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AN INTEGRATED FRAMEWORK FOR IT IMPACT ANALYSIS

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Abstract

This paper tries to analyze IT impacts on firm boundaries and their strategic implications. The existing literature has focused on application of transaction cost theory to analyze the IT impacts. These analyses have lead to some misleading conclusions and equivocal managerial implications. This paper first gives an overview of the literature and points out some weaknesses in the existing literature. Then the paper develops an integrated framework for firm boundary analysis using widely agreed-on research in industrial organization. By identifying the role of IT over such an integrated framework, we can get a more complete and dynamic picture of IT impacts on firm from several case studies. This paper contributes to the area of research in impacts and strategy of information technology. And there could be a series of research starting from here.

Introduction

The literature of IT impacts on firm boundaries mostly uses transaction cost economics as a reference theory (Bakos and Treacy 1986; Malone et al. 1987; Gurbaxani and Whang 1991; Clemons and Row 1992; Brynjofsson et al. 1994; Hitt 1999). Transaction cost theory states that an increase in transaction cost relative to management cost sufficiently leads to vertical integration, thus enlarging a firm boundary; a reduction in transaction will sufficiently lead to vertical disintegration, therefore reducing the firm's boundary. So relative increase in transaction cost is both necessary and sufficient for firm integration. The IT impacts literature then argues that IT leads to vertical disintegration because IT can reduce transaction costs. But Coase (2000) and Freeland (2000) point out that relative increase in transaction cost only leads to problematic situations where integration is one of the possible solutions. Relative change in transaction cost is neither a necessary nor a sufficient condition for firm integration. This paper further identifies some other evidence that shows some fatal errors in transaction cost theory advocated by Williamson (1985) and Klein et al. (1978). Considering Coase (2000) and Freeland (2000), this paper develops a new framework for IT impacts analysis, which treats transaction cost only as one of possible factors for firm integration or disintegration

Firm Boundary Research in Industrial Organization

Horizontal integration, scale expansion, vertical integration and diversification, all have effects on firm boundaries. Perry (1989) in his chapter "*Vertical Integration"* classifies three broad determinants of vertical integration. There are technological economies, transactional economies, and market imperfections. Market imperfections include imperfect competition with monopoly and monopsony, externalities, and information asymmetry. Since monopoly or monopsony is prohibited by regulations, this paper won't consider monopolistic situation.

Demsetz (1995) finds that informational advantage accruing to managed direction of activities may restrain the scope of vertical integration. Information advantage refers to the enhancement in team's productivity that results from reasonable labor division. But there is a cutoff point beyond which the great burden of acquiring and dealing with different types of knowledge would reduce competitive advantage of a firm.

Chandler (1977) and Porter (1985) suggest that it is often profitable for firms to keep an internal supply operation, which runs at full capacity, leaving outside suppliers to absorb fluctuations in demand. Carlton (1979) proposes a model where firms may integrate backward to reduce the total costs attributable to input demand fluctuations. Liberman (1991) empirically confirms Carlton's model that a firm is more likely to integrate when the other buyers of the input have high variability in demand, and that a firm accounting for a large fraction of total demand for the input is more likely to integrate.

Sutcliff and Zaheer (1998) classify uncertainty into three categories: primary uncertainty, competitive uncertainty, and supplier uncertainty. They define primary uncertainty as reflecting a lack of knowledge about the state of nature; competitive uncertainty is that associated with the actions of competitors; and supplier uncertainty is caused by *ex ante or ex post* behavioral opportunism. Sutcliff and Zaheer find that primary and competitive uncertainties are negatively related to vertical integration, but supplier uncertainty is positively related to vertical integration, a result that is not inconsistent with Williamson (1985). This paper treats primary and competitive uncertainty as likely factors leading to disintegration. Since supplier uncertainty is derived from behavioral opportunism discussed with transaction cost, it should not be repeated.

The factors this paper has discussed above include: technological economies or economies of continuity in operations; relative cost difference between market and firm mechanisms; externalities; information asymmetry; Demsetz's informational advantage from existing knowledge; variability in demand; primary and competitive uncertainties. Most of these factors are only very likely and often not sufficient for vertical integration.

In addition to vertical integration, diversification and horizontal expansion are other two concerns that will influence firm boundaries. When a firm has excess capacity, diversification is a natural choice. Horizontal expansion happens when a firm tries to merger another firm in the same industry, or increases its production size or service area. Horizontal expansion is usually a result from the concern of economies of scale in production and administration.

To understand the IT impacts on firm boundaries, we should try to include all these factors in the framework. And we should try to keep ourselves from confusing logics. As this paper discussed early, transaction cost explanation actually suffers a self-contradicting reasoning. Transaction cost theory tries not to use technologies and other traditional factors to explain the existence of a firm (Williamson and Winter 1991). But actually relative cost difference is influenced by many factors such as technological development and market demands. So we need a better understanding of the existence of a firm. This paper suggests here to add two necessary conditions for the existence of a firm.

> *Assumption 1: There are profit-seeking motivation and the existence of scarce resources that can provide competitive advantage and profit in short or long-run term (such scarce resources include proprietary information, specific knowledge from experience or unique history, technological resources, human resources, capital accumulation, and so on).*

These two conditions guide all activities of a firm in a long or short term period. If there were no profit-seeking motivation and scarce resources that can provide competitive advantage and profit, there wouldn't have been firms in the world. So it is imperative and in the very benefit of a firm to maintain, identify, and create new kinds of such scarce resources. This actually is the starting point of resource-capability view of the firm in the area of strategic management (Amit and Schoemaker 1993).

> *Assumption 2: The adoption of information technology is motivated by profit-seeking motivation and a pursuit for scare resources*.

And,

> *Assumption 3: the installation and use of information technology should have effects on: technological economies, transaction cost; economies of scale and scope; information asymmetry; informational advantage; externalities; variability in demand; primary and competitive uncertainty; diversification.*

The Integrated Model

IT and Technological Economies

Traditionally when people discuss technological economies, they refer to cost savings from efficient organization of a continuous production process. When the key processes to produce a final product are integrated within one company, consistent coordination and efficient organization can be realized to eliminate unnecessary or repetitive activities along the production line, under the

overall context of the applied technology. If several companies had controlled the processes in such a production line, there would be natural motivations to integrate the whole production line processes into one company.

The emergence of IT system is enlarging the content of technological economies. Today IT systems are widely applied in business administration such that not only production but also administration process can be technology-intensive. And there is an inclination in industries to integrate manufacturing systems with administration and decision support systems. So here this paper considers technological economies, not just for production organizing, but also for technology-intensive administration, and perhaps more importantly, for the whole business process where production and administration technologies are integrated within a seamless IT system network. Today IT systems cover almost all aspects of business processes and activities. Big companies have continuous pipelines for information flow from suppliers to buyers or consumers to ensure a quick response to market changes. At such a time we should try to understand system economies of IT network. Instead of using technological economies, this paper uses economies of IT system, or economies of system network. System economies can be understood at two levels.

The first level is economies of an individual system. Such economies come from system features for 1) time saving, 2) cost reducing, 3) accuracy enhancing, 4) system integrity, security, and continuity, 5) system adaptability, 6) programmed intelligence, and 7) scale and scope of activities a system covers or is applied to.

The second level is economies of a network of IT systems. There are so many systems that work simultaneously and complement each other. Economies of system network have become a dominant concern. The economies of system network are derived from 1) economies of individual systems included, 2) the efficiency of interfaces and middleware between systems. Here this paper assumes that systems included in the network are all compatible by adopting certain interfaces or middleware. If systems are not compatible at all, then there is no economy of system network. 3) The quality of personnel who work with these systems. The involved employees, end users, are actually dynamic knowledge systems because they accumulate skills and knowledge and respond to the changes using accumulated knowledge and experiences. End users are intelligent agent but may make mistakes. They are actually live interfaces between systems and, live interfaces between an IT system and the real world. The trained end users are the most determining factors to achieve the productivities of a system or a system network. 4) Scale and scope of activities a system network covers or is applied to. 5) Efficiency and effectiveness in system and end user management. 6) Security, safety, and continuity of a system network, more secure, safe, and continuous, more economical.

Traditional technological economies are activity-based according to mechanical or electro-mechanical engineering. What is concerned is eliminate unnecessary or repetitive activities and steps. Such concerns should still be taken care of. However economies of IT system network should consider all factors that influence system or network economies. Such a request implies that a company should have 1) efficient systems, 2) compatible systems, 3) uniformly trained end users, 4) elimination of unnecessary repetition of system functions or repetitive systems in system networks, 5) efficient interfaces between different business processes and divisions, and 6) security and safety and seamless continuity of data flow and proprietary information.

Economies of IT system require quality live interfaces and compatible dynamic knowledge systems—quality end users. If they are not compatible with systems, either systems should be improved or replaced, or people should be better trained or replaced. But detailed discussion of end user problems is out of the scope of the paper.

The security and safety of proprietary information flow is one of the leading and decisive concerns. Integrity and safety of the pipelines for proprietary information flow from one business process to another and from one division to another should be protected. This suggests that *Adoption of IT systems requires a strengthened integration of business processes and sectors that produce and accept proprietary information within a company*. This is not just for cost saving, but also for survival and competitive advantage of a company.

So economies of IT systems need, and actually strengthen the need of, unbreakable integration of critical business processes and sectors within an existing firm. Economies of a system network over a supply chain will ask all participants in the supply chain to coordinate their related systems together. Incompatible systems and failure in maintaining system consistency and integrity will increase overall coordination cost of the supply chain and harm the competitive advantage of the final buyer.

IT and Economies of Scale and Scope

Once a system is running, economies of scale and scope in system use and in other aspects are concerns. Generally economies of scale and scope in system use are a reflection of economies of scale and scope in production and administrations. Given a level

of economies of scope, we want to see volume increase in each area of the scope, that is, to reach and exploit economies of scale in each business area whenever possible. Given a structure of existing scope of businesses and certain level of scale economics, systems should be flexible and adaptive enough to meet information processing requirements for expanded or switched business at a low cost.

It is in the benefit of a firm to increase the scale of activities a system covers and has a flexible system such that switching cost is lower. It is troublesome for a firm to see a decrease in business volumes after a system is set up. From this viewpoint, a firm has no incentive to limit or reduce its boundaries when such a range of firm boundaries is in the economies of scale and scope and profitable. Design of IT systems is not intended to reduce or limit the firm boundaries anyhow. Currently we have no cases showing that IT systems will make a firm smaller or to divest anything from its own. As Economic Report of the President in 1985 summarizes:

> Divestures often occur when firms undo prior acquisitions that did not work out as planned, or when firms decide to raise cash to reduce debt generated by earlier acquisition programs, or to invest in new projects. In addition, many divestures are currently designed to focus the parent corporation's operation in their most profitable lines of business. (Sources: 1985 Economic Report of the President together with the Annual Report of the Council of Economic Advisors, reloaded from Carney 2000, P. 7)

Divesture by a firm must be caused by some reasons not related to IT adoption in coordination. In the past decade, GM has divested Electronic Data System (EDS), and Delphi Automotive System. FCC and DOJ are scrutinizing its splitting off Hughes Electronics. Though GM has probably the most sophisticated IT systems in the world for all aspects of its business processes and activities, these divestitures are obviously motivated for GM 1) to focus on its core business: vehicle assembling and related core capabilities; 2) to establish a lean supply system when it is facing more challenge from lean competitors such as Toyota, DamlerChrysler and Reynolds-Nissan, and its US market share is continuously declining to 28% in 2000 from 35% in 1991 (GM annual reports, 1991-2001); 3) to find competitive suppliers for newly identified core components when functions of core components are more and more determined by their embedded micro-IT systems (Delphi Annual Reports, 1999).

IT and Externalities

There are three kinds of externalities: external economy, external diseconomy, and pecuniary externalities (Worcester 1969; Liebowitz and Margolis 1994). For any two company A and B without ownership in each other, external economy usually refers to a situation where A's activities benefit B. External diseconomy refers to the opposite situation where A's activities harm B's benefit. Pecuniary externalities refer to a situation where, consumers are final beneficiary when the competitors in an industry do the same thing to compete against each other. this paper will discuss pecuniary externalities in section of IT and informational advantage.

Usually integration is one of possible solutions to external diseconomies (see any advanced microeconomics textbook). Though external diseconomies do not necessarily lead to integration, integration may be suggested to reduce the loss or cost caused by external diseconomies. On the other hand, external economies provide incentives for a firm to keep as an independent one and to expand its scale in its business sectors, and may create simple or natural monopoly (Worcester 1969).

But how IT will affect externalities in non-IT industries depends on whether IT may bring about cost reduction in common business practices or processes and, whether IT will generate any incentive or pressure for standardization in those industries (Worcester 1969; Katz and Shapiro 1994; Benson and Farrell 1994). The results vary with respect to natures, stages and structures of different industries.

In early of 20th century, the use of telephone and telegraph dramatically reduce the communication cost, and therefore transaction cost. Chandler (1962, 1977) shows that how reduction in communication cost, combined with technological development in transportation and mass production, enabled a firm to expand across the nation; how business cycles pushed a firm to diversify using excessive capacities; how scale expansions push firms to integrate backward and forward to ensure smooth coordination and sufficient supplies; and how expansions in scale and scope forced a firm to invent new organizational structure in order to coordinate their business more efficiently.

Inter-bank clearance system was first improved by telecommunication network, and later by electronic system. A quick clearance system provided firms with reduced time for money on the way, quicker cash flow from accounts receivable, and therefore

reduced cost for current assets, and less friction in payment between buyers and sellers. Hence a quick clearance system built over telecommunication network also reduced coordination cost for business transactions. Cash cycle time is dramatically reduced.

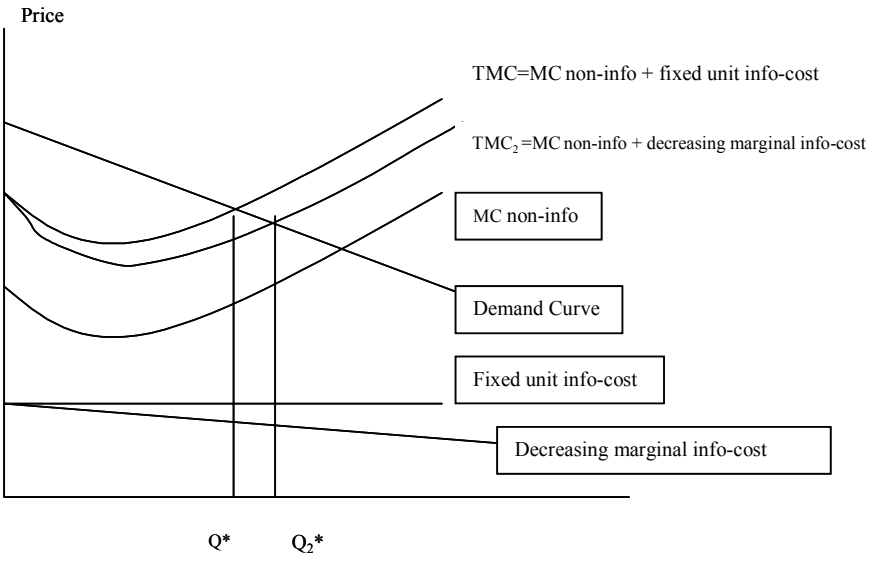
Transportation highway system, telecommunication network, inter-bank clearance system, all create external economies to firms and cultivate an environment for firms to grow in size.

In late decades of 19th century, catalog retailing developed via postal service. Retailers sent their catalogs to consumers. Order, delivery, and payment were completed via mail (Chandler 1962). When phone, telegraph, and transportation vehicles were available, transaction time is reduced. When electronic clearance system and credit card were invented, so-called virtual market emerged with catalog delivered via mail. But virtual market perhaps is not an appropriate term because both buyers and sellers are in the real world. When PC and Internet are available, catalogs can be retrieved online. The big difference is that more information can be provided to consumers or buyers in a customized way at a relatively lower cost.

EDI has been used in industries since 1970s and is a basic infrastructure for communication and coordination pipelines between buyers and suppliers. Most users have reported cost savings through EDI (Cooper and Slagmulder 1999).

From telephone, telegraph, fax, and electronic clearance system to EDI and Internet, since the last several decades of 19th century, Innovations in transportation, communication and computing technologies have brought continuous cost reduction in communication and coordination for business transaction. But no case studies have shown that cost reduction in information processing, delivery and communication may reduce the firm boundaries.

Instead reduction in cost of information processing, delivery and communication provides incentives for firms to expand their scales in their given scopes of business. *Ceteris paribus*, at a given level of output, reduction in marginal cost for information processing, delivery and communication will reduce the total marginal cost for additional unit of the output, and thus the quantity of the output can be increased for more profits until the marginal cost increase in other activities offset the marginal cost reduction in information processing, delivery and communication. That is, the optimal amount of the output will be enlarged when there is a continuous reduction in marginal cost of information processing, delivery and communication. See figure-1.



MC means marginal cost. Info-cost is cost for information processing, delivery, and communication. Non-info refers the cost excluding info-cost. TMC equals to fixed unit info-cost plus MC for non-info. When there is a decreasing marginal info-cost, TMC move downward to TMC_2. As a result, optimal quantity moves from Q* to Q_2*.

Figure 1. Decreasing marginal info-cost expands optimal quantity

Standardization is a complex problem for which IT system and any component of IT can have no effects. Take a look at the auto industry. That industry has developed for more than 100 years. There were many consolidations in early decades of 20th century. But today GM, Ford, and DamlerChrysler all maintain their own part series. Only a very limited number of parts are interchangeable among thousands of auto parts. All makers have their own supply chains to meet their demands. The point is that these companies, like those in any other industries, have to decide a strategic balance between final product differentiation and parts or input standardization. Such a strategic balance is maintained by a firm's leadership and varies with respect to natures, stages, and structures of different industries where a firm is located. The more standardized parts, the more chances for suppliers to produce parts in a larger scale, and so lower average costs for final buyers. But the more standardized parts, the fewer differentials of final products, and so less competitive advantage from differentiation.

IT and Information Asymmetry

Information asymmetry is a result of knowledge specialization and different business focusing, and is a source of price discrimination and competitive advantage. So information asymmetry, especially which created by protection of proprietary information, is not a problem that IT is able to solve or reduce. IT systems themselves don't have any inherent natures to reduce information asymmetry though they can be designed to provide a platform for possible information sharing. In addition, any information sharing needs negotiation and contracting between involved parties.

In supply chain management, in order to lower inventory level, to optimize production scheduling, and to coordinate concurrent engineering design for some components, some level of non-proprietary information sharing is negotiated, contracted, programmed, and implemented. But such sharing is not supposed to affect competitive advantage that the buyer holds over its suppliers and competitors. The Buyer is careful that any non-proprietary information sharing with its suppliers won't nurture the suppliers to be its potential competitors and, won't be used by its competitors to erode its market share (Cooper and Slagmulder 1999).

Though vertical coordination or control can be influenced by IT systems, the ownership structure or vertical integration extent in a supply chain is not decided by information technologies or information sharing, but by the changing definition and identification of core capabilities, the profitability of capabilities and related scarce resources, differentiation strategies the buyer firm follows and, the buyer firm's history and culture (Cooper and Slagmulder 1999). The pipelines for proprietary information flow should be integrated and protected. Profitable scarce resources should be maintained, improved and invented continuously. Higher reliance on differentiation strategies requires stricter vertical control over and higher integration of the supply chain.

On the other hand, information asymmetry may be enlarged because of different focuses in knowledge specialization and differentials in information processing capabilities. Such a situation is more probable when competition becomes intense and thus both sides have to focus on more profitable lines of their business. The best example comes from IT service. The rapid change in IT and inconsistent standards make most non-IT companies hard to supply IT service by themselves. Though these companies have their own IT departments, it's easier and cheap to outsource their IT service to professional IT service companies such as IBM, EDS, HP, Accenture, and so on. These professional IT service giants can provide a series of IT service in a department store-like style. Meanwhile non-IT companies can focus on their own lines of business and keep control over their proprietary information and develop unique systems as their proprietary systems. IT outsourcing business reached 317.2 billion in 2000 according to IBM and will be increasing in the future.

While information asymmetry strengthens the interdependence between different industries, asymmetry also creates complementarities between businesses. If such complementarities may become strategic advantage, then consolidation may happen between the complementary businesses, like what we can see in the consolidation in the telecommunication industry and in the merge between AOL and Time-Warner (AOL SEC filing—Form 425, 02/25/2000).

So IT systems may push firms to expand not by helping share non-proprietary information between firms, but by strengthening asymmetry and creating strategic complementarities.

IT and Informational Advantage

Demsetz (1995) derives concepts of vertical restraint and informational advantage from his analysis of team productivity. In his viewpoint, specialized knowledge acquisition and, stability and association of team members provide good team productivity.

But if the scope of activities of team members increases, then diversification of members' time and effort increase difficulty in coordination, and results in less specialization. So there is a cutoff point where vertical integration should stop for a firm to keep competitive forces.

IT systems have been developed to increase team productivity. IT systems, like knowledge management systems, expert information systems, data warehousing and data mining, Robots, and a variety of groupware, can lift up such restraint by overcoming the limits bounded rationality and old technologies have put. IT systems can reduce and automate repetitive and secretary-like work, and reduce time in information searching, copying, collecting, and formatting, and enable team members to focus on critical and inventive activities.

But advantage is a relative concept, not an absolute one. A firm's competitive advantage depends on differentials between what it has and what its competitors have, not just what it has. Widespread availability of general IT systems means increased productivity from IT systems may just be a temporary advantage or even just a defensive strategy from being defeated (Pennings 1998). To be competitive, a firm may still need to be quite specialized in profitable business sectors and dynamically improve its systems.

That is, while IT systems may increase productivity, competitor's actions will still put a restraint over the vertical scope of integration. Whether such a vertical restraint may be lifted up is not decided by the firms themselves, but by the competitors' actions. From this viewpoint, general IT systems won't be a source of sustainable competitive advantage. They are just some systems for defensive strategies. Sophisticated proprietary IT systems may provide sustainable competitive advantages. Wal-Mart's experience can shed lights on these points.

Wal-Mart is the leader in IT adoption in retailing industry. Wal-Mart is especially famous for its data warehousing system. The big difference of Wal-Mart from its competitors, as Westerman (2001) emphasizes again and again in its book, "Data Warehouse using Wal-Mart model", is that Wal-Mart never stop learning and experimenting with new ideas. Wal-Mart may not be the first mover, but it tries hard to be the leader. Wal-Mart was one of the first to use POS system from IBM in 1973, and one of the first to install cross-docking conveyor system to distribute merchandise from suppliers' trucks to its own trucks in its Distribution Center. In 1980s, Wal-Mart subsequently installed EDI to connect with its suppliers, Collect System to faster gather customer data with POS, CAD/CAM for store layout design, Data Warehouse for decision support, and Retail Link system with its suppliers. At that time, other big retailers also installed similar systems. Small retailers never have big enough scale to justify the expense for building such systems by their own. Small retailers had to pool their money together to build some of similar systems or to be affiliated with a bigger retailer (Levy 2001). But as Westerman (2001) says, when competitors had similar systems, Wal-Mart had begun to prototype new systems and improve the existing systems to build stronger functions. Meanwhile, Wal-Mart IT department tries to create some proprietary characteristics in their systems. Wal-Mart IT department says that they have written millions of lines of private codes by their own (Wal-Mart annual report 1998).

IT and Variability in Demand

Variability in demand may motivate a firm to integrate backward as argued by Chandler (1977), Porter (1985) and Carlton (1979), and empirically confirmed by Liberman (1991). So it has been an interesting problem whether IT systems such as EDI, Supply Chain Management System, Quick Response, and Customer Relationship Management Systems, can reduce variability.

Evidence has shown that EDI, Supply Chain Management System, and Quick Response can reduce variability in inventory by enabling simultaneous sharing of sales data, reducing replenishment time, and increasing replenishment frequency (Levy 2001; Cooper and Slagmulder 1999; Varley and Gillooley 2001; Lowson et al. 1999). Such IT systems enable a firm to better understand customer by using customer relationship management system and customer databases, more accurately predicting market trends by sharing sale data, and quickly adjusting to the changes. That is, these IT systems can not control or reduce variability in demand, but have developed functions to better adapt to the changes and thus reduce risks and costs to a firm or the whole supply chain. Since the main reason for firms to integrate backward facing input demand variability is the total cost attributable to high inventory and price markup during peak demand period as suggested by Carlton (1979), supply chain management system and other similar systems apparently would reduce such motivations. Whether such IT systems will eliminate such motivations is a question to be investigated and may vary with respect to different firm and industrial situations.

Whether such IT systems will motivate an existing firm to divest its internal input suppliers, however, is another different problem, and depends on many other factors that have been discussed in the above sections.

IT and Uncertainties

The adoption of IT systems bring about timesaving in almost all the processes and activities where IT systems are applied, thus having accelerated operational rhythm. As a result, product life cycle is reduced, and decision-making cycle is shortened (Hp case studies, 2001). While IT systems reduce cycle time in major business processes and activities, and strengthen information asymmetry, primary uncertainty increases. Xerox, who has pioneered in many innovations and applications of IT, has found that its markets eroded and replaced by digital chips, CDs and disks, and is in trouble (Cnnfn.com, 12/05/2000).

Competitive uncertainty also increases when most competitors act in the same way, and also very quickly respond to the market changes. Widespread mimicking in IT system building removes advantage very fast (Pennings 1998), and in the same time rapidly changing IT drives companies to follow. Often a system is not appropriate when it is just installed. IT system building has been a tiring processes to take and most companies have outsourced their general IT service business.

While increased primary uncertainty may make firms to make more outsourcing decisions, increased competitive uncertainty seems to have pushed merge waves in telecommunication, banking, media, and healthcare industries in the last decade as companies tries to reduce excessive competition, eliminate unnecessary repetitive investment in IT, and maximize the economies of scale and scope in IT system use (Caroll 2001; Karpoff and Wessels 2001; Shull and Hanweck 2001).

Transaction Cost Economics

As Coase (2000) himself says, relative cost difference between internal and external mechanisms only leads to some problematic situations where vertical integration is only one of the possible solutions. One point to emphasize here is that relative cost difference between buying and making perhaps is not constant; it may change when market demands fluctuate. It may also change with the development of new related technologies. More importantly, it may change with some mutual interactions. When mutual knowing and trust increase between the two parties, both sides may do something beneficial to maintaining the long-term relationship for the two sides. Thus the supplier may reduce its price for this firm. It is not surprising that both sides may reach a price and quality agreement through which the firm is indifferent between buying and making. With so many other factors that may influence the relative cost difference. It's hard to tell whether the relative cost difference may change in one unique direction (sometimes buying cost is higher than making cost; and sometimes buying is cheaper than making). It's also hard for managers to think of their strategic decisions of vertical integration just based on this relative cost difference. Coase (2000) also states that the effect of asset specificity and opportunism has been exaggerated and such exaggeration is misleading.

In real decision-making environment, managers would have no awareness of such cost difference. Though accounting system and regulation have been developed to eliminate opportunism, accounting does not differentiate what is internal coordination cost and what is external coordination cost (transaction cost). Actually it's very difficult to do so. No one in a GM parts purchasing department can tell that how much of their budget is spent for internal coordination, how much is for external coordination, and how much they get from headquarters' supporting. The Retail Link software was freely given to and installed for Wal-Mart's suppliers. Because both sides have the common information, negotiation time and lead time (time difference between order and receipt) is dramatically reduced. Can anyone tell how much cost reduction is on the side of internal coordination and how much cost saving is on the side of external coordination side? No. Nobody can.

Furthermore, there are other strategic concerns that influence firm boundaries, such as quick response or consistent coordination (Casadesus-Masanell and Spulber 2000; Lowson et al. 1999), more market share, more revenue or more stock turns, and development of future core capabilities and business (Amit and Shoemaker 1993). In some situations, one or more of these strategic concerns will be overwhelmingly more important than any other concerns and thus dictate the structure and boundaries of a firm to implement such strategies in a certain period of time. Wal-Mart presents a case where a company's service can be provided by both its internal and external suppliers.

Wal-Mart has its own real estate company in charge of its store building, but it outsources more than 50% of store building business to outside real estate companies; and a large number of its stores are leased from outside real estate companies. Wal-Mart has its own truck teams around its distribution centers. Wal-Mart thinks this truck team is essential to its smooth and quick response to market change. At the same time, Wal-Mart leases trucks from outside carriers. Wal-Mart sells a large quantity of national brand name merchandise, but now it also sells a rich series of its own store brand products. Wal-Mart thinks that such a mixing way is effective in cost saving and control and very important for its every day low price strategy (Wal-Mart annual reports, 1972-2001).

Due to the considerations above, this paper thinks it's not appropriate to use transaction cost economics to analyze IT impacts on organizations. Though IT can dramatically reduce or control costs in coordination, IT can also serve to realize other strategic concerns. In many situations, such other strategic concerns have more strong impacts on firm organization. Transaction cost analysis may be theoretically appropriate when the tradeoff of such cost difference is overwhelmingly important, and expected relative cost difference between make or buy is much bigger than expected profit increase that can be realized by prioritizing other strategic concerns.

Some empirical research in the past confirms that asset specificity is positively related to the extent of vertical integration of a firm (Shelanski and Klein 1995). This research should point out here that asset specificity is often highly correlated with the competitive advantage the asset can provide. As a firm, you have to do something by yourself that tell markets you are different and tell investors that you can make profits. So a highly specific asset is often owned by a firm in its initiation or developed later by the firm itself. Though a firm can also buy such highly dedicated asset, nevertheless an empirical test to find relationship between asset specificity and vertical integration extent is certainly positively biased.

IT and Diversification

Diversification is a choice when excessive resources are available or when one company wants to look for new growth point in new industries. While IT may create new business windows and reduce coordination cost for diversification, a more competitive environment induced by the wide adoption of IT will limit the scope of diversification as discussed in the section about informational advantage. To this point, how IT will influence diversification will vary with respect to a firm's own characteristics and the industry where the firm is engaged.

In general IT effects over firm boundaries could be summarized as in Chart 1.

Conclusions

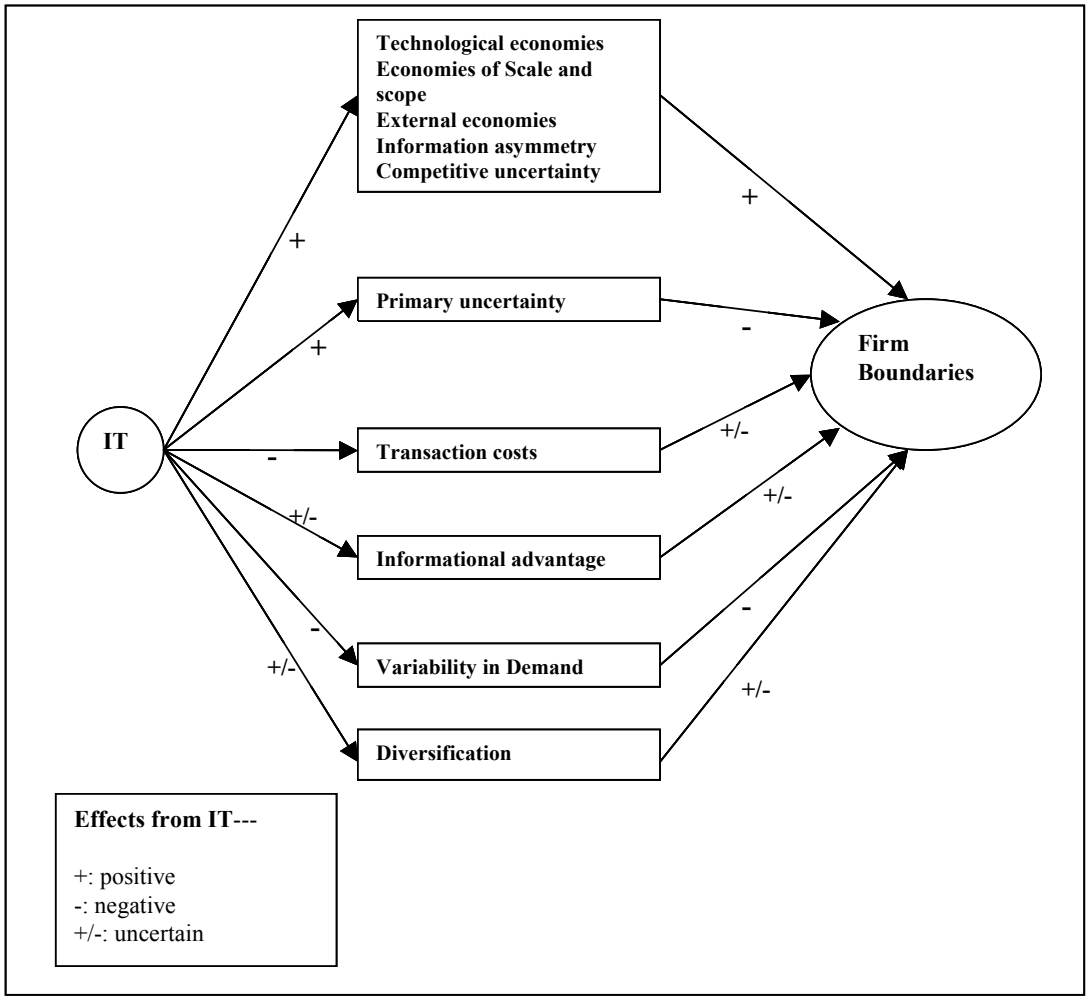
In the sections above, this paper has discussed IT impacts from many perspectives according to the model. **T**hey are summarized these discussions as below:

1) System economies can be understood at two levels: economies of an individual system and economies of a network of IT systems. Integrity and safety of the pipelines for proprietary information suggests that Adoption of IT systems requires a strengthened integration of business processes and sectors that produce and accept proprietary information within a company. Economies of scale and scope in system use means that system building should also be justified by a firm's business scale and scope. Small business won't provide enough resources to build a system and exploit economies of scale in system use. Though IT systems may reduce costs, economies of scale and scope in system use should motivate a firm to remain big to reduce costs associated with system use.

2) External economies provide incentives for a firm to keep as an independent one and to expand its scale in its existing business sectors, and may create simple or natural monopoly. External diseconomies may motivate a firm to internalize some outside business processes. But how IT will affect externalities in non-IT industries depends on whether IT may bring about cost reduction in common business practices or processes and, whether IT will generate any incentive or pressure for standardization in those industries. The results vary with respect to natures, stages and structures of different industries. Innovations in transportation, communication and computing technologies have brought continuous cost reduction in communication and coordination for business transaction. Such external economies provide incentives for firms to grow in size by enabling a decreasing marginal cost curve in information processing, delivery and communication. But Standardization is a complex problem for which IT system and any component of IT can have no effects because all firms have to decide a strategic balance between differentiation and standardization.

3) Information asymmetry is a result of knowledge specialization and different business focusing, and is a source of price discrimination and competitive advantage. While information asymmetry may be enlarged because of different focuses in knowledge specialization and differentials in information processing capabilities, adoption of IT systems may also create strategic complementarities, which may provide motivations to consolidate complementary businesses.

Chart 1: Extended Model for IT Impact



4) Informational advantage brought by IT systems is a relative concept, not an absolute one. A firm's competitive advantage depends on differentials between what it has and what its competitors have, not just what it has. Widespread availability of general IT systems won't provide unique and sustainable advantage. As Wal-Mart shows us, sustainable competitive advantage does not come from a once system but from continuously learning and dynamically improving one's systems.

5) By providing functions to better and fast adapt to market changes, IT systems such as Quick Response can reduce motivation for backward integration. But whether such IT systems will motivate an existing firm to divest its internal input suppliers is another different problem.

6) Reduced cycle time in business and market patterns has increased primary uncertainty. Wide mimicking among competitors in IT adoption reduces duration and effectiveness of competitive advantage associated IT capability and make competition in many industries hot white. Sustainable advantage perhaps is just a continuum of many temporal advantages that are maintained through continuous learning and improvement. While increased primary uncertainty may make firms to make more outsourcing decisions, increased competitive uncertainty seems to have pushed merge waves in the last decade as companies tries to reduce excessive competition, eliminate unnecessary repetitive investment in IT, and maximize the economies of scale and scope in IT system use.

7) How IT will influence diversification will vary with respect to a firm's own characteristics and the industry where the firm is engaged.

8) It's not appropriate to use transaction cost economics to analyze IT impacts on organizations. Though IT can reduce or control costs in coordination, IT can also serve to realize other strategic concerns. In many situations, such other strategic concerns have more strong impacts on firm organization. Transaction cost analysis may be appropriate when (1) such cost concern is overwhelmingly important; and (2) expected relative cost difference between make or buy is much bigger than expected profit increase that can be realized by prioritizing other strategic concerns.

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