Interorganizational Information Systems in Industrial Markets

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Abstract

The impact of Interorganizational Information Systems (IOS) on industrial markets is complex because of multiple individual effects. We separate the impact into three effects: value added to the marketed good, buyer IOS adoption costs, and less volume sensitive supplier costs. We conclude the first and last of these effects explain marketed good premiums and discounts found in practice. The presence of buyer adoption costs also reveals why successful IOS always involves additional effort from suppliers. Because preemption is at the heart of IOS launch decisions, IOS introductions are found to occur early, and must be followed up by improved versions.

1 Introduction

In the last two decades a structural change has swept through many industries: interorganizational information systems, or IOS. This change has compressed time and space between suppliers and buyers, allowing the order-delivery cycle to occur more quickly and easily, making transactions more productive and efficient. This transformation has altered the nature of the supplier-buyer relationship, redefining the basis of competition.

We study IOS that are offered by suppliers of a marketed good downstream to buyers in industrial markets, that is, where suppliers and buyers are firms[1]. Our view is that the purpose of IOS is to enhance and support the supplier-buyer relationship, and that there are three fundamental IOS impacts. First, IOS adds value to the marketed good, and the resulting quality differentiation mitigates supplier price competition. Second, when choosing to use a supplier's IOS, buyers incur one time adoption costs which can act as a barrier to IOS success. Third, IOS shifts the supplier's cost structure for the marketed good to one with lower marginal cost, making the supplier a more effective competitor. We evaluate each of these effects under three market conditions: supplier monopoly, supplier oligopoly but only one supplier has IOS, and supplier oligopoly where many suppliers have IOS.

We also examine the race to introduce a first IOS in an industry, and consider the impact of successive generations, or versions, of the IOS. In general, this competition forces suppliers into games of preemption with IOS, which persist over multiple generations.

Our objective in this chapter is to present and integrate results from prior research and to draw out the implications for senior managers considering the effect of IOS on their firms and industries. We employ three paradigm examples of industrial market IOS throughout

[1] Other general research on IOS includes [Bakos, 1991], and [Clemons and Kleindorfer, 1992].

to motivate the discussion: American Hospital Supply's (Baxter Healthcare) ASAP system, Pacific Pride's Cardlock fueling system, and McKesson Drug's Economost order system.

- American Hospital Supply Corporation (AHSC), now part of Baxter Healthcare, used an order processing IOS (ASAP) to link directly with hospitals. Subsequently, Baxter launched ASAP Express, an IOS that acts as an industry platform, intermediating between hospitals and hospital suppliers.
- Pacific Pride provided customers its Cardlock IOS which gave secure, 24 hour access to fuel, and full reporting of fuel purchases. A Cardlock IOS works similar to an automated teller machine, except that it employs a specialized fueling card. Since then the IOS network has been extended nationally through Cardlock franchising to non-Pacific Pride owned outlets.
- McKesson Drug offered its order processing IOS (Economost) to small independent drugstores, providing them with the functions necessary to compete with larger drugstore chains.

The chapter is organized as follows. Each of the three impacts of IOS are presented in turn. This is followed by a discussion of IOS introduction timing games. A summary outlining guidelines for senior managers forms the conclusion.

2 How Industrial Markets Work

The primary difference between retail markets and industrial markets is that in the latter both the buyer and the supplier are firms. Using the term *marketed good* to refer to the good sold by the supplier to the buyer, in industrial markets the marketed good does not satiate a buyer's need. Rather, the marketed good is an input to the buyers production of some other output. This difference between retail and industrial markets is reflected in the buyer's objectives: the buyer and the supplier are assumed to maximize profits. Three examples are used to illustrate these points.

- Baxter Healthcare (supplier) sells hospital supplies (input) to hospitals (buyers) who use these supplies in their provision of medical services (output);
- Pacific Pride (supplier) supplies vehicle fuel (input) to commercial customers (buyers) who use trucks and vans to transport freight (output);
- McKesson Drug (supplier) wholesales drugstore products (input) to drugstores (buyers) who are retailers of the drugstore products (output).

The buyer may have many inputs into its production of output, and the marketed good is one of these inputs.

To show how IOS can affect these markets it is important to understand how buyer demand for the marketed good is derived from the demand for the buyer's final output. Buyers maximize profits by selecting a level of output. This level of output in part determines the buyer's requirements for the inputs. The extent to which the buyer will employ substitutes for the marketed good depends on a combination of how specific the marketed good is to the production of the output, that is, whether substitutes are possible, and the relative price of the marketed good (Asset specificity here is the extent to which the marketed good is specialized to the output's production. For more background see [Williamson, 1981]). Feasibility of substitutes depends, in part, on the buyer's production technology. If substitutes are available then higher marketed good prices favor the substitute, whereas lower marketed good prices will cause the buyer to demand greater quantities of the marketed good. In this

1. Adds Value
2. Costly Adoption
3. Shifts Cost Structure

Table 1: **IOS Impacts**

way price affects quantity of the marketed good demanded by a buyer. To summarize, the quantity demanded by a buyer of the marketed good will depend on the buyer's production technology, the level of output the buyer chooses, and the unit price of the marketed good.

Also important to the buyer is the cost of building a relationship with a supplier. In industrial markets, there are repeated transactions between supplier and buyer. In other words, the relationship is ongoing. Thus, the anticipated costs of setting up, or dissolving, such relationships may determine whether a supplier and buyer form an ongoing relationship. Should these adoption costs be high then the buyer will be less inclined to begin the relationship. If adoption costs are low, or alternatively if the supplier takes steps to facilitate adoption, then buyers will find the potential relationship more attractive.

Our view is that IOS has three impacts on supplier-buyer relationships, illustrated in Table 1. First is that the use of the IOS can enhance transactions of the marketed good by adding value. Second is that, because IOS are information technology based, initial adoption of an IOS is difficult or costly, and thus erects a barrier between the supplier and the buyer. Third, use of an IOS changes the supplier's cost structure for producing the marketed good to one with higher fixed, but lower variable, costs.

3 Quality

The first impact of IOS on supplier-buyer relationships in industrial markets is that IOS adds value to the marketed good transacted. This allows the supplier with IOS to be vertically differentiated from the buyers' point of view, i.e. differentiated based on *quality*, from suppliers without IOS, a principle consistent with Porter's "Niche" strategy [Porter80]. This quality difference can affect two dimensions. If the IOS content affecting the marketed good is passed on by the buyer to customers further downstream then the buyer's output is of higher value. More commonly, the IOS facilitates transactions between the supplier and buyer, in which case the buyer receives benefit from lower inbound logistics costs. This latter dimension can be affected by, for example, an IOS that facilitates buyer transition to just-in-time manufacturing, leading to significant reductions in materials inventory and work in progress. In each of our three examples the supplier's IOS was able to reduce buyer's costs.

- At AHSC the ASAP IOS, and its predecessor Tel-American, were bundled to hospitals as part of an overall materials management system. Hospitals benefitted from lower inventory, lower shrinkage and spoilage, reduced paper work, and assured and timely delivery of hospital supplies [HBS Case Services, 1985]. Further benefits to hospitals resulted from ASAP Express, Baxter's open, multivendor system. With logistics costs twice that of supplies themselves, ASAP Express reduced costs by consolidating ordering to a single system [HBS Case Services, 1989].

- Benefits to buyers from Pacific Pride's Cardlock IOS included convenience, control, and credit [Nault and Dexter, 1991]. Buyers had access to fuel 24 hours a day across a broad network of locations. Drivers did not need to carry cash or credit cards, and fueling took less time than at retail stations. Buyers received detailed statements of fuel purchases throughout the network, which provided monitoring and tracking ability. Finally, the Cardlock IOS offered some credit, similar to more general purpose credit cards.

- McKesson's Economost allowed buyers to enter the drugstore's complete order into a single hand held device and transmit the order directly to McKesson, reducing transaction costs [Clemons and Row, 1988]. Drugstore inventories were reduced to near zero as McKesson delivered the order the same or following day. Restocking was facilitated as the order arrived specially sorted for the particular drugstore's physical layout, with price stickers provided to reflect the specific drugstore's pricing policy. The IOS also provided detailed management reports on the drugstore's purchases and sales.

There are two key ways a supplier can transform increased quality from the IOS into higher profits: higher prices and/or greater sales volumes of the marketed good. To buyers, the argument is that increased unit price and increased quality are offsetting. Recalling our earlier discussion of industrial markets, a marketed good enhanced by an IOS is a substitute for the marketed good transacted without the IOS. Because the IOS-enhanced substitute reduces the buyer's production costs, at equal marketed good prices the buyer will produce more output, requiring a higher volume of the factor input. That is, the buyer will demand more of the marketed good. Alternatively, the supplier could increase the price of the marketed good, thereby increasing buyer's costs, counterbalancing the gains made by the buyer through the higher quality of the IOS-supported marketed good.

These arguments are portrayed in Figure 1. Here $q_{w/oIOS}(p)$ defines a given profit maximizing buyer's demand schedule, that is, quantity demanded at different price levels, when the marketed good is not supported by an IOS. $q_{w/IOS}(p)$ is the corresponding demand schedule when an IOS is used to support the marketed good. The effect of an IOS on a buyer's demand for the marketed good is to increase the quantity demanded at a given price. In

Figure 1 at price p_b the quantity demanded of the IOS-supported marketed good is q^+, and for the unsupported marketed good is q^*, where $q^+ > q^*$. Alternatively, the buyer will pay a higher price for a given quantity of the IOS-supported good, in other words, the IOS makes the marketed good more valuable. Restating, for q^* the buyer is willing to pay a unit price of p_a for the IOS- supported marketed good versus p_b for the unsupported marketed good, where p_a is priced at a premium.

*** Insert Figure 1 Here ***

There are three market situations to consider. The most straightforward situation is if the supplier is a monopolist in the marketed good. Because the quality due to the IOS and the marketed good price are offsetting, the IOS gives the supplier the latitude to increase profits from higher prices, larger volume, or both. The supplier also has an additional degree of freedom offering two different marketed goods[2].

More complicated is when there are several suppliers of the marketed good, but only one offers buyers an IOS, for example because of patents or other barriers to IOS imitation. In this case a unit premium on the marketed good supported by the IOS is the only stable competitive outcome because at equal or discounted prices the supplier with the IOS would drive out all other suppliers of the marketed good. There is an additional principle at work in this case, that of maximal differentiation. In general, suppliers would prefer to offer versions of the marketed good which are as different as possible, with the goal being to mitigate price competition between them[3]. This can be best illustrated by duopoly, that is, when there are two suppliers of the marketed good. Using the basic result from [Judd, 1985], [Nault, 1990]

[2]For monopolist choices of quality in Economics see [Mussa and Rosen, 1978].

[3]For studies of oligopoly see [Shaked and Sutton, 1982], and [Gal-Or, 1983]. For an information technology investment model see [Barua, et al., 1991].

has shown that if one of the suppliers introduces an IOS, this supplier should leave the non-IOS-based sales of the marketed good to the competitor. Following this strategy accomplishes two things. First, the two versions of the marketed good are differentiated, which reduces price competition. Second, there is no incentive for the non-IOS supplier to imitate the IOS as this would initiate direct price competition in the IOS-supported marketed good.

Most complex is the case when several suppliers have IOS. In this environment the IOS becomes a *strategic necessity*, that is, it is not possible to compete for buyers without an IOS. Because of the intensity of competition between suppliers with IOS, there is often no market remaining for the unsupported marketed good.

There is some evidence of the pricing outcomes suggested above in our three examples.

- AHSC was able to charge a premium of 1-2% for hospital supplies sold through ASAP, even after competitors had responded with their own IOS. AHSC believed, however, there was significant product pull from ASAP, in other words, ASAP increased the volume of hospital supplies sold by AHSC.

- Benefitting from being unique in network scope, Pacific Pride charged a fuel price premium of between 5% and 12% for Cardlock fuel sales. Subsequent IOS competition has eroded these premiums.

- McKesson faced IOS competition immediately, and as a result provided drugstores with price discounts on orders through Economost. Thus, discounts relative to non-IOS-supported goods were required to maintain sales volume.

4 Adoption Costs

The second impact of IOS on supplier-buyer relationships is the up-front costs buyers must incur to set up a transaction- based relationship. The incremental fixed cost for buyers joining a supplier's IOS are *adoption costs*. These additional buyer costs due to IOS can range from changes in regular operations to developing the human skills necessary to perform business functions. These costs can include purchases and installation of hard assets such as computing equipment, and expenditures on soft assets such as personnel retraining and modifications to inventory numbering schemes. Typically these costs are required to integrate the IOS into the firm's normal operations [Bakos, 1991]. Occasionally they involve terminating previous contractual arrangements [Chismar and Meier, 1992]. These adoption costs can affect supplier-buyer relationships in two ways. First, because these costs act as an additional barrier to joining the system, these costs can affect whether a buyer adopts the supplier's IOS. We expect that less costly IOS will be more readily adopted. Second, these costs can impact whether a buyer switches from one supplier to another. In this context these adoption costs are in fact *switching costs*[4]. Suppliers often act to bring down these adoption costs, particularly those related to softer assets, by providing initial training and set-up services. In each of our examples IOS adoption costs were present, and suppliers took actions to reduce the buyer's adoption costs.

- AHSC's selling of Tel-American and overall materials management meant hospitals had to be more disciplined in following inventory procedures. Often AHSC staff helped physically rearrange inventory to get a hospital started on the IOS. Later versions of ASAP allowed hospital's internal inventory numbers, or competitors' item numbers, to be used. Software customizations were often done by AHSC to integrate ASAP into a

[4] For models in Economics see [Klemperer, 1987], for an information technology model see [Davamanirajan, et al., 1991].

specific hospital's information system. To lower buyer's costs, AHSC paid for the IOS telecommunication charges, and ASAP was offered at no charge. The advent of ASAP Express meant that hospitals only needed to learn and integrate a single system, rather than one from each vendor.

- There was a cost to training drivers to use Pacific Pride's Cardlock equipment and to locate Cardlock stations, which was made more difficult if the driver had limited literacy skills. There were additional costs of initially issuing and distributing Cardlock cards and overcoming driver resistance to change. Pacific Pride spent significant time meeting with the buyer's staff, particularly the dispatcher, to ease the transition to the Cardlock network.

- Typical buyer adoption costs for McKesson's Economost included relabelling inventory, data conversion, and data entry. Competition between McKesson and a rival with similar IOS led to suppliers bearing the full cost of switching a drugstore to their system.

Rather than affecting the quantity demanded by an individual buyer, adoption costs affect whether a buyer develops a relationship with a supplier through the IOS. This is because the buyer is facing two decisions: whether to adopt a supplier's IOS and how much of the marketed good to purchase. The buyer is assumed to make these two decisions in the following way. Suppose there is a supplier with an IOS and one without, and apart from the IOS they are identical. For each supplier, the buyer follows the production decisions outlined in Section 2, and then selects the supplier that enables it to make the greatest profit. In the buyer's choice of output level the IOS adoption costs are not marginal costs; therefore, they do not affect the buyer's output level, and thus do not affect the buyer's marketed good demands. Adoption costs, however, determine to which supplier a buyer will direct its business.

Thus, IOS adoption costs only affect aggregate marketed good demand through the number of buyers to which the supplier sells. In other words, adoption costs do not impact individual buyer's demands for the marketed good as before, but rather impact whether the buyer will adopt a particular IOS. The problem for the supplier is how to induce buyers to adopt the IOS. There are two ways to entice buyers to choose the IOS-enhanced marketed good. Both involve *subsidies* targeted at overcoming buyer adoption costs. The first, *explicit subsidies*, can take many forms, for example a fixed rebate for IOS adoption or a unit discount for the first x units purchased. Therefore, the buyer is offered the equivalent of a fixed monetary incentive for adoption. More common is an *implicit subsidy* which, rather than a payment, involves suppliers bearing buyer adoption costs. Examples include enhanced customer service, training, provision of equipment, and even installation and implementation of the IOS at the buyer's site. In each of our examples the supplier used *implicit subsidies* to overcome their buyers' barriers to IOS adoption.

Figure 2 shows the effects of a subsidy. If buyers differ in their production technology, where a higher technology parameter, t, means they receive more added value from the IOS, there will be a critical point at which a buyer is indifferent between adopting and not adopting the IOS. That is, this buyer makes the same profit regardless of whether it adopts. All buyers with production technology higher than the critical buyer adopt the IOS, while those with a lower technology parameter do not. The effect of a subsidy is to lower the critical level of the production technology parameter required to receive greater profits from IOS adoption than non-adoption, thereby increasing the proportion of buyers that adopt.

*** Insert Figure 2 Here ***

For a monopolist supplier it may not be necessary to subsidize buyer adoption of IOS. Buyers may have little alternative except to adopt the supplier's IOS in order to have access to the marketed good, particularly if there are no substitutes. In this case the supplier should consider a multipart pricing scheme, the simplest of which is a two part tariff. A two part tariff is a pricing structure consisting of a unit price and a fixed fee, with the latter similar to the fixed charges for telephone installation or club memberships. Depending on the distribution of buyer production technologies, it may be optimal to *charge* for access to the IOS with the fixed fee, or possibly to subsidize adoption as described above. Following intuition, a monopolist should never offer a subsidy greater than the buyer's adoption cost [Nault, 1990].

When there are multiple suppliers of the marketed good but only one has IOS, a multipart tariff with a fixed access charge may still be optimal for the supplier with the IOS. Because more than one supplier continues to offer the marketed good without IOS, an adoption subsidy is not necessarily limited to the buyer's adoption costs. Thus, with competition in the marketed good, we hypothesize that it could be optimal for the supplier with IOS to further entice buyers with an adoption subsidy greater than adoption costs.

When there are multiple suppliers with IOS it becomes less clear that there is an outcome which involves fixed fees or subsidies ([Nault, 1990]). Should a fixed charge be implemented by one supplier it would be competed down to zero or less. Moreover, competition on fixed subsidies would make unit prices unstable. We have observed just such price instability over time in a consumer IOS market: charges for use of automated teller machines[5].

5 Supplier Costs

The third impact of IOS on supplier-buyer relationships is the change in the supplier's cost structure for producing and delivering the marketed good. The positive benefits of IOS

[5]For a more detailed analysis of automated teller machines see [Kauffman, 1988].

on the buyer's production process also affects the production and delivery of the marketed good. Examples include economies of scale from computing, timeliness of information, and cost avoidance ([Barrett and Konsynski, 1982]). Typically these cost reductions affect the *marginal cost* of the marketed good. Evidence from our three examples is extensive.

- At AHSC Tel-American and early versions of ASAP made hospital orders more accurate and timely, both of which also reduced AHSC's costs. Sales personnel could focus on sales rather than order taking. After the merger with Baxter, ASAP was seen as providing significant cost savings through automation of the customer service function, and potentially greater savings if further market penetration of ASAP could be achieved.
- As compared to commercial fuelers without an IOS, Pacific Pride had lower invoicing costs as all transactions were on one system and buyer invoices could be generated automatically. In addition, because Cardlock stations were unattended, Pacific Pride saved the major marginal cost in retail fueling: direct labor in the form of a site attendant.
- Economost allowed McKesson to reduce the number of order entry clerks by 98 percent, and orders are now captured in computerized form which allows McKesson to improve their warehousing and purchasing efficiency. Similar to ASAP, sales personnel are freed up to sell rather than take orders.

In contrast to the supplier's production and delivery cost reductions from IOS, the additional costs of implementing and operating the IOS are not primarily marginal costs. For IOS there is typically a fixed implementation cost, periodic fixed operating costs, costs to install new buyer accounts, and a *negligible* marginal cost per transaction. Further support is offered by [Bakos, 1991] who argued IOS have high initial (fixed) costs, smaller capacity and maintenance (mixed) costs, and minimal marginal costs.

There is some evidence in our three examples that supports these IOS cost arguments.

- The HBS case on ASAP, [HBS Case Services, 1985], suggests that $30 million was spent building ASAP (fixed implementation), and maintenance required permanent staff and annual operating costs (periodic). AHSC also paid for buyer software customizations (per customer) and telephone charges (per transaction);
- Although little information disclosed regarding Pacific Pride's Cardlock implementation, the cost of computing equipment at each new Cardlock node was $20,000. Data communications costs included daily polling at each node and additional costs for check-ups and maintenance (periodic). There was also a small cost of setting up a new buyer account (per customer);
- Clemons and Row, [Clemons and Row, 1988], report that $20 million to $30 million has been spent on Economost software development (fixed implementation), and significant staff is required for ongoing development and maintenance. McKesson also pays for the 800 WATS line used for data communication (periodic).

Between the IOS effects on production and delivery costs of the marketed good, and the costs of the IOS itself, the overall impacts on the supplier are increased fixed costs, but decreased marginal costs. As a result the supplier that has invested in an IOS can cover its marginal cost at a lower price than its rivals, and thus has a more flexible competitive position, allowing the supplier to operate with a low cost focus *or* a niche focus ([Porter80]) based on quality as described in Section 3.

As a monopolist, for a given price, the IOS supplier can earn larger margins on the marketed good due to the reduced marginal cost. This reduced marginal cost suggests that the supplier will also sell a larger volume of the marketed good to buyers, at a lower price, because marginal revenue will equate with marginal costs at a higher level of output.

In an oligopoly of suppliers where only one has an IOS, the IOS supplier can successfully follow a low cost strategy. While competition will drive the price of the marketed good down to non-IOS marginal cost, the IOS supplier makes a positive profit on marginal sales at that price. The IOS supplier controls entry into the marketed good market because, by undercutting their marginal costs, this supplier can drive competitors from the market and dissuade possible entrants. This control of the market is even more likely when one considers the potential quality advantage provided by IOS. At equal prices, assuming IOS adoption costs do not dominate, all buyers will purchase the marketed good from the supplier with IOS. Thus, along both quality and marginal cost dimensions, the supplier with IOS that cannot be imitated is capable of driving all other suppliers from the market.

When several suppliers have IOS the result is a competitive market where marginal cost has been redefined by the IOS. This is again the case of *strategic necessity*, that is, where the IOS is a competitive necessity for a supplier offering the marketed good. Where the IOS are equivalent the suppliers cannot earn positive profits, and may lose their fixed investment in IOS.

In each of our examples competitive pressures have forced IOS evolution down a different path.

- Baxter, after AHSC's rapid growth due in part to ASAP, is now offering an industry IOS platform through ASAP Express. Thus, the ASAP Express is being used to gain advantage as the industry intermediary between hospital suppliers and hospitals.

- Pacific Pride responded to both growth and competition by allowing non-Pacific Pride nodes, or networks of nodes, to become part of the Cardlock network as franchises.
- McKesson, which has faced the most direct IOS competition of our three examples, has responded by using its expertise, diversifying into other distribution businesses. This has provided opportunities to gain further economies of scope from Economost.

6 IOS Introduction

Stepping back from the analysis of IOS impacts on how suppliers compete, we arrive at the question of why IOS are launched and what determines the timing of their introduction. Conceptually, IOS are implemented to improve the profitability of the supplier. In practice, IOS profitability is likely difficult to determine because it is often hard to predict the magnitudes of the three impacts described in the previous sections (quality, adoption costs, supplier costs), and the costs of IOS development and implementation are highly variable. If these two predictions can be made it is possible to determine the pattern of IOS introduction, and we can learn from the analysis.

We argue that within an industry, for example, suppliers of the marketed good, information about IOS development and pending deployment is common knowledge. That is, all industry members are aware of IOS activity and all members know that all members are aware. Support for the common knowledge assumption can be found in the airline industry where competition to be first to launch computerized reservation systems (CRS) between American and United Airlines carried over into competition to be first to announce the future launch of CRS ([Copeland and McKenney, 1988]). This also illustrates the need to beat the competition to the punch. Thus, preemption becomes important in the decision of when to introduce an IOS. The intuition is presented graphically in Figure 3.

*** Insert Figure 3 Here ***

Consider a supplier duopoly with suppliers A and B. Supplier A has an IOS cost advantage because of superior IOS know-how or IOS compatible infrastructure. Hence, it costs supplier A less to develop and implement the IOS. Suppliers are identical in all other respects. In Figure 3, $L^i(T)$ is the net present value of profits for supplier i being first to launch the IOS at time T, that is, leading at time T. $F^i(T)$ is the net present value of profits for supplier i following second with IOS. From the discussion of differentiated marketed goods in Section 3, we know that in a duopoly the follower never introduces an identical IOS. These results imply, however, that $F^i(T)$ is always positive because the follower can make profit on the non-IOS-supported marketed good. $M^i(T)$ is the net present value of profits should suppliers introduce identical IOS simultaneously, and is always negative as potential gains are competed away and suppliers are left bearing IOS introduction costs. $L^A(T)$ is everywhere higher than $L^B(T)$ because supplier A's IOS costs are lower than supplier B's[6]. T_1^i represents the time at which leading would yield profits equal to those of following, and $\hat{T}^i$ is the optimal time for supplier i to introduce given no IOS introductions have occurred.

Reasoning backwards in time using Figure 3, the nature of preemption becomes clear. Should an IOS introduction have occurred before $\hat{T}^B$, supplier B will certainly lead because for supplier B there is no better time to introduce first. Supplier A reasons identically about $\hat{T}^A$, so $\hat{T}^B$ will never be reached. For supplier B, leading is, however, a more profitable strategy than following or simultaneous introduction onwards from T_1^B. Similarly for supplier A from T_1^A. Thus, to avoid supplier B leading after T_1^B, supplier A must launch its IOS by T_1^B. That is, supplier A preempts supplier B's IOS introduction by leading just before it becomes profitable for supplier B to do so. This is the preemption outcome.

[6]Other assumptions required for the positioning and curvature of these functions are available in [Nault, 1991].

This result suggests that, rather than launching IOS at "optimal" times, IOS introductions are often forced to occur prematurely in order to preempt competition. Therefore, the competition to introduce IOS can reduce aggregate industry profits because neither supplier introduces at its optimal time.

When there are different generations of IOS, preemption remains a dominant strategy in the presence of new IOS launches. In fact, in a model with two generations of IOS, where IOS costs are falling over time and the costs of the second generation are substantially higher, preemption is also the dominant strategy for the introduction of the second generation ([Nault, 1991]). This, of course, raises the question of whether a single first move can provide a sustainable advantage. Again referring to this two generation model, there is no scenario where a single first move is sustainable. The supplier launching the first IOS must follow up with a second generation of IOS, improving on the first. Thus, in the face of competition, first mover advantage is not sustainable. In our three examples there is significant affirmation of this result.

- AHSC developed at least six versions of its IOS, Tel-American and ASAP through ASAP 5, which were released as improved systems over time. More recent development of ASAP Express as an industry platform continues this trend.
- Surprisingly, there has been little change to the Pacific Pride Cardlock system. The significant hardware upgrade allowed buyers to install a Cardlock machine at their own bulk fuel site, and integrated this proprietary site into the Cardlock network so that fuel reporting could combine the drawing of fuel at any Cardlock station as well as at the buyer's own site.
- McKesson's Economost has been continually upgraded, as evidenced by additional investment in technology and human resources over time in Economost development.

In addition, to better service hospital buying groups, McKesson has introduced a new hospital management system.

7 Guidelines for Senior Management

Because there are interrelated impacts from IOS on industrial markets, we have separated these impacts into individual effects in order to comprehend each more clearly. Only after each effect is understood can the combined impacts be evaluated.

To appreciate the recombining of these effects, we offer five guidelines for senior managers making decisions involving IOS:

1. *IOS changes the basic economics of the supplier-buyer relationship.*

   IOS changes both the value of what the supplier offers by increasing quality, and the cost of making that offering by reducing marginal, but increasing fixed, costs. As a result very different price-volume relationships emerge.

2. *The supplier should implicitly subsidize IOS adoption.*

   IOS involves building a long-term supplier-buyer relationship, and facilitating adoption is the key to IOS success. In most cases these extra costs are easily covered over the duration of the relationship. Implicit subsidies encourage personal contacts, helping to lock in the buyer. Replacing these contacts becomes a major cost when buyers switch to another supplier's IOS.

3. *The IOS supplier should recognize the meta-game: control of market entry and exit.*

Because of the change in marketed good value and marginal cost, the IOS can drive out the non-IOS-supported good. Moreover, the incumbent's low marginal costs and captive buyers is a credible threat against new entrants and substitutes.

4. *Suppliers must lead with IOS before it becomes profitable for competitors to do so.*

   To wait until the IOS becomes profitable for a competitor invites preemption or simultaneous and direct competition. Thus, a supplier is likely to have to launch its IOS earlier than it would otherwise like.

5. *Any IOS must be followed up with new generations of technology.*

   Except under cases of extreme switching costs, it is not possible to sustain an IOS advantage without staying ahead. In addition, staying ahead will require preemptive releases of new versions or generations of the IOS. This future history should be included in the IOS decisions.

8 Appendix: A Note on Methodology

In this chapter we have employed a relatively new research methodology: matching analytical economic models with rich case studies to provide evidence in support of the analytics. The methodology involves first formulating the analytical models, essentially selecting a set of assumptions, and deriving results using deductive mathematical methods. The results, therefore, depend on the assumptions selected and how they interact. This interaction makes clear the mechanisms which produce the analytical results. Determination of these mechanisms through logical analysis is the strength of analytical economic modelling.

The second step is to compare the analytical model assumptions, mechanisms, and results with evidence from multiple case studies. Because slight changes in assumptions or conditions can produce radically different results, the verification of analytical assumptions through to results is the advantage of using rich case study evidence. Using this methodology we can not only study model prediction, but we can qualitatively validate the *explanation* of the results provided by the analytical models. Employing the language of behavioral research, not only can we study inputs and outputs, but we can examine the how and why questions associated with the process.

9 Glossary

Adoption Costs: Costs incurred by buyers adopting an IOS.

Explicit Subsidy: A payment, or discount on a fixed quantity of the marketed good, made by a supplier to buyers to defray adoption or switching costs.

Fixed Fee: A fixed charge by a supplier to buyers for IOS access.

Implicit Subsidy: Effort (non-monetary) made by a supplier to help reduce or eliminate buyer adoption or switching costs.

Industrial Markets: markets in which both suppliers and buyers are firms.

Interorganizational Information Systems (IOS): systems based on information technology that cross organizational boundaries.

Marketed Good: The good underlying the IOS being sold by suppliers to buyers.

Preemption: The launching of an IOS by one supplier in order to launch before another supplier.

Strategic Necessity: When an IOS is necessary for a supplier to continue to compete.

Switching Costs: Costs incurred by buyers switching from one IOS to another.

Vertical Differentiation: Differentiation based on quality where all buyers recognize the higher quality.

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