EC and other enabling information technologies to improve the competitiveness

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of their supply chains (Kurt Salmon Associates, 1995; Holland, 1995; Johnston and Lee, 1997). Adoption of such systems, however, has proved to be extremely difficult since they span organizational boundaries. Adoption of IOS by a particular organization involves interactions with external entities (such as trading partners, regulators and third parties) that normally have different and conflicting interests. In addition, adoption of such systems involves significant changes to organizations’ culture, structure, business relationships and working practices over time and space (Elramm, 1995; Allen et al., 1999; Kurnia and Johnston, 1999a,b).

Although there have been a number of empirical studies (for example, Elramm, 1995; Iacovou et al., 1995; Laderos et al., 1995; Marcussen, 1996; Chau and Tan, 1997; Hart and Saunders, 1997) of IOS adoption, they tend to give insufficient attention to the inter-organizational context of such systems. These previous studies are based on the factor approach that assumes that outcomes of technology adoption by organizations are determined by a number of predicting variables (factors) identified at a particular time. They are normally concerned with individual organizations as a unit of analysis or, at best, pair-wise relationships and within a limited perspective. Such studies, therefore, are unable to capture the complex and dynamic interactions of individual organizations with trading partners and other industry organizations that occur in the course of adopting IOS. To capture these interactions, it is necessary to extend the unit of analysis and the time scale used in studies of IOS adoption. This introduces a need for the processual approach and different notions of causality in theorizing IOS adoption.

In this paper, we demonstrate how recognition of the inter-organizational context of IOS adoptions leads in a natural way from the factor approach to the processual approach if the full richness of the adoption experiences is to be captured. It then becomes clear under what conditions the more straightforward factor approach can be expected to give useful insights about successful adoption. To illustrate our argument, we use our studies of adoption of Efficient Consumer Response (ECR) in Australia. We describe a ‘first-order’ factor model of ECR adoption that we have used in earlier studies. We then demonstrate how inter-organizational interactions, which we have examined through multiple case studies of ECR adoption along various supply chains, have led to the development of a ‘second-order’ processual model of ECR adoption.

The structure of the paper is to first present the taxonomy of technology adoption theories put forward by Markus and Robey (1988), which will be used to make explicit the commitments of various IOS adoption theories discussed. We describe the factor and the processual approaches, characterize each approach using the taxonomy of Markus and Robey and discuss their strengths, weaknesses and appropriate research methods. Then we illustrate how the two approaches can be used in a complementary way in studying ECR adoption in Australia, resulting in the development of the first-order factor model and the second-order processual model of ECR adoption. Finally, we present a multiple case study of the adoption of various distribution strategies (refer to Appendix A), advocated as part of the Continuous Replenishment Program of ECR in order illustrate the existence of the more complex causal links posited in the second-order model.
2. The taxonomy of Markus and Robey

Before discussing approaches to studying IOS adoption, it is useful to have an explicit classification of different types of theories of technology adoption. We use that of Markus and Robey (1988), which has three principal dimensions.

2.1. Causal agency

This dimension refers to the nature and source of causal agency. There are three perspectives on this dimension:

- **Situational control perspective:** This perspective assumes that the characteristics of technology, potential adopters and other forces determine actions in terms of the use and consequences of adoption.
- **Rational actor perspective:** According to this perspective, actions can be chosen and there is almost unlimited control over the use and consequences of technology adoption.
- **Emergent perspective:** This asserts that actions cannot be predicted either by the intention of the actors or by the conditions of the environment alone. The use and consequences of adoption of any technology emerge from complex social interactions.

2.2. Logical structure

The logical structure refers to the time span of the theory (static versus dynamic) and the hypothesized relationships between predicting variables and outcomes. On this dimension, theories can be classified into two categories:

- **Variance theories** assert that the values taken by certain predicting variables at a given time are necessary and sufficient to determine outcomes.
- **Process theories** contend that the outcomes are only partially predictable from the predicting variables. The outcomes are also determined by dynamic interactions between technology and potential adopters over time.

2.3. Level of analysis

This refers to the type of social entities that are the main concern of the study. It can be a **macro-level** analysis when dealing with large-scale collectives (such as industries, populations, societies) or a **micro-level** analysis when dealing with small groups (such as individual persons or firms).

3. The factor approach to technology adoption

Many previous studies of diffusion and adoption of technology in general (Zaltman et al., 1973; Robertson and Gatignon, 1986; Kwon and Zmud, 1987; Iacovou et al., 1995;
Drury and Faroomand, 1996) have used approaches, which according to the classification of Markus and Robey are micro-level, situational control, variance theories. In this paper, we refer to these theories as the factor approach. The theories assume that a number of predicting variables identified at a particular time determine actions or decisions regarding the adoption. Generally, these predicting variables, which are also known as ‘factors’, can be classified into three groups: the nature of the technology adopted; the capability of the adopting organization and aspects of the external environment. The unit of analysis is individual adopters, which in the IOS case would be individual organizations. Under this approach, adoption at the broader level of industries or individual supply chains is explained mainly by critical-mass effects (Hoban, 1993; Cool et al., 1997; Greenbaum, 1997; Rai et al., 1998). A typical model explaining adoption of technological innovations with the factor approach is depicted in Fig. 1.

The factor approach has several attractive features. Firstly, it posits a simple type of causality. Hence, straightforward generalizable research methods such as survey can be employed and relationships between variables can be statistically tested. Secondly, the resulting model of adoption does not require complex interpretations by academics and practitioners and it can be readily translated into a set of guidelines. Such a model, however, limits the number of variables that can be investigated and also fails to capture complex inter-organizational interactions that occur during IOS adoptions (Tornatzky and Fleischer, 1990; Dawson, 1994; Damsgaard and Lyytinen, 1998; Kurnia and Johnston, 2000; Wilkins et al., 2000).

A number of authors (Grover, 1993; Iacovou et al., 1995; Prekumar and Ramamurthy, 1995; Chau and Tan, 1997; Crook and Kumar, 1998; Chengalur-Smith and Duchessi, 1999; Kurnia et al., 1999; Kurnia and Johnston, 1999a,b) have recently applied the factor approach to studying adoption of IOS. When such approaches are used in the context of IOS, the implicit assumption is that organizations are passive victims of the technology, their own limited capability, and their external environment, including other organizations in the industry. These approaches are therefore well suited to studies of IOS adoption by small industry players since such organizations are normally more ‘passive’ than large enterprises in adoption of technologies. Their actions are usually determined by the nature of the technologies, their own capabilities, and external forces such as pressure from other more influential trading partners. The work of Iacovou et al. (1995) is a good illustration of

![Fig. 1. A typical adoption model with the factor approach.](image-url)
the use of such a model. At the other extreme, however, very influential companies may construct or modify technological visions for the industry and define the organizational capabilities that they require. By virtue of their influence, they define what constitutes ‘adoption’. In this case, the direction of arrows a and b in Fig. 1 would be reversed. This opposite extreme would be an example of what Markus and Robey refer to as the rational actor perspective.

4. The processual approach to technology adoption

Neither the factor approach described above nor the rational actor approach can provide a complete model of IOS adoption when dealing with companies of intermediate size. Typical companies are neither totally victims of their environment nor in total control of their environment. They exercise an influence over part of their environment by virtue of their interactions with other organizations that make up the industry of which they are part. If adoption by typical companies is to be considered, the inter-organizational environment has to be taken into account. The inter-organizational environment consists of supply chains, trading partners, standards organizations, industry bodies, transport companies, trade organizations, software providers, and so on. These organisations are in turn linked by a set of relations (transactional, political, normative, communicative, economic, corporate), which constitute the industry structure (Gregor and Johnston, 2000). Through the interactions of a company and its inter-organizational environment, the organization’s capability to adopt a technology and indeed the nature of the technology itself can be altered over time. Therefore, in order to study adoption of IOS more comprehensively, the unit of analysis has to be extended beyond the organizational level (vertical analysis) and the time scale needs to be extended beyond a single epoch (horizontal analysis) (Dawson, 1994). This necessitates a number of changes to underlying theories of IOS adoption: from situational control to emergent causality, from a variance to a process logical structure, and from a micro level to a micro/macro level analysis, using the terminology of Markus and Robey. In this paper, we refer to the resulting kind of theory as ‘processual’.

Fig. 2 illustrates the conceptual changes leading from the factor approach (Fig. 2a) to the processual approach when the inter-organizational environment is considered in IOS adoption studies. First, the unit of analysis is extended to the focal organization and its inter-organizational environment (supply chain and the entire industry) as shown in Fig. 2b. Adopting this large unit of analysis then leads to a reconsideration of what factors are external (Fig. 2c). Some factors identified as ‘external’ using the factor approach are now recognized as part of internal industry interactions within this larger unit of analysis. Finally, the interactions within the inter-organizational environment lead to a changed view of the causal links between actions of organizations, inter-organizational environment, nature of the technology, and capability of the organizations (Fig. 2d). Now, not only are actions of an organization mediated by the nature of the technology factors, its capability factors, and environmental factors, but these factors are themselves altered by mutual interactions of the focal firm with its inter-organizational environment. These interactions cannot be explained by the causal links of the factor model alone.
The model arrived at in Fig. 2d provides a richer and broader picture of IOS adoption as it incorporates extra influences arising from complex and dynamic interactions between organizations and change processes occurring in the process of adoption. Since the two-way interactions between variables proposed in this model are difficult to analyze with statistical methods or other positivist scientific approaches, the model suggests the use of more in-depth interpretive research methods, such as case studies or action research. Such methods allow the researcher to document mutual influences of actions of various organizations over time. While this approach promises to give greater depth of understanding of dynamic and complex interactions of organizations within the industry in IOS adoptions, we must also acknowledge that it provides a reduced ability to make general statements. Furthermore, due to the complexity and richness of the analysis, it may create barriers to the interpretation of the findings, particularly for practitioners (Dawson, 1994). Given these disadvantages of the processual approach, the factor approach should also be considered useful in certain kinds of studies: when for the purposes of the study, interactions of the focal organization and other organizations can be validly ignored; when characteristics of technology and organization are largely given; and when the focus of studies is limited at a single epoch. We therefore advocate the use of both factor and processual approaches in a complementary way to give a better total understanding of adoption of inter-organizational systems, as illustrated in the next section.

Fig. 2. Change of conceptual framework from the factor approach to the processual approach as the inter-organizational environment is recognized.
5. Two models of ECR adoption

The adoption experience of the Australian grocery industry with ECR, which is an example of an EC-enabled IOS, is now used to illustrate our argument. ECR originated in the US as a direct response by major retailers to threats from alternative store formats. It is designed to reform the grocery industry in order to make the industry more efficient and, hence, able to deliver better value to consumers. ECR promotes strategic initiatives in the areas of store assortment, product development and introduction, promotion, and product replenishment. These four strategic initiatives of ECR are supported by two EC-enabled programs, namely Category Management and Continuous Replenishment Program, which are in turn enabled by standardized product numbering, automatic identification, Electronic Data Interchange, Computer-Aided Ordering and Activity-Based Costing (Kurt Salmon Associates, 1993; Tripplet, 1995; Kurnia et al., 1998).

5.1. A ‘first-order’ model

As a starting point in the development of an ECR adoption model, we employed the factor approach. A survey of the Australian grocery industry was conducted in October 1998 to get a snapshot of ECR practice within the industry and to identify likely generalizable factors affecting adoption of ECR in Australia. The unit of analysis was individual organizations within the Australian grocery industry. A number of candidate variables relating to aspects of the adopted technology, capabilities of the organization, and external environment of the organization, purported to influence adoption of innovations, were identified from an extensive literature (Lewin, 1952; Zaltman et al., 1973; Moch and Morse, 1977; Zmud, 1982; Rogers, 1983; Gatignon and Robertson, 1985; Kwon and Zmud, 1987; Robertson and Gatignon, 1987; Tornatzky and Fleischer, 1990; Frambach, 1993; Grover, 1993; Chau and Tan, 1997; Prekumar et al., 1997; Crook and Kumar, 1998; McGowan and Madey, 1998; Niederman, 1998) and were included in the survey questionnaire. A senior level manager or individual responsible for ECR pilot projects of each company was requested to complete the questionnaire. From the statistical analyses, we then identified those attributes that had strong relationships with ECR adoption by organizations (adoption factors). These ECR adoption factors are consistent with previous studies of adoption of other innovations. This work, which we have previously published (Kurnia and Johnston, 1999a,b, 2000), led to the development of the first-order model of ECR adoption, summarized in Fig. 3. As this part of the ECR study is not the main focus of this paper, we will only present a brief summary below of the usefulness of this model.

The first-order model posits that certain essentially fixed independent variables can explain the adoption of ECR by an individual company and implicitly by the Australian grocery industry. It is a valid and useful approximation to the extent that its implicit assumptions hold. These are that the focal organization can be viewed as independent from its industry context and that industry-wide adoption is predictable from individual firm adoption through critical-mass effects. This model can be readily translated into a set of implementation guidelines because it can provide indications for individual companies when to adopt the program. Using the model, for example, individual companies can assess their readiness to adopt ECR by examining their perception of ECR, the availability
of IT infrastructure to support ECR program, and the existence of the capabilities required for successful ECR adoption. Companies also need to assess their environment in terms of partnership and trust issues within supply chains of which they are part. Individual firms may change their capabilities to better understand the program before adopting ECR. However, if external factors that are beyond the control of individual firms are unfavorable for adoption, companies may need to wait till these external factors change over time. Thus, such a model can be used by individual organizations to improve their chances of adopting ECR successfully. This model has been useful in exploring the experiences of the Australian grocery industry with ECR adoption and explaining the slow adoption rate within the industry (Kurnia and Johnston, 1999a,b, 2000).

5.2. A ‘second-order’ model

While the first-order model can successfully identify some factors that are necessary for adoption of ECR, the variation in levels of adoption observed across the industry and the findings of more recent case studies of IOS adoption (Damsgaard, 1996; Damsgaard and Lyytinen, 1998; Allen et al., 1999; Gregor and Jones, 1999; Kurnia and Johnston, 1999a,b) suggest that these factors are not in themselves sufficient to account for the richness of adoption experiences. The inter-organizational nature of ECR requires concerted actions by firms in particular supply chains and perhaps across the entire industry for adoption.
As a result of detailed case studies conducted with companies along several supply chains of the Australian grocery industry, we have arrived at a ‘second-order’ model of ECR adoption shown in Fig. 4. It can be viewed as a modification of the first-order model in which the existence and consequences of the inter-organizational context of ECR are explicitly recognized.

As the inter-organizational interactions are considered in the study, the second-order model demonstrates that some factors identified as external forces in the first-order model are now seen to be part of internal industry interactions. For instance, pressure from trading partners, which is one of the external factors in the first-order model, now becomes part of the internal interactions between organizations and their trading partners, as organizations being pressured by their trading partners may negotiate trading terms to ensure the mutuality of ECR adoption. With this mutuality, cooperation between trading partners can be then obtained, leading to the establishment of partnership and trust over time. Therefore, partnerships and trust between trading partners are also no longer viewed as external factors that are beyond the control of organizations. These factors now become part of the internal industry interactions, which are very much tied in with the political, competitive, economic and corporate relations among the industry players.

In addition, as the interactions of the organizations with their supply chains and the industry are considered, the nature of the causal links between actions of organizations and the nature of the technology and between actions of organizations and their capability are

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**Fig. 4.** A ‘second-order’ model of ECR adoption in Australia.
now changed. This is indicated by two-way arrows (a, b, c, d, e and f) in Fig. 4. Although the nature of ECR and the capability of organizations may enable or constrain actions of organizations, through interactions with their inter-organizational environment over time, organizations are also able to modify the nature of ECR and their capability. All these mutual interactions are mediated by the structure and conditions of the inter-organizational environment, but this environment can be changed if the organizations are powerful enough within the industry to routinize the changes. This duality of action and structure is reminiscent of Giddens’ Structuration Theory (Giddens, 1984; Orlikowski, 1991; Rose, 1999; Gregor and Johnston, 2000).

When intended or unintended consequences of adoption become routinized, a new structure of supply chains and the industry may be established, which is consistent with ECR practices. Only at this stage, will the adoption of ECR by the Australian grocery industry be successful (arrow h). This is a more emergent perspective on ECR adoption than the strong causal connection of the first-order model. All mutual interactions shown in the model are products of change processes that need to occur over time and space in the course of routinizing the work practices proposed by ECR within the Australian grocery industry. With this model, there are still external factors that are beyond the control of organizations and, therefore, have essentially a one-way influence on actions of organizations (arrow g).

6. The multiple case studies

In this section, we justify the argument given above by presenting case study evidence for the various causal links posited in the second-order model of ECR. The case studies were conducted with three leading Australian manufacturers and two leading retailers to examine the adoption of the Continuous Replenishment Program (CRP) and Category

<table>
<thead>
<tr>
<th>Company</th>
<th>Company type</th>
<th>Interviewee(s)</th>
<th>Annual sales</th>
<th>CRP strategies studied</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Manufacturer</td>
<td>Regional Customer Service Manager</td>
<td>$750 million</td>
<td>DSD</td>
</tr>
<tr>
<td>B</td>
<td>Manufacturer</td>
<td>Supply Chain Manager, ECR Manager, Business Analyst</td>
<td>$60 billion</td>
<td>VMI, cross-docking, flow-through</td>
</tr>
<tr>
<td>C</td>
<td>Manufacturer</td>
<td>Logistics Manager</td>
<td>$55 billion</td>
<td>VMI</td>
</tr>
<tr>
<td>D</td>
<td>Distributor/retailer</td>
<td>Logistic Planning Manager, National Supply Chain Manager, Regional Distribution Center Manager, National Distribution Center Manager</td>
<td>$19 billion</td>
<td>DSD, VMI, cross-docking, flow-through</td>
</tr>
<tr>
<td>E</td>
<td>Distributor/retailer</td>
<td>National Supply Manager, Business Manager</td>
<td>$4 billion</td>
<td>DSD, VMI, cross-docking, flow-through</td>
</tr>
</tbody>
</table>
Management (CM), being the two main programs of ECR. For brevity, only examples from CRP implementation are presented here. However, the second-order model was derived from studying the entire programs of these companies.

CRP is a practice of partnering among distribution channel members to allow products to flow smoothly and continuously from manufacturers to consumers (Cross, 1993; Hinkkanen et al., 1997). CRP can be implemented using a number of strategies such as cross-docking, flow-through, direct-store delivery (DSD) and vendor-managed inventory (VMI) (see Appendix A). Each of these replenishment approaches is appropriate for different types of products and thus a single manufacturer can implement more than one of these approaches with a single customer. Through collaboration between participants within a supply chain, CRP allows deliveries to be made more frequently and in smaller quantities, which results in the elimination of high inventory levels. Therefore, CRP is also referred to as ‘Just-In-Time distribution’ (Martin, 1994).

Table 1 summarizes the participating companies and the CRP strategies examined in each company. The retailers both manage their own distribution and this allowed us to embrace the distributor function of each supply chain studied.

Each manufacturer in these case studies supplies both retailers and, therefore, there are six supply chains within the Australian grocery industry involved in this study as depicted in Fig. 5.

The unit of analysis of the case studies was individual organizations and the interactions with their trading partners. A ‘theoretical sampling’ technique (Strauss and Corbin, 1990) was employed in the case selection. Cases were selected only when they contribute to the emerging themes identified from the previous cases. Data collection terminated when new data obtained from the case studies provided insignificant contributions to the emerging theory, that is, when the theoretical saturation was achieved (Strauss and Corbin, 1990; Dey, 1999). Data collection techniques employed included semi-structured interviews with management, industry presentations, review of relevant project, and site inspections. In many cases, follow-ups were carried out by phone or electronic mail.

Case study data were analyzed using a qualitative technique for theory building that is similar to those proposed and used by a number of authors (Eisenhardt, 1989; Strauss and Corbin, 1990; Miles and Huberman, 1994; Orlikowski and Hofman, 1997; Carol and SWATMAN, 2000). The recorded field data were transcribed directly after each visit.

Fig. 5. Supply chain position of participants and their trading relationships.
‘Within-case’ analyses were conducted to identify some concepts of interest from data collected from the first participant. As more case studies were conducted, ‘cross-case’ analyses were carried out to look for recurring patterns and to refine the emerging concepts. The process of data collection, analysis and theory development was iterative. Finally, as theoretical saturation was reached, the insights obtained from the case study data were documented, resulting in the development of the second-order model of ECR adoption in Australia. The total period of the iterative data collection, analysis and theorizing process was 11 months.

In keeping with the aims and limitations of interpretive research in IS, we do not claim that the case studies directly prove the validity of the second-order model. Rather they demonstrate various instances of the mutual interactions amongst the theoretical constructs shown in Fig. 4 contrary to the assumptions of the first-order model, which allowed the second-order model to be derived from the first. Consequently, the discussion of the cases will focus on presenting illustrations of the various causal connections represented in Fig. 4 by labeled arrows. The discussions of the case studies are grouped according to the ECR elements being experimented with by the participants.

7. Cross-docking and flow-through

7.1. The findings of the case studies

Adoption of cross-docking and flow-through were examined in the case studies conducted with companies B (manufacturer), D (retailer) and E (retailer), within two supply chains of the Australian grocery industry. Site inspections of two distribution centers of company D were undertaken to assess the practices and economics of cross-docking and flow-through. Interviews were conducted with the supply chain manager and a business analyst of company B, the logistics planning manager, the national supply chain manager, a regional distribution center and the national distribution center manager of company D, and the national supply manager of company E. A detailed study of cross-docking can be found in Kurnia and Johnston (2000).

To work most effectively, cross-docking and flow-through require quite high levels of EC compliance by retailers, distributors and manufacturers. Retailers/distributors must be able to send EDI purchase orders direct to manufacturers. Company D has the required EDI infrastructure in place and is able to send orders via EDI, while company E has been using fax to transmit orders to suppliers, reducing the operational efficiency of company B. Company E has recently started piloting EDI systems for placing orders to company B and other large suppliers and using web-based forms with small suppliers.

Likewise, manufacturers should be capable of sending an EDI Advance Shipping Notice (ASN) prior to delivery and providing a Serial Shipping Container Code to identify shipment. This greatly facilitates automated checking of delivery contents. In addition, manufacturers need to be able to produce standardized bar coded labels to identify each designated retail store. At this stage, only company B has the capability of sending ASNs to the distribution function of company D. Therefore, due to lack of trust between retailers and manufacturers, random checks on supplier deliveries still have to be carried out at the
distribution center of both retailers for cross-docking operations. About 50% of the manufacturers dealing with company D’s cross-docking pilot project are able to produce the bar code label. For each carton delivered by non-barcode-compliant manufacturers, DC staff must produce and apply the labels, introducing extra labor costs and reducing the efficiency of the entire operation.

According to the Logistic Planning manager of company D, the CEO of company D was the one who initiated various pilot projects for ECR. Because of this top management involvement at company D, most of the resources required for ECR projects, including cross-docking and flow-through, have been forthcoming.

When fully implemented, these distribution strategies can produce substantial reductions in distribution costs, while offering many benefits to distributors and retailers through improved efficiency compared to the traditional pick-and-pack method (see Appendix A). However, they impose significant extra costs on the manufacturer’s side since they require high EC compliance levels and a more complex order processing infrastructure to deal efficiently with small individual store orders. Retailers potentially face a greater risk of product stock-outs. There are benefits to manufacturers (greater visibility of consumer behavior) and retailers (longer shelf-life), but as argued by Kurnia and Johnston (2000), a mutual distribution of costs, benefits and risks requires complex negotiation of changed trading terms between all parties. The retailing and distribution functions of companies D and E have corporate links, so such negotiations are less complex than between distributors and manufacturers. Since Australian retailers are more powerful than the manufacturers, company B is actively engaged in an Activity-Based Costing (ABC) study to obtain concrete evidence regarding costs, benefits and risks of ECR initiatives, in order to better position itself in trading-term negotiations (Kurnia et al., 1999a,b). The results of the ABC study will also be useful in obtaining the required top management support.

Regulators such as the EAN Australia, the Grocery Industry Supply Chain Committee (also known as ECR Australia), and the Retail Logistics Group are assisting organizations within the Australian grocery industry to implement ECR initiatives to enhance the efficiencies of the industry. The EANWorks, for example, sponsored by EAN Australia and a number of other industry bodies, provides a supply chain best-practice demonstration model to allow organizations to learn about and visualize the opportunities to streamline their businesses along ECR lines. This will, in turn, support the implementation of cross-docking and flow-through, through the use of the EAN standardized numbering to identify products, shipments and destination stores, standardized EDI systems, and scan-pack technologies (EAN Australia, 1999).

7.2. Illustration of the model

Table 2 summarizes a number of specific instances of the causal links between the theoretical constructs of the second-order model (shown as labeled arrows in Fig. 4) that are illustrated by these case studies of cross-docking and flow-through.

Firstly, the case studies illustrate that both companies D and E are experimenting with cross-docking and flow-through because they perceive these distribution strategies as beneficial (arrow a). Furthermore, both companies are experimenting with these distribution strategies to reduce distribution costs through improved efficiency (arrow g). In
Table 2
Specific instances of causal links in the second-order model identified from cross-docking and flow-through case studies

<table>
<thead>
<tr>
<th>Causal link(s)</th>
<th>Specific instances from the X-docking and flow-through case studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consistent with the causal links of the first-order model</strong></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>Companies D and E perceive cross-docking and flow-through as beneficial and therefore are experimenting with these distribution strategies</td>
</tr>
<tr>
<td>g</td>
<td>Both companies D and E are experimenting with cross-docking and flow-through to reduce distribution costs through improved efficiency of product distribution</td>
</tr>
<tr>
<td>d</td>
<td>The existence of top management support and the required IT infrastructure enables company D to experiment with cross-docking and flow-through efficiently</td>
</tr>
<tr>
<td><strong>Additional causal links when the inter-organizational context is considered</strong></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Due to EC non-compliance of trading partners, company D needs to produce the barcode labels for store numbers</td>
</tr>
<tr>
<td>e</td>
<td>Due to the lack of trust, random checks on suppliers’ deliveries have to be performed by companies D and E</td>
</tr>
<tr>
<td>e</td>
<td>Due to the existing power relations between manufacturer and retailer, company B is conducting an ABC study to ensure the mutuality</td>
</tr>
<tr>
<td><strong>Causal links with reversed direction to those of the first-order model</strong></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>The results of the ABC study conducted by company B may alter the perceived benefits of cross-docking and flow-through as mutuality is achieved</td>
</tr>
<tr>
<td>c</td>
<td>The results of the ABC study can be used to gain top management support and improve adoption strategies through a clearer vision</td>
</tr>
<tr>
<td>c</td>
<td>Company E is improving its capability in terms of IT infrastructure availability to support cross-docking and flow-through implementation</td>
</tr>
<tr>
<td><strong>Other causal links</strong></td>
<td></td>
</tr>
<tr>
<td>b and d</td>
<td>Efficient implementation of cross-docking and flow-through by company D due to the existence of the required IT infrastructure results in a better perception of the distribution strategies</td>
</tr>
<tr>
<td>b and e</td>
<td>As more trading partners become EC-compliant, more benefits of cross-docking and flow-through can be obtained through a more efficient implementation</td>
</tr>
<tr>
<td>b, e and f</td>
<td>Negotiations of trading terms between company B and retailers, based on the ABC study, may alter power relations and economic relations within the supply chain and industry over time. This may in turn modify the perception of cross-docking and flow-through</td>
</tr>
<tr>
<td>b, c, d, e and f</td>
<td>Involvement of industry bodies may alter the capability of organizations in implementing cross-docking and flow-through over time, which will in turn alter the perception of these distribution approaches and the structure of the industry</td>
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</table>

In addition, the case studies indicate that company D is able to experiment with these strategies more efficiently than company E due to the existence of top management support and the required IT infrastructure (arrow d). These first three causal links are consistent with the first-order model.

The case studies additionally illustrate the causal connection between the action of organization and the inter-organizational context (arrow e in Fig. 4). Company D, for instance, needs to produce bar coded labels to indicate store numbers at the distribution center for products delivered by non-EC-compliant suppliers that are not able to produce such labels. Moreover, due to lack of trust between manufacturers...
and retailers, random checks on manufacturers’ deliveries have to be performed by companies D and E (retailers). Finally, since Australian retailers are more powerful than the manufacturers, company B is conducting an ABC study to assist the company in trading term negotiations with retailers to ensure mutual benefits of cross-docking implementation and other ECR programs.

The case studies also illustrate causal connections in the reverse direction to those of the first-order model. These links are between actions of organizations and the nature of the technology (arrow b) and between actions of organizations and the capability of organizations (arrow c). The results of the ABC study conducted by company B, for instance, can be used to achieve the mutuality of cross-docking implementation and this will alter the perceived relative advantage of cross-docking by company B (arrow b). Likewise, these results can be used to gain top management support and commitment, which may in turn alter other aspects of the capability of company B in cross-docking and flow-through implementation (arrow c). The possibility that organizations can modify their capability is further illustrated by the case studies through the effort of company E in improving the existing IT infrastructure within the organization to support cross-docking and flow-through implementations (arrow c). These reversed causal links cannot be explained by the first-order model.

There are other complex interactions that are also beyond the scope of the first-order model. The existence of the required IT infrastructure and top management commitment at company D, for instance, allows the company to effectively implement cross-docking and flow-through, leading to it having a better perception of these distribution strategies (arrows b and d in Fig. 4). Moreover, as more trading partners become EC-compliant, cross-docking and flow-through can be implemented more efficiently through the elimination of bar coded label production at the distribution centers of retailers and the elimination of random checks as the scan pack technology is utilized. Consequently, this will improve the perception of cross-docking and flow-through. These interactions are represented by arrows b and e.

Furthermore, trading term negotiations between company B and retailers based on the ABC study may alter power relations and economic relations within the supply chains and the industry over time to ensure mutuality. As a result of mutual sharing of costs, benefits and risks, organizations’ perception of cross-docking and flow-through can in turn be altered. These interactions are represented by arrows b, e and f. In addition, the involvement of industry bodies such as the EAN Australia in assisting organizations to implement supply chain management best practice through appropriate education will impact the action of organizations. This will, in turn, alter the capability of organizations in implementing cross-docking and flow-through, their perceptions of these distribution strategies and the industry structure over time. These interactions are represented by arrows b, c, d, e and f. Finally, these case studies demonstrate that some of the factors (pressure from trading partner, partnership, trust and mutuality) identified as external factors in the first-order model now become part of the internal interactions between organizations and their inter-organizational environment.
8. Direct-store delivery

8.1. The findings of the case studies

Adoption of DSD was examined in case studies with companies A (manufacturer), D (retailer) and E (retailer), within two supply chains. Interviews were conducted with a Regional Customer Service manager of company A, the Logistics Planning manager and the National Supply Chain manager of company B, and the National Supply manager and a Business manager of company E. In addition, a site visit to the manufacturing plant and distribution center of company A was undertaken to examine the replenishment operations of manufacturers for DSD.

One important observation obtained from the case studies is that DSD requires low levels of EC implementation for information sharing since the manufacturer’s representatives directly monitor the performance of the manufacturer’s products at the store level and take action accordingly. This observation was obtained from the following excerpt of the Regional Customer Service manager of company A:

Because suppliers control the movement of goods, there is no great need for electronic commerce technologies at this stage. Only the EAN-TUN bar code is used as part of the picking process at suppliers’ warehouses.

Manual shelf checking, however, can be eliminated through EC implementation that allows point-of-sale (POS) data of retailers to be shared electronically with manufacturers. This yields a more efficient implementation of DSD (ECR Central, 1997).

DSD requires trust between manufacturers and retailers since manufacturers are given control over the replenishment of products at the retail stores. The Business Manager of company E expressed her concern about lack of trust between manufacturers and retailers in Australia, as revealed in the following excerpt:

There is not a lot of trust at the moment. Some vendors are still fighting against retailers. Unless manufacturers realize that they cannot grow unless the retailers grow, it is difficult to work with manufacturers.

DSD also requires of manufacturers high warehousing efficiency to enable them to be responsive to customers’ needs and to deal efficiently with small, frequent orders. Therefore, company A chose to automate its warehouse fully for the sake of operating efficiency. High transport efficiency of manufacturers is also important to enable small, frequent deliveries to individual retail stores. According to the Regional Customer Service manager of company A, since company A deals with high volume orders, there is no problem with the utilization of trucks. Although most distribution costs using DSD are incurred at the manufacturer’s side, company A has gained significant advantages from this approach in maintaining competitive advantage through the full control they possess over the performance of its products at the store level. Other manufacturers with low order volumes may not gain many benefits from this distribution approach.

Company E is now experimenting with flow-through distribution from company A, since company E believes that retailers are better at transportation and warehousing and therefore should be in control of replenishment activities. In addition, DSD leads to
increased traffic on the streets and clutters the backdoor activities of the retail stores. Therefore, both retailers in the case study prefer cross-docking or flow-through to DSD. The Regional Customer Service manager of company A, however, is not very content with the retailers’ initiative to replace DSD with flow-through, as demonstrated below:

Retailers want manufacturers to deliver to their warehouse. However, we believe that direct-store delivery is cheaper for retailers.

8.2. Illustrations of the model

Table 3 summarizes specific instances of the causal connections between the theoretical constructs proposed by the second-order model that are demonstrated by the DSD case studies. Firstly, the case studies show that because of the existence of the required IT infrastructure at company A, the company is able to perform efficient warehousing and transportation to facilitate DSD (arrow d). This causal link is in line with the first-order model.

The case studies then illustrate that company A needs to have a representative to perform manual shelf checking in individual stores of companies D and E (retailers) since companies D and E do not share POS data with company A. In addition, although DSD has been highly beneficial to company A, company A has to take part in cross-docking and flow-through pilot projects of companies D and E to replace DSD since Australian retailers are more powerful than the manufacturers. These interactions illustrate that political and trust aspects of the structure of the supply chain/industry setting mediate actions of company A as represented by arrow e in Fig. 4.

The case studies further demonstrate that due to the ability of company A to perform DSD efficiently, this distribution approach is perceived to be highly beneficial by company

<table>
<thead>
<tr>
<th>Causal link(s)</th>
<th>Specific instances from the DSD case studies</th>
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<tbody>
<tr>
<td><strong>Consistent with the causal links of the first-order model</strong></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>The existence of sophisticated IT infrastructure at company A allows the company to efficiently handle warehousing and transportation for DSD</td>
</tr>
<tr>
<td><strong>Additional causal link when the inter-organizational context is considered</strong></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>Because companies D and E do not share POS data with company A, company A needs to perform manual shelf checking at the store level of companies D and E. As retailers are more powerful than manufacturers in Australia, company A needs to take part in companies D and E’s projects to replace DSD although it has been beneficial to company A</td>
</tr>
<tr>
<td><strong>Other causal links</strong></td>
<td></td>
</tr>
<tr>
<td>b and d</td>
<td>Due to the existence of the required IT infrastructure for managing DSD efficiently at company A, the company perceives DSD as highly beneficial</td>
</tr>
<tr>
<td>a, b and e</td>
<td>Lack of trust between manufacturers and retailers in Australia results in company E having an unfavorable perception of DSD. Therefore, company E is now experimenting with cross-docking and flow-through to replace DSD</td>
</tr>
</tbody>
</table>
A. Other manufacturers with less capability may not perceive DSD as beneficial. This indicates that organizations may have different perceptions of the same technology as a result of their differing capabilities. These causal links are represented by arrows b and d in Fig. 4. Finally, due to a lack of trust between Australian manufacturers and retailers, company E does not favor DSD. Lack of trust has caused company E to feel out of control of the product range, quality, and replenishment activities, and to have a negative perception of DSD. Thus, company E is now experimenting with cross-docking and flow-through with company A to replace DSD. These interactions are represented by arrows a, b and e. These case studies thus reinforce the observations from the previous case studies that the supply chain and industry structure interacts with actions of the focal organization. Through these interactions, the nature of the technology in question and the capability of the organization can be altered over time. These interactions cannot be explained by the first-order model.

9. Vendor-managed inventory

9.1. The findings of the case studies

Adoption of this distribution approach was investigated in case studies with companies B (manufacturer), C (manufacturer), D (retailer) and E (retailer), within four supply chains of the Australian grocery industry. Interviews were conducted with the Supply Chain manager of company B, Logistic Planning manager of company D and the National Supply manager of company E.

Companies B and D have been trialing this distribution strategy for two years on 20 food products. Most of this time has been spent on developing electronic interfaces using EDI to allow information about DC withdrawal and stock on hand to be sent from company D’s distribution center to company B and to allow company B to send ‘reverse’ purchase orders to company D. Companies C and E have also been engaged in a VMI project recently. Company C has the responsibility to manage the inventory of its products at company E’s distribution center for all SKUs within an agreed inventory level. Company C also generates orders for replenishment on behalf of company E, which are communicated via fax.

Interviews with various managers of the case study participants revealed that VMI requires implementation of EC technologies to enable effective information sharing and high integration between trading partners. At the moment, company D is capable of sharing information with company B via EDI, while company E shares information via fax with company C. The use of the Advance Shipping Notice (ASN) and Serial Shipping Container Codes (SSCC) further improves the efficiency of the receiving process. However, most Australian manufacturers are still incapable of sending ASN to retailers. Only company B and another manufacturer are capable of sending ASNs. Cooperation and trust between manufacturers and retailers is crucial for VMI to work. Such cooperation and trust has proved difficult to establish among case study participants. According to the Logistics manager of company C, this barrier is gradually being removed:

There was no trust between {company C} and trading partners in the past. Today,
has a Customer Business Development corporate strategy which is an enabler for ECR. This strategy promotes working in a close collaboration with all trading partners.

Interviews with the participants further revealed that Australian manufacturers and retailers do not gain significant benefits from VMI. For this reason, both retailers in the case studies are not very enthusiastic about adopting VMI. In addition, they believe that retailers are better at forecasting demand since they are closer to the consumers and they should have control over replenishment. Companies B and E expressed their belief that VMI is not the right approach to pursue in Australia, as revealed below:

In a long term, the problem with VMI is that we are managing a wrong problem…. It is better for all parties to invest in cross-docking or flow-through.

Because we are moving towards flow-through and cross-docking, VMI is not appropriate since there should not be any inventory to manage (National Supply Chain Manager of company E).

Therefore, the application of VMI has been very limited in all supply chains studied and there is no plan to extend its application in each case. This appears to be because of the erroneous application of VMI within the traditional pick-and-pack distribution rather than with cross-docking or DSD. By implementing VMI using distribution center withdrawal data rather than the US practice of driving it with actual retail store-level POS data (Walton, 1992), much of the benefit of VMI, particularly transparency of consumer behavior to manufacturers, is being lost.

9.2. Illustrations of the model

Table 4 summarizes specific instances of the causal links drawn from the VMI case studies. Consistent with the causal connections posited by the first-order model, the case studies illustrate that since VMI is not perceived to be advantageous to the Australian grocery industry both companies D and E do not have any plan to extend the application of the VMI. This causal link is represented by arrow a in Fig. 4. The case studies further demonstrate the effect of industry structural relationships upon adoption (arrow e). The availability of the EDI infrastructure at companies B and D, for example, enables the companies to share DC withdrawal information, stock level information and delivery information efficiently. Furthermore, the ability of company B to send ASN and produce SSCC for shipment identification improves the efficiency of the receiving process of company D.

The case studies also illustrate a causal link with a direction reverse of those of the first-order model, as companies B and D modified their organizations’ capability by developing the required IT infrastructure to facilitate VMI implementation (arrow c). In addition, the case studies illustrate that not all initiatives proposed under the banner of ECR are readily applicable and beneficial to the Australian grocery industry. VMI does not seem to be widely accepted in Australia as a better alternative to the other advanced distribution strategies due to the lack of compatibility with the objectives of the Australian grocery industry (arrows b and e). In fact, VMI has been a very successful approach for some US retailers such as Wal-Mart (Walton, 1992; Jilovec, 1997; Lamb, 1997).
Table 4
Specific instances of causal links in the second-order model of ECR adoption identified from VMI case studies

<table>
<thead>
<tr>
<th>Causal link(s)</th>
<th>Specific instances from the VMI case studies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consistent with the causal links of the first-order model</strong></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>VMI is not perceived to be beneficial in Australia and therefore both companies D and E do not have any plan to extend the application of VMI</td>
</tr>
<tr>
<td><strong>Additional causal link as the inter-organizational context is considered</strong></td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>The availability of EDI infrastructure at companies B and D allows the companies to exchange information efficiently</td>
</tr>
<tr>
<td></td>
<td>The ability of company B to send ASN and produce SSCC improves the efficiency of the receiving process at company D</td>
</tr>
<tr>
<td><strong>Causal links with reversed direction to those of the first-order model</strong></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>Companies B and D developed the required IT infrastructure to facilitate VMI implementation</td>
</tr>
<tr>
<td><strong>Other additional causal links</strong></td>
<td></td>
</tr>
<tr>
<td>b and e</td>
<td>VMI which offers many benefits to the US retailers and manufacturers is perceived unfavorably by companies A, B, C and D. This is caused by a lack of compatibility with the objectives of the Australian grocery industry</td>
</tr>
<tr>
<td>a, b and e</td>
<td>The concept of VMI has been modified by large companies to suit their own agendas. Company D provides company B with DC withdrawal information instead of POS data for the replenishment purpose. This reduces the perceived benefits of VMI</td>
</tr>
<tr>
<td>a, b, c, d, e and f</td>
<td>Involvement of industry bodies may alter nature of VMI, organizational capability and the structure of the industry over time and space. This may result in a better perception of VMI and a better capability to implement VMI efficiently</td>
</tr>
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</table>

The misapplication of VMI in Australia illustrates the ability of organizations to alter the nature of the technology either inadvertently or as a consequence of historical commitments, which in turn reduces the perceived benefits of VMI (arrows a, b, and e). The normative influence of trade bodies, such as ECR Australia, may correct this situation but they may not be entirely independent of the agendas of influential players. The regulatory influence of standards bodies such as the EAN Australia in assisting companies to become EDI-capable will allow companies to implement VMI more efficiently as the capability of organizations is improved over time and space. This may, in turn, produce new industry structures more favorable to VMI. These interactions are represented by arrows a, b, c, d, e and f in Fig. 4. All these interactions are beyond the scope of the first-order model.

10. Conclusions

Studying adoption of inter-organizational systems adoption has proved to be complex and difficult since such systems span organizational boundaries. Technology adoption by one organization is thus influenced by complex and reciprocal interactions between it and other organizations in its supply chain and industry, which are played out over time and space. Consequently, the factor approach that has been popular for studying adoption of
discrete technologies in an organizational context proves inadequate due to its focus on a single organization, at a single epoch, and inadequate treatment of the inter-organizational context. This paper has argued theoretically that a rich treatment of the inter-organizational context of IOS adoption leads rather naturally to the processual view of such adoptions, which places emphasis on mutual interactions between the nature of the technology, the capabilities of organizations, and the industry structure, and posits an emergent history-dependent causal connection between the actions of organizations and outcomes.

The argument has been illustrated by the construction of the second-order processual model of adoption of ECR in the Australian grocery industry from our previously published factor model. The steps in this construction, especially the introduction of two-way causal links between technology, capability, and industry structure, have been justified using data from multiple case studies of the adoption of various distribution strategies advocated within ECR, conducted with companies in six supply chains within the Australian industry. Interestingly, the importance of the situational factors identified using positivist research methods in the first-order model was confirmed by the case studies. However, the strict causal status of these factors suggested by the first-order model must be questioned since many other complex interactions and causal links were uncovered by the case analysis and incorporated in the second-order model.

The second-order model suggests that the trajectory of each organization in adopting ECR is unique. Each organization will enter into a complex series of interactions with other parties in its industry group in the course of adopting ECR. During this period, organizations’ knowledge and perceptions of ECR will change, their capabilities will change, and their interactions with industry partners will change. Significant adoption of ECR will occur when this interaction results in stable new structural relations amongst industry players and routinized new practices are consistent with ECR principles. On this view, outcomes are difficult to predict and the adoption factors of the first-order model are seen as necessary but not sufficient to guarantee success.

For practitioners, the model can aid in understanding the complex dynamics of adoption of EC-enabled supply chain reforms, such as ECR, that arise because of their inter-organizational nature. Therefore, while less prescriptive, the model can help managers produce a richer and more individual situational analysis to guide ongoing implementation decisions. For academics, the second-order model shows that the causal connection between the various entities required to explain adoption of EC-enabled inter-organizational systems is not as straightforward as imagined in the traditional adoption/diffusion literature. Interpretive research methods are more appropriate to elucidating the kind of two-way causal links of the second-order model than positivist methods. Nevertheless, by making the assumptions of the first- and second-order models explicit, this paper indicates the possibility of a principled use of a combination of methods under certain circumstances.

This study encourages further studies of adoption of ECR in Australia to employ the processual approach in order to examine change processes that occurred over time and space in the course of ECR adoption and how these changes are eventually routinized. At the same time, such studies will be useful in evaluating and refining the second-order model developed from this study. Likewise, future studies of adoption of other EC-enabled IOS by other industries, employing both factor and processual approaches, are desirable to further refine the theoretical arguments presented in this study.
Appendix A. Distribution strategies in the grocery industry

A.1. Pick-and-pack

With the pick-and-pack strategy, buffer stocks of items are maintained at a centralized distribution center (DC). Retail stores send orders (preferably by EDI) to the DC on a frequent basis. Goods are picked from stock at the DC and shipped. Goods are replenished from the manufacturer in large, infrequent lots when the DC stock falls to a predetermined level. Because replenishments are not tied to store level orders, pick-and-pack places low electronic coordination demands on the manufacturer, but requires sophisticated inventory, forecasting and warehousing systems at the DC.

Pick-and-pack is widely used in Australia particularly for fast-moving items. However, because it relies on buffer-stocks and thus reduces the efficiency, responsiveness and transparency of replenishment, it is not advocated as part of ECR. The following alternative distribution strategies are supported as part of ECR (Kurt Salmon Associates, 1993; ECR Central, 1997) and each is appropriate to different product or distribution network characteristics.

A.2. Cross-docking and flow-through

Cross-docking is a distribution strategy, which makes use of a centralized DC but without the use of buffer-stock. Replenishment is initiated by a retail stores placing an order with the manufacturer (ideally using EDI). Manufacturers ship orders for several retail stores to the DC where they are broken down, inspected, sorted by destination store, repacked and delivered. Compliance to bar code standards can enable automated sortation and compliance to EDI Advanced Shipping Notices can simplify or eliminate inspection. Thus cross-docking requires high informational coordination between supply chain participants. Its application in Australia has been limited to medium to slow moving items, to avoid stock-out problems at the store level (Andel, 1994; Fleischer, 1997).

Flow-through is a step beyond cross-docking. With flow-through, whole pallets delivered by suppliers are for specific individual stores and, hence, no sortation is required at DC. These pallets can be brought straight to the dispatching area. With this approach, suppliers initiate the replenishment activities. In Australia, flow-through is applied to very high volume or promotional products.

A.3. Direct-store delivery

With DSD, goods are delivered directly from manufacturers to retail stores, without the use of a DC. Manufacturers or retail stores can initiate replenishment. To implement DSD effectively, supplies and customers need to be able to share POS data electronically. This approach is required for delivering products that are perishable, fragile, extreme in density (do not allow efficient utilization of trucks), require special handling and payment by regulations or have unique sales pattern (such as slow moving items with high variety and impulse) (ECR Central, 1997).
A.4. Vendor-managed inventory

VMI is a distribution strategy in which manufacturers are given responsibility to replenish retailer store inventory based on usage data provided by the retailers. In the ideal model promoted by Wal-Mart, POS data collected by bar code scanning is transmitted by EDI to the manufacturer who then delivers product directly to restock retail store shelves (Walton, 1992). However, in Australian practice, DC withdrawal data is often used to drive VMI. VMI requires some EDI capability of manufacturers, distributors, and/or retailers in order to share data. It is mainly used with fast moving items.

References


EAN Australia, 1999. EAN Systems and Solution, Victoria, Australia, EAN Australia.


