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以交易成本分析單邊投資決策：以液晶顯示器及工業電腦代工廠商為例

Analyzing Unilateral Investments made by OEM for key accounts:

Transaction Cost Approach



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Thesis Abstract

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Analyzing Unilateral Investments made by OEM for key accounts: Transaction Cost Approach

This paper discusses the features of transaction cost economics (TCE): asset specificity, governance mechanism, prior ties; and to consider resource-based view theory together, how OEM suppliers in LCD monitor and Industrial PC (IPC) industries deal with their customers in accordance with transaction cost theory. OEM suppliers have some key activities in the product or project development schedule. The features of TCE will impact the managers to make decisions on the necessity of unilateral investments without the commitments from the customers; and how much to invest in these key activities to secure current business and to expand the business scale.

The findings state OEM suppliers in IPC industry implicitly follow TCE on investments in accordance with customers' requests. In LCD monitor assembly industry, due to limited supplier selection and less product design deviation, OEM suppliers could be willing to offer unilateral investments upon the business consideration.

Keywords: transaction cost economics (TCE), OEM, unilateral investments, LCD monitor, Industrial PC, IPC

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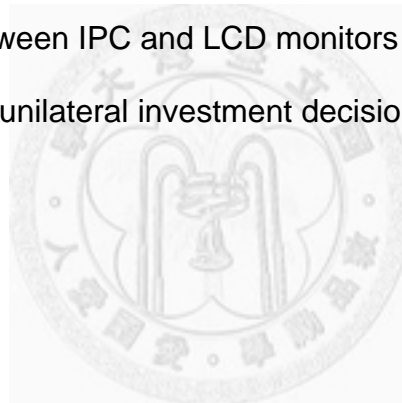
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Chapter 1 、 Introduction

1. Research Background

Transaction cost theory has long suggested that OEM suppliers seek to minimize costs through internalization or external alliance with regard to the asymmetry of information and decision making process. Nowadays the impact of information asymmetry is getting lower and business models are more mature. The aim of this paper is to understand if OEM suppliers still follow conventional transaction cost theory to conduct their business models, or have improved their business process methodology to fit into modern business modes. Example questions for discussion include whether the number of competitors impacts strategic decisions; or the complexity of products leads suppliers to follow different resource planning logic; furthermore, whether the length of learning curve influences short-term and long-term strategies for developing or enhancing relationships with customers.

To adapt to the fast-moving industrial environment, international brands in many industries, especially in the PC/NB/LCD monitor (LCDM) industries (including the likes of Dell, HP, Lenovo, acer) adopt strategic outsourcing policies to increase their operational flexibility. Taiwanese OEM suppliers, in particular, are investing specific resources to pursue business growth and promote product excellence. These investment activities are referred to as “unilateral investments”, and cover tooling, testing equipment, dedicated technical development teams, which may not

be specifically requested by the customers. In conventional transaction cost theory, such investments, which are defined closely as sunk costs, will improve the transaction efficiency between customers and suppliers, but the value of these investments will decrease if the relationship with a specific customer is terminated. Though these investments can be transferred to other customers, there must be extra costs occurred since customers require specific modifications. This is the way that OEM suppliers deal with one specific customer. When extending the scope to a wider base of customers, similar business terms and conditions are used, but with certain customizations. For instance, using the same database but changing some columns into different formats on reports for shipping information and stock status. This paper also analyzes whether the OEM suppliers retain same concept as when serving an individual customer, or adopts a new process to deal with a whole group of customers.

Table 1. Features of Multiple and Single sourcing strategies

	Multiple sourcing	Single sourcing
Features	<ul style="list-style-type: none"> ● Competition-cost benefit ● Assured supply ● Market intelligence ● Supplier Appraisal 	<ul style="list-style-type: none"> ● For bulk material, large quantities will gain lower costs ● Closer cooperation & communication between supplier and buyer

LCD monitors are the common products bundled with desktop and laptop computers that people are using in daily life. The exploded view of the typical LCD monitor is shown as Figure1.

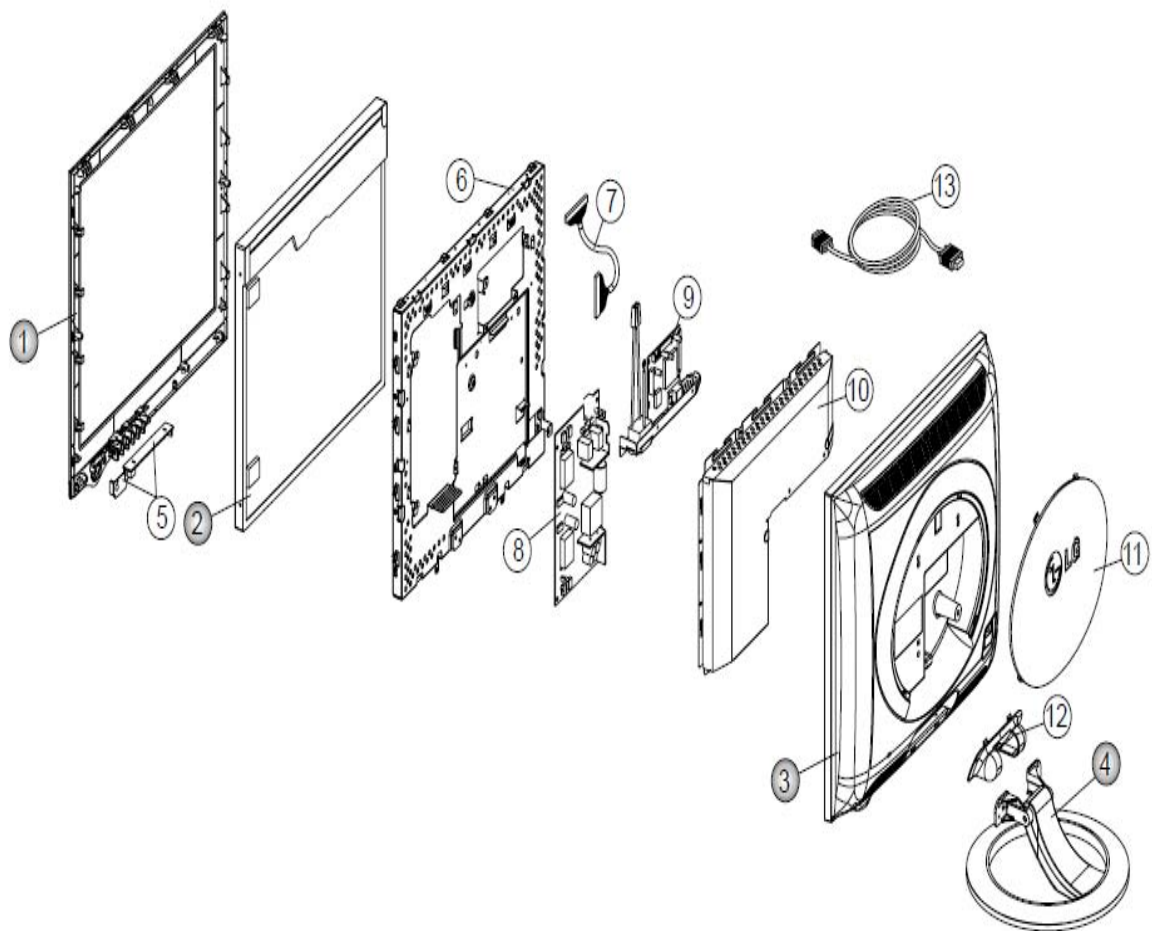


Figure 1. LCD monitor exploded view

And the parts list is shown as Table 2 below.

Table 2. LCD monitor major parts list

1	Cabinet assembly	8	PWB(PCB) assembly, power
2	LCD (Liquid Crystal Display)	9	PWB(PCB) assembly, main
3	Back cover assembly	10	Metal assembly, rear
4	Tilt swivel assembly	11	Cover, back cap
5	PWB(PCB) assembly, sub, control	12	Cover, hinge cap
6	Metal assembly frame	13	Cable, D-sub
7	Connector assembly 30P		

In practice, items 1, 2, 3, 4, 6, 10, 11 and 12 are called “mechanical parts”: items 1, 2, 3, 4, 11 and 12 are made from plastic injection; items 6 and 10 are made from metal stamping (either aluminum or steel). Items 5, 7, 8, 9 are called “electrical parts”. Ideally OEM suppliers want to have all of the customers use the same toolings as items 3 to 12. It means no matter which customer has business with this OEM supplier, the only unique parts need to be created will be items 1 and 2. If unilateral investments are necessary, the amounts of the investments could be limited and easily estimated.

IPC products are not as common as LCD monitors; include SBCs (Single Board Computers), EBCs (Embedded Board Computers), backplanes, industrial chassis, panel PCs, industrial control cards and workstations. Of these, EBCs and panel PCs are the most commonly applied and can be used in variety of applications and environments.




SBC	EBC	Industrial chassis
		

Figure 2. Types of IPC products

IPC is a highly customized product with a diverse range of features, and normally produced in limited quantities, in comparison sharply with mass-produced consumer PCs. IPC also have to accommodate harsh environments. With diverse features and limited quantities, it normally takes longer time to develop new products based on the needs from different clients, and the product verification periods could span up to six months. However, if a product is accepted then introduced into a client's supply chain, standard shipments can sustain to two years or more. In this case even this is a next-generation product, clients would sometimes consider the original suppliers first. It is not appropriate to state that IPC clients are less sensitive to pricing and margins, but to have a long-term stable product supply and consistent standard quality level are the crucial two things to be secured.

To explain the complexity of IPC product design, another exploded schematic diagram for a typical rackmount IPC product and major parts list are shown below.

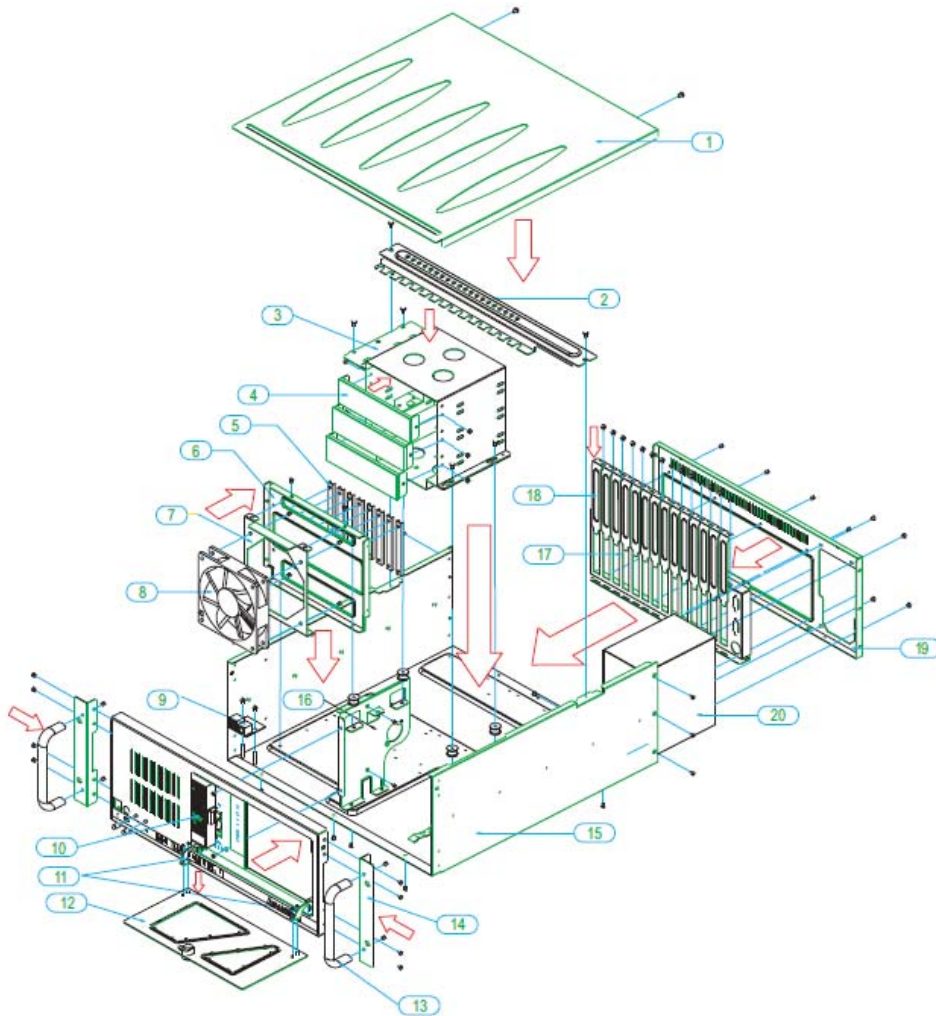


Figure 3. Rackmount IPC exploded view

From this example, all of the items including electrical parts like fan, hard drive, CD-ROM and mechanical parts like hinge, handle, and bracket chassis are exactly the standard components to be sourced on the market. It looks simple to compose them into finished goods. The detailed parts list is listed below.

Table 3. Rackmount IPC major parts list

1	Top cover	11	Hinge
2	Hold down clamp	12	Front door
3	Drive bay	13	Rackmount ear
4	5.25" CD-ROM cover	14	Handles
5	Card guide	15	Body of chassis
6	Card guide bracket	16	Disk mounting bracket
7	Fan bracket	17	I/O bracket
8	120 mm fan set	18	Adapter bracket
9	USB & PS/2	19	Rear window bracket
10	Filter cover	20	Power supply

The complexity comes from the combination of parts. For example, this combination is available for customers A and B, but customer C wants to have another body of chassis (item 15 in Table3) and some additional parts to use in a bigger machine and the total demand for the new chassis body is only 3000 pieces. If this supplier never has this new chassis, nor other current customers are willing to share this new tooling costs, the managers are in a dilemma to invest this new mechanical design or not.

I have chosen to analyze the LCDM and IPC industries because Taiwanese OEM suppliers in these two industries play crucial roles in the entire supply chain respectively. According to the MIC 2009 ICT yearbook, 69.1% of global LCDM shipments (or nearly 110 million sets) were produced by Taiwanese OEM suppliers in 2008. In comparison, although many IPC companies exist in their niche markets, Taiwanese OEM suppliers occupied over 15% of overall global market

share.

In the description of customers and suppliers history and decision-making activities in the previous section, the feature that the use of assets or investments can be transferred from first one customer to other customers is called “Asset specificity” in transaction cost theory. “Governance mechanism” means the commitments, usually presented in formal contracts, binding the rights and liabilities between customers and suppliers, and impacts the decision-making process and consideration that OEM suppliers’ management team keeps. All of the changes in the product design-production process are concluded as “Resource-based view”. The relationship between customers and OEM suppliers and transaction frequency are represented in term of “prior ties”.

2. Research Objectives

In traditional transaction cost theory, suppliers react passively to the customers’ demands. However, some suppliers show a willingness to invest in advance of the actual opportunities arising. I will review and confirm whether Taiwanese OEMs in these industries still largely follow traditional transaction cost theory; or whether indeed OEM suppliers make adjustments to adapt to this fast-moving business environment. The study will focus on the following aspects:

i. Asset specificity:

To serve a single customer - for a single transaction completion - may require a number of specific resources. However, in the case of single customer but with

repeated transactions, or for a set of customers each requiring one single transaction, will specific resources still be required for each single customer? For example, some equipment is currently specific to individual customers.

What is the effect if the numbers of customers and suppliers are fixed?

ii. Governance mechanism:

Customers are rarely willing to agree to be bound by long-term commitments (or even contracts) with their suppliers.

To counter this, will suppliers proactively initiate certain actions, even though the governance mechanism does not exist?

iii. Resource-based view:

Materials preparation has an impact on costs and efficiency, which may directly impact customers' benefits. To narrow down the impact, suppliers prefer having commitments from their customers. It is very common that customers require OEM suppliers to carry inventories on long lead time materials; and those parts are usually expensive. How do suppliers decide whether to take their own risks of preparing these parts requested by their customers?

iv. Prior ties:

The decision can be made based on close business relationship; and imply the potential further business opportunities in the future. Suppliers will also consider this factor (the attitudes or intentions of their customers) to decide whether they should proceed with specific asset investments without agreed commitment.

The concept of prior ties explains the willingness of OEM suppliers to consider unilateral investments. The governance mechanism and resource-based views are the business processes by which OEM suppliers adjust their specific assets through further investment. OEM suppliers will assess these 4 key factors to decide: (1) the necessity of unilateral investments, and if the answer is true, (2) the level of unilateral investments.

3. Scope of Research

This study aims to analyze how Taiwanese OEM suppliers in the LCDM and IPC industries respond to requests from their customers in relation to four key factors: prior ties, asset specificity, governance mechanism and resource-based view. The paper includes interviews with, and analysis of Taiwan's four largest LCD monitor OEM suppliers and four typical IPC suppliers, to answer the question of whether their business behavior follows traditional transaction cost theory.

In general, there are seven main activities for products or projects development process in LCDM and IPC industries: mechanical design, key electrical components design, testing, production scheduling, quality assurance, management information system (MIS), and account team support. These activities could be linked to the four factors in the traditional transaction cost theory as followed in table 4:

Table 4. Relations between transaction cost theory factors and main OEM activities

Relevant factors in transaction cost theory	Main OEM activities
Asset specificity	Mechanical design
	Testing
	Account team support
Governance mechanism	Mechanical design
	Key electrical components design
	Quality assurance
	MIS
Resource-based view	Mechanical design
	Key electrical components design
	Production scheduling
	Testing
	MIS
Prior ties	Mechanical design
	Key electrical components design
	Production scheduling
	MIS
	Account team

Chapter 2 · Literature Review

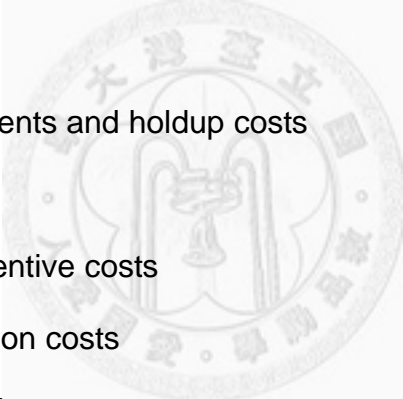
1. Transaction cost theory

In “the Nature of the Firm”, Ronald H. Coase (1937) argued that “the firm and the market were the alternative ways of organizing production or economic activities”. When will certain economic activities be performed by the firms, and when will they be performed in the marketplaces (Carton & Perloff, 2000). Coase put an emphasis that costs are involved while making use of the marketplaces. The other possible way is to have one big firm to do so within its own organization. When will the firm decided to produce a product internally and when will it rely on the marketplaces to do so? According to Coase, a firm would expand when its costs of engaging an economic activity internally is equal to the costs of relying on the marketplaces to accomplish this activity. The costs of relying on the marketplaces to conduct the business activities are called transaction costs.

Transaction costs may be involved with business activities in searching information, bargaining a deal and enforcing a contract/ agreement. From the origin of Economics, there are two forms of economic mechanism. The one is market mechanism—the invisible hands characterized by Adam Smith, where individuals and firms make independent decisions in their engagements in economic activities. The other is administrative mechanism—the visible hands characterized by Alfred Chandler, where managers make decisions in their engagements in production, sales and procurement process. If the transaction

costs in connection with market mechanism are higher than the firm's own administrative costs, the production activities can be internalized within the firm (Grant, 2002). Transaction costs are the costs, by definition of Besanko, Dranove & Shanley (2000), of using arm's length market exchange for goods and services, and there exist some transaction costs that force a firm to engage in economic transactions internally instead of externally.

McAfee (2002) mentions there are eleven categories of costs in association with performing transactions which are often qualitative in nature and are not easy to quantify:

- 
- i. Specialized investments and holdup costs
 - ii. Coordination costs
 - iii. Motivations and incentive costs
 - iv. Information acquisition costs
 - v. Information processing costs
 - vi. Contracting costs
 - vii. Search costs
 - viii. Enforcement costs
 - ix. Bargaining costs
 - x. Measurement costs
 - xi. Influence and lobbying costs

Transaction cost theory (Williamson, 1985, 1991), the mortgage

model(Williamson 1983) , and the 'mutual hostage' model (Williamson, 1996) all indicate that the larger transactions with relationship-specific investments are, the more there is a need for an ex-ante protection mechanism or reciprocity in order to maintain transaction efficiency. There are some recommended protection mechanisms as: requesting the counter party to sign formal contracts to ensure the continuity of mutual benefits (Williamson, 1996) or asking the counter party for commitment on the sunk costs (mutual hostage) (Kim & Mahoney, 2006; Williamson, 1983). This means such investments will not be conducted till reciprocity is agreed by both parties on these relationship-specific investments. Furthermore, research has found that OEM suppliers often invest in specific tangible or intangible assets for customers who have not committed to reciprocity (Rokkan, Heide, and Wathne, 2003). In contrast with the findings of transaction cost theory, customers do not generally commit to such investments in terms of reimbursement to the sunk costs. These investments which lack a transaction protection mechanism and complete decision-making mechanism are viewed as a form of "myopia" (Williamson, 1996:239). However, conventional transaction cost theory only considers single transactions in its analysis. As a result, positive effects incurred from learning or capability improvements are not taken into consideration. For example, these on-going transactions may be related to each other, or result in spillover effects.

Williamson (1999) also states that the theory could be enhanced through focusing on the scope of organizations, learning capabilities and other related factors because only transaction behavior itself is discussed in the theory - factors related to costs are not included (this includes production costs, and can be

extended to include differences in capabilities). In further researches, Williamson(1999) introduces organizational behavior theory, focusing on specific effects such as suppliers' capabilities and learning effects, to try to explain the differences in governance mechanism selections and investment decision processes.

The level of asset specificity is at the core of the transaction cost theory, but the measures to evaluate the costs are only from the demand side, not from the supply side. From the supply side, that means the value of the specific assets assigned to one customer could be the same if those assets can be transferred to other customers. The tools employed in previous research have commonly used interviews with experts to evaluate whether these assets are non-transferrable to other customers, and measuring how much suppliers invest in advance for customers on specific items (c.f. tooling, account team, MIS) (Bensaou & Anderson, 1999; Rokkin, Heide & Wathne, 2003). Therefore, these tools can only measure the scale of specific investments (tangible or intangible) but cannot assess whether there are barriers in transferring these assets to other customers. Therefore, the full picture of relation-specific investments remains unclear.

In summary of the empirical and measured papers mentioned above, relation-specific investment is considered to be a Multidimensional Construct (Law, Wong & Mobley, 1998), and can be divided into two sub-constructs. The first is referred to as "Relation Investment", and focuses on specific transactions or counter parties. This is examined in terms of engineering or labor expenditures. This investment type is seen as a result of suppliers' strategic decisions or actions

focusing on specific transaction efficiency or requests from specific dealing parties. These investments can be categorized by aspects including tangible assets, process and labor. Specific measures would include: tooling, account team, standard of process (SOP), places, timing, unique experiences and knowledge.

The second sub construct is called “Asset Specificity”, representing which specific supplier assets for one customer can be easily used for other customers. High asset specificity means the sunk costs of the said assets are high and the residual value can be seen as zero. If the supplier expects to use these assets on other customers or usage, the production value will be reduced heavily. Also, if the transactions have been completed, the modification of these assets for use on other transactions requires much time and expense. Therefore, ‘relation investments’ are not the equivalent of high specificity in human or equipment assets; on the contrary, there is no concern on equipments seen as ‘highly assets specific’, such as tooling, but these have less value. We can conclude that relation-specific investments have are characterized as for specific customers, with high percentage to total investment amounts, and not easily transferrable.

The commentary in the theory regarding how relation-specific investments will impact the business relationship (Rokkan et al., 2003) varies extensively. From the negative side, committing to relation-specific investments causes “Hold-up” (Klein, 1996; Klein, Crawford & Alchian, 1978; Williamson, 1985). In this imbalanced relationship, the investing party is locked in the business relationship and prone to be treated unfairly by the counter party; furthermore, it is hard for the supplier to switch to new business partners due to the consideration of sunk costs.

After the investments have been made, the opportunity to select business partners is limited, and the counter parties may have speculative incentives in the ties but the investing party is trapped.

The more positive view, Williamson (1985, 1991), suggest that the main reason for relation-specific investments is to create or enhance transaction efficiency. Beyond that, there are other purposes or intentions in the relation. For example, this kind of investments delivers a positive impression to reassure counter parties of sincerity and security. Whenever one party promises relation-specific investments, it is the equivalent of making commitments on relations (Williamson, 1983) or hostage (Anderson & Weits, 1992). One-sided commitment turns the 'prisoner dilemma' into a successful cooperation form of game theory, allowing the cooperation among different parties will be getting smoother. As long as the relationship is getting closer or mutual trust is increasing, the effect of inter-organizational knowledge transfer increases. (Ghosh & John, 1999) ◦

2. Governance mechanism

In his early research on transaction cost theory (Williamson 1975), Williamson suggests that the way to deal with transaction costs is via vertical integration. In empirical studies the earliest discussion starts from the impact of relation-specific investments on vertical integration (Monteverde & Teece, 1982). Usually weaker parties (OEM suppliers) do not have vertical integration capabilities; on the contrary the stronger ones (in general 'brand' customers) have capabilities and resources to perform vertical integration, but they keep the core competence in

their business models and outsource the rest to OEM suppliers (Prahalad & Hamel, 1990).

Even if OEM suppliers cannot deal with transaction costs through vertical integration, they still can choose to use either long-term contracts or other non-contract (non-market) governance mechanisms to protect the deals. Williamson (1983) suggested “Credible Commitments” on the basis of hostage model to explain how to increase cooperation inducements to maintain non-market transactions.

Williamson (1983) stated the reason why suppliers request commitments on relation-specific investments is connected to inducements from the customers. In some conditions, suppliers have to start relation-specific investments to reach production efficiency; their customers then commit to buying agreed quantities, (this is the counter offer to the suppliers). However, uncertainty exists on the market - customers cannot always avoid changes to the ex-ante commitments. Whenever suppliers have concerns regarding the commitments from the customers, they will act conservatively in early investments. In order to maintain such investments at a certain level, Williamson (1983) suggests that customers provide feasible mortgages as credible commitments; correspondingly suppliers will agree to commit relation-specific investments (Anderson & Weits, 1992; Bensaou & Anderson, 1999).

Some forms of compliant mortgage model exist in the governance mechanism - for example: share investment, reciprocity specific investments and financial links.

When transactions are terminated unexpectedly, the value of these mortgages is reduced. These mortgages act not only as mutual commitments but also provide a signal of sincerity. Other studies have discussed the effect of relation-specific investments as a form of mortgage to create a cooperation-type game (game theory) (Celly et al., 1999; Gulati et al., 1994). For example, committing to relation-specific investments allows the supplier to limit the options and to lead the counter party to enter this cooperation game. One party provides the mortgages bilaterally to improve the pay-off between both parties. Assuming the deal starts in good faith, the counterparties will move in the direction of cooperation.

The range of 'mortgages' results in a range of differing effects, and can be evaluated by their true value, durability and observability, amongst other measures. One example is strategic investments in the company's shares: although this has a financial value, minor investments in shares have a low mortgage effect. However, when considering durability, if the possibility of selling/transferring shares is limited, even minor investments can be seen as an exit barrier and perform the mortgage effect.

Another example is provided by reciprocity-specific investments. Anderson & Weitz (1992) argue that both suppliers and customers invest extensive resources - such as time and manpower - towards staff training and order systems. When suppliers know the value of specific investments made by their customers, they will volunteer to invest more freely. However, the authors' survey revealed an acknowledgement asymmetry with regard to the understanding of specific investments on each side. That means the specific investments that suppliers

recognize may not be agreed or recognized by the customers. The mortgage effect is therefore limited and weaker than would be expected. In summary, measurable/obvious or highly visible relation-specific investments have clear and stable mortgage effects.

3. Resource-Based View

Predictions linking relation-specific investments to the governance mechanism are supported by significant empirical evidence. (David & Han, 2004; Geyskens, Steenkamp & Kumar 2006; Rindfleisch & Heide, 1997; Shelanski & Klein, 1995). However, Carter and Hodgson (2006) point out that most of the empirical research on transaction cost theory does not consider transaction costs directly. In cases where transactional features such as relation-specific investments, uncertainty or prior ties is confirmed to have impact on governance, it is viewed as supporting the existence of cost minimization in transaction cost theory. Without the measurement of direct transaction costs, other concepts should be considered although the empirical evidence does support the theory (Masten, 1996; Carter & Hodgson, 2006). These concepts include organizational capabilities (Monteverde, 1995), and other strategic explanations (Heide & John, 1990).

Specific investments contain relation-specific assets and common resources. These should be utilized properly to create customer value. Nobeoka, Dyer & Madhok at el(2002) specify “Relation-specific Knowledge” and “Re-deployable Knowledge”, the latter of which is more easily transferred or shared. Transaction cost theory only covers the former - relation-specific investments - but capability

viewpoint focuses on the latter - the knowledge owned by suppliers which can be transferred. In practice these two resources are used together and cannot be clearly separated.

Further, the experience gained from the supplier's continued investment of time and human resources for one customer is tied to a specific transaction relationship. If such knowledge or experience can be duplicated for the benefit of other customers, this duplication is seen as an independent leverage capability (Lorenzoni & Lipparini, 1999). OEM suppliers have to not only manage external customer relationships but work to effectively facilitate internal coordination (Takeishi, 2001). This capability should enhance OEM suppliers' competitive strength and reduce the risk which is tied into specific customers.

Using a resource-based view and 5-force analysis theory (Michael Porter, 1985), the determinants of price negotiation between buyers and suppliers are listed below:

- i. Purchasing quantities;
- ii. Appropriate substitutes;
- iii. Buyers' transformation costs;
- iv. Product differentiation;
- v. Brand acknowledgement;
- vi. Information asymmetry;
- vii. Profits;
- viii. Quality;
- ix. Forward/backward integration capability

Customers will maximize total demand quantities to seek to minimise costs; suppliers will also have their own methods of creating potential demand to negotiate their best prices.

4. Interdependency

If both suppliers and customers commit to relation-specific investments or exchange mortgages (Williamson, 1983), these commitments are a bilateral protection based on a high level of mutual balanced dependency. However, when the mutual dependency is unbalanced in the first place, relation or bilateral governance cannot be applied to maintain such balance (Heide, 1994). Under such asymmetric conditions there is a low chance that stronger parties (normally brand customers) will provide mortgages actively to encourage suppliers to perform relation-specific investments. It is logical that powerful customers may not be willing to help suppliers due to their superior position. In this case, even if customers will not offer to provide mortgages to enhance transaction efficiency; suppliers will still commit to relation-specific investments in expectation of future opportunities.

Chapter 3 、 Methodology

1. Research framework

The theories of transaction cost, governance mechanism, resource-base view and interdependency are the basis of this research framework. According to these theories, the decision-making process in such transactions would likely operate as followed:

- (1) Customers raise requests: for example, a demand increase or decrease, specification change, new product design, workflow modification;
- (2) Suppliers receive the requests and review all of the necessary information to decide how to respond, Considerations could include material stock status, engineering resources & technology maturity, gap analysis for workflow change;
- (3) Suppliers will also ask for commitments from the customers. Without the commitments from the customer, suppliers will not bear risks and instead might react conservatively to protect themselves;
- (4) Customers are not completely satisfied with the response from suppliers, so customers and suppliers start to negotiate to reach a consensus;

(5) After reaching the consensus, suppliers will implement all of the necessary actions to realize the commitments.

This logic is illustrated into a workflow chart as followed:

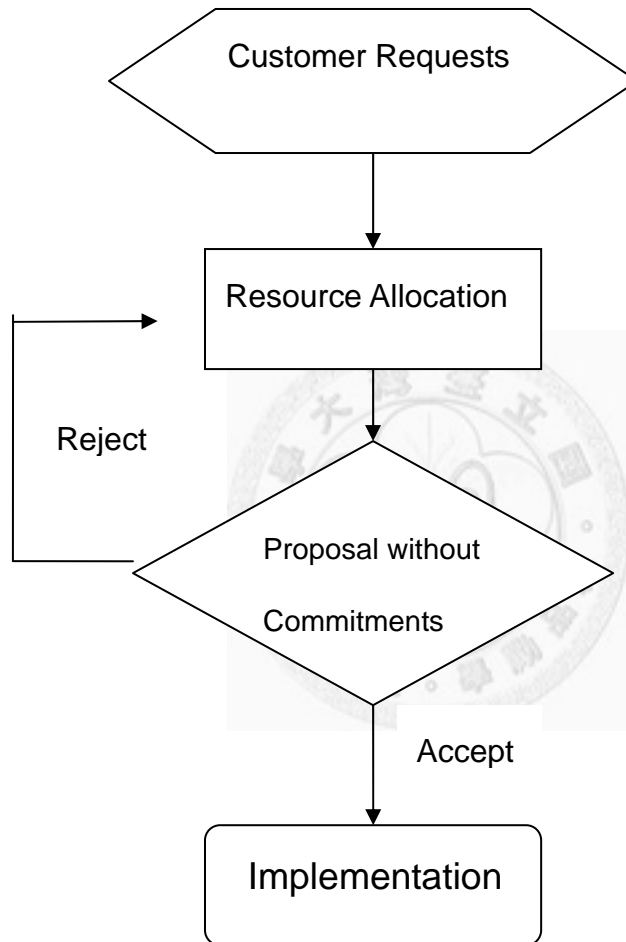


Figure 4. Negotiation flow without unilateral investment

Most real-life cases, demonstrate that customers and suppliers usually negotiate the resource allocation and level of commitments. This can take a lot of time and

efforts to reach a compromise or a consensus. The results may either enhance or hurt the relationship between customers and suppliers. The entire process works as a cycle. As long as the business is on-going, this discussion cycle continues to revolve.

The observation is carried out on the basis of 1-year projects. Every customer has its own unique procedure for instigating changes, and suppliers will follow a variety of techniques to respond the requests for change in order to keep the business relationship.

Alternatively, if it were to move more aggressively, the decision-making logic would act in a different way, as followed:



External Consideration

Internal Consideration

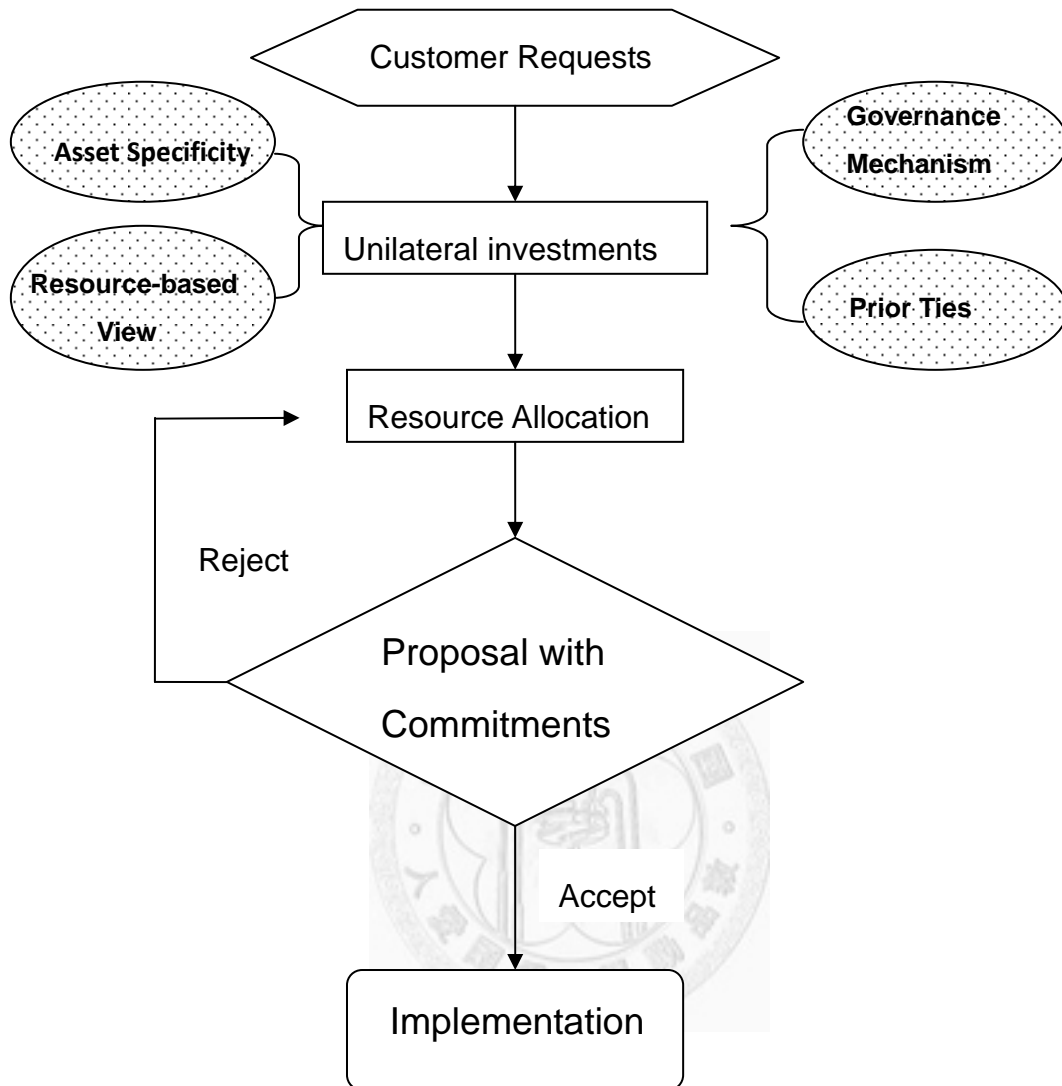


Figure 5. Negotiation flow with unilateral investment

Comparing the two similar process flows, the dependent variables can be viewed as the timing to decide unilateral investments and the lead time to complete all of the actions to confirm an agreement, while the independent variable would be the customer satisfaction and immediate order allocation.

Table 5. Dependent and independent variables in the research framework

Dependent Variables	Independent Variable
Timing to decide unilateral investments	Change of customer satisfaction and immediate order re-allocation
Lead time to complete unilateral investments	

2. Research approach

This study will review whether OEM suppliers will follow conventional transaction cost theory and carry it out in order to respond commitments from customers. If this is the case, the question is: how OEM suppliers maintain business growth in relation to current customer behavior; if not, what actions OEM suppliers have to take to compete in this fast-moving product cycle and competition environment. By using the LCDM and IPC industries as examples, we can examine the different actions OEM suppliers have with respect to the degree of commoditization. Research literature, case studies and interview are used in this study.

In LCD monitor industry, the major 4 OEM suppliers occupied around 65% of the global market in 2009. They are referred to here as 'LCD1 Company', 'LCD2 Company', 'LCD3 Company' and 'LCD4 Company'. They have different processes/criteria in respect of product design, production, quality assurance, service, material procurement; although these differences are limited because they serve the same group of key account customers (the Top 10 worldwide PC brands excluding Samsung and LG). These four companies represent the cases in this

research.

In IPC industry, four Taiwanese IPC suppliers will be interviewed: “IPC1 Company”, “IPC2 Company”, “IPC3 Company” and “IPC4 Company”. They are using the same components as many as possible, but have different technology and design to serve their customers.

3. Procedure

This study will follow the steps below:

- i. Establish the study topic, target and direction
- ii. Collect and study research literature, industry information, and cases
- iii. Analyze the data collected
- iv. Conduct interviews
- v. Analyze the findings
- vi. Conclusion and managerial implications



In step iii, I will dispatch questionnaires to the interviewees first to collect current operation status at every target company. Then, in step iv, there are 8 experienced managers in different companies to be interviewed. Then the results are reviewed and analyzed, to compare the difference between the evidence and the theories, and then to revise the framework of this study.

The background of the interviewee is listed below:

Table 6. Interviewee summary

Company	Title	Experience
LCD1	AVP	15 years in sales/PM in the same industry
LCD2	AVP	20 years in sales/ PM/ procurement in the same industry
LCD3	Director	13 years in sales/PM in the same industry
LCD4	Senior manager	8 years in sales/PM in the same industry
IPC1	Senior project manager	8 years in marketing/PM in the same industry
IPC2	Service manager	11 years in PM/ R&D/ service in the same industry
IPC3	Senior sales manager	9 years in sales in the same industry
IPC4	Sales manager	5 years in sales in the same industry

Chapter 4 、 Research Findings

1. LCD monitor industry

LCD1 Company is now the world's No. 1 OEM PC monitor supplier. It was established in 1967 and moved its production to China in 1990. From 2001 up to the present, 'T' Company has been at the forefront of the PC monitor OEM business, for both CRT and LCD monitors. Its core business is LCD monitor assembly, LCD TV assembly, and other applications including touch monitors, and public displays. In 2009, it shipped 45 million LCD monitor sets and 10 million LCD TV sets, representing 29% and 8% worldwide market share respectively. In 2010, the company aims to ship 60 million LCD monitors and 15 million LCD TV sets, representing 40% and 10% of the total global demand respectively.

LCD2 Company was set up in 2004 as a subsidiary of Foxconn Technology group. Through stable panel supply and strategic planning, 'L' Company shipped 10 million LCD monitors in 2007, 27 million in 2008, and 37 million in 2009, and plans to ship 45 million sets in 2010. The company also announced a merger with 'C' Company, the world's fourth largest LCD panel supplier, and an LTPS panel supplier, effective from April 1, 2010. This merger made the company the 3rd largest LCD panel supplier in the world (just behind Samsung and LGD) in terms of capacity, and strengthened its 2nd position in LCD monitor assembly business.

LCD3 Company was a subsidiary of Acer group in early 80s, and was spun-off as an individual entity in 1984. In both CRT and LCD monitors, 'Q' Company has

gained a reputation for leading technology and stable quality performance, which is borne out by the fact that the monitor business represents more than 60 percent of total company turnover. In 2009 'Q' Company shipped 16 million LCD monitors and is projected to ship 18 million sets in 2010.

LCD4 Company took over LCD monitor final assembly business from 2nd half of 2008. The deal included most of its equipment and staff and enabled it to expand its product portfolio, increase revenue and increase its synergies in LCD TV development. In 2009 LCD4 Company shipped 8 million LCD monitors and plans to ship 12 million sets in 2010.

Table 7. LCD monitor interview company shipments from 2007 to 2009

Suppliers	Shipments (Unit: million sets)		
	2007	2008	2009
LCD1	27	45	45
LCD2	10	29	37
LCD3	10	12	16
LCD4	N/A	N/A	8

Data source: annual reports from the interviewed companies, Display Search

Though Samsung and LG produce most of their own LCD monitors (Samsung only outsources 5% of its whole output; LG sources more, but still merely 15%), they have been shown to adopt the same methodology to maintain their product

competitiveness on the market. In the wake of the year 2000 Asian financial crisis, South Korea's government began to clamp down on corruption within the main 4 industrial groups in Korea: Samsung, LG, Daewoo and Hyundai. Previously, the LCD panel module business unit and the LCD monitor business unit were under one big business unit umbrella, with the profit and loss of each business unit not clearly identified, and the resources not utilized efficiently. After the clampdown, the respective operations of each unit were completely separated, including in terms of approaching customers and procurement. Business unit profit and loss results were reviewed individually as well. The result was that the LCD monitor business unit became one of the customers of the LCD module unit and had to identify a competitive cost structure.

From each of the following items, we will review the specifics of the industry and the scope of specific investments which OEM suppliers need to personally account for:

i. Mechanical design : Customers have their own product planning, and they bear their own costs to develop the mechanical tooling; this means OEM suppliers do not need to invest unilaterally. If some OEM suppliers are willing to achieve more orders on mainstream models, they will develop the molds proactively, then to discuss with customers how to get more orders from a business negotiation perspective, not in terms of sunk costs. Furthermore, in the case of small and medium sized customers, the costs of tooling modification can also be recovered from the customers. This means almost no sunk cost is involved. OEM suppliers will not hesitate to invest on tooling.

ii. Key electrical components design : To account for product life cycles and to avoid inventory of idle unique parts on end-of-life products, customers always request that OEM suppliers use common key electrical components in product design. Also, since the number of key electrical components suppliers is also limited, OEM suppliers prefer to adopt this method themselves to enjoy the potential benefits from resource leverage and cost down activities. In fact these companies use a so-called “common platform” for standard products to fit “time-to-market” requests from the customers. Though there are some pioneering designs, in these cases, the customers will share the design costs with OEM suppliers. Therefore, OEM suppliers do not need to make unilateral investments in advance, but are able to persuade these key customers to use common components to share the benefits and to reduce the risks. In general for a supplier’s current design capability, the common platform covers at least 70% of all requirements for product function requirements and mechanical dimensions.

iii 、 Testing equipment: All customers will clarify the CPU chipset/ motherboard list for system compatibility tests, and even provide such hardware for tests. Since CPU sources are limited, OEM suppliers have the capability to develop software to work with different motherboards. Testing equipment such as signal generators is quite standard equipment; - investment in this equipment is not risky or unilateral.

iv 、 Production scheduling : All OEM suppliers organize maximum production capacity to meet peak season demand, which is a long-term plan for business growth rather than for a single customer. In the case of sudden demand increase, OEM suppliers go through systems like ERP to re-prioritize the order sequence so

that production capacity and material supply match the demand.

v 、 Quality assurance : ISO 9000/14001/18000 、 WEEE and other quality/environment protection requirements are the same for all customers. There is no over investment on this item.

vi 、 MIS : When customers have their own system and request OEM suppliers to create interfaces to connect to this, OEM suppliers will either develop a new system to connect, or to modify the current system for connection. Based on the experience, the customer requests are pretty similar, OEM suppliers do not need to over-invest on MIS; and the data format which customers request can be discussed or negotiated to optimize such investments.

vii 、 Account Team build-up : it is common for OEM suppliers to set up a separate team (which can be either physical or virtual) to serve each key customer with full functions including sales, project management, engineering, delivery, quality, and even a small supporting team on the customer side. OEM suppliers will not see this as unilateral or relationship-related investment because: (1) it is requested by the customers and helps mutual understanding between clients and suppliers; (2) as time goes by, it is common to all of the customers as an industry standard. The standard is now common to the industry..

2. IPC industry

In comparison to the LCD monitor industry, conditions in IPC industry are very different. With a variety of product applications, and different categories of sales channels, no single OEM supplier is able to occupy a significant percentage of total market share. This implies IPC OEM suppliers face a high risk of suffering the effects of huge sunk costs. If there is not enough demand to share these sunk costs, specific investments cannot be amortized properly. However, IPC OEM suppliers still seek ways to break through these limitations. If common parts or platforms can be introduced effectively, OEM suppliers will invest aggressively for business growth and customer relationship improvement.

In this research, 4 Taiwanese IPC companies will be discussed:

IPC 1 Company was set up in 1983, and went public in 1999. From 2004 until the present, this company has generally held 9% to 10% of the global IPC market share, making it the 2nd or 3rd largest supplier in the world.

IPC 2 Company was set up in 1993 and went public in 2001. IPC 2 has technological advantages on some specific products, and this advantage has led to stable revenue growth.

IPC 3 Company was set up in 1995 and went public in 2004. The company's strong R&D capability enabled it to grow rapidly. Its annual turnover has exceeded USD 60 million since 2006.

IPC 4 Company was set up in 1992, and went public in 1999. This company arrived too late for product diversification, so its growth path has been slower than other new companies. Nevertheless, it has made firm progress, with annual turnover exceeding USD 60 million from 2007.

Table 8. IPC interviewed company turnover from 2006 to 2008

Suppliers	Turnover (in USD million)		
	2006	2007	2008
IPC1	452	482	523
IPC2	82	112	118
IPC3	60	67	74
IPC4	46	60	63

Data source: annual reports from the interviewed companies

These 4 companies focus on major IPC products: embedded single board computers (EBC), single board computers (SBC), panel applications, and industrial automation. Many companies in this industry categorized by high turnover have not selected in this research because they do not offer such a broad range of product varieties, and the complexity of the product design, production process, and other aspects is lower than the interviewed companies.

Through interviews with senior managers in this field, we have identified some

differences in the same criteria with which we reviewed the LCD monitor industry:

i. Mechanical design : Customers have their own product planning, and they bear their own costs to develop the mechanical tooling; this means OEM suppliers do not need to invest unilaterally. In this industry an order in the range of thousands of units is large enough, OEM suppliers will not seek further orders in terms of tooling investment because IPC tooling is huge and cannot be modularized. Any modification on the specific tooling cannot be shared by other customers.

ii. Key electrical components design : IPC products have relatively long product life cycles. Material costs are less important than system integration capability and stable supply. Therefore, customers usually request cost reduction but do not ask for increased design flexibility.

However, OEM suppliers never stop considering ways to allocate resources efficiently, including considerations of cost reduction and material management. The concept of common parts or platform still helps IPC OEM suppliers expend less efforts in platform design. For example, in the past, one large main board with 3 functions was used. Of these, 1 function is requested 80% of the time and the others are 20% of the time. Engineers would have a common board with all of the 3 functions, but remove the extra functions if customers did not request these. For this design the dimension of the main board was still large. The new concept is to divide the original main board into 2 small boards. If 1 function is requested, the new small board can be supplied. Though this is not a huge cost saving, some of the cost of the printed circuit is saved. Furthermore, by enabling more

complex function or mechanical design, this concept provides flexibility on the choice of input/output locations. From the interviews, all of the Taiwanese IPC OEM suppliers have introduced this concept, covering 80% of their customer requests. The difference with the LCD industry is that IPC OEM suppliers will rarely conduct unilateral investments. The reason is straight-forward: it is inefficient to invest for a total potential demand in the range of thousands of pieces.

iii 、 Testing equipments: Unlike the LCD monitor industry, there are not so many different chipsets/ motherboards/ signals to be tested - testing criteria for IPC customers is relatively simple. Only the testing plan/criteria itself will be raised with OEM suppliers, and most of this can be covered by standard testing equipment. In the case of extra/special testing items, OEM suppliers will still perform them but will ask for extra charges and the customers are normally willing to pay for those charges.

iv 、 Production scheduling : The difference between peak and slow seasons in IPC industry is not significant, so OEM suppliers do not need to reserve much extra production capacity to meet urgent demand increases. Planning tools like ERP/ MRP are also introduced for internal resource utilization, as opposed to usage related to frequent changes on production scheduling.

v 、 Quality assurance : ISO 9000/14001/18000 、 WEEE and other quality/environment protection requirements are the same for all customers. There is no over investment on this item.

vi · MIS : OEM suppliers may invest in e-platforms for internal use, but generally not as a result of customer requests, since the demand is insufficient to justify building a system for shipment tracking or other functions.

vii · Account Team build-up : it is common for OEM suppliers to set up a separate team (which could be physical or virtual) to serve every single key customer with full functions including sales, project management, engineering, delivery, quality, and even a small supporting team on the customer side. OEM suppliers will not see this as unilateral or relationship-related investment because: (1) it is requested by the customers and helps mutual understanding between clients and suppliers; (2) as time goes by, it has become commonplace as an industry standard.

viii. Prior ties: this does not influence the intention of suppliers to invest in specific assets in advance because costs mean money and profits. In IPC industry, prior ties and switching costs are highly related. Customers use acceptable performance, reliable quality, and stable supply as the key criteria to select qualified suppliers. Due to exclusivity of product designs, prior ties may bring stable or long-term business to suppliers but never necessarily imply suppliers will make unilateral investments in advance of potential opportunities.

3. Comparison between LCD monitor and IPC industries

The table below constructs the key variations on LCD monitor and IPC product.

Table 9. Differences between LCD monitors and IPC

Difference	LCD monitor	IPC
Market size	Customized products, low volume, smaller market	Standard products, larger volume, larger market
Applications	Non-commercial and specialist areas	Homes and offices mainly
Purpose	Requirements vary in different environments (application driven)	General purpose and more stable environments
Environment	Harsh environments (long hours, harsh weather, outdoors, shock/water-proof)	Stable environments (short working hours, indoors, normal temperature)
Delivery	Low volume and wide varieties	Large volume and limited varieties
Pricing sensitivity	Low	High
Life cycle	Long (3-5 years)	Short (approx. 2-4 quarters)
Customization	High	Low (multiple standards)
Reliability requirement	High	Low
Procurement driver	Quality, stability, reliability, flexibility	Cost/performance ratio
Service quality demand	High	After-sales service for standard products
Customer loyalty	High	Low
Major players	Advantech, Kontron, Radisys, etc	Dell, HP, acer, ASUS, Lenovo, etc

In the following table based on the interview results, if OEM suppliers make unilateral investments, the answer is “Yes”; if not it is “No”:

Table 10. Conclusions on unilateral investment decision

Criteria \ Industry	LCD monitor	IPC
Mechanical design	Yes	No
Key electrical components	Yes	Yes
Testing equipment	No	No
Production scheduling	Yes	No
Quality assurance	No	No
MIS	Yes	No
Account team	Yes	No

The detailed explanation of the criteria and results is explained as follows:

i. Mechanical design : LCD monitor suppliers have the capabilities to volunteer to develop new tooling with respect to mechanical design because customers have limited numbers of suppliers to select from; and these customers, whether they supply large quantities or not, usually plan to expend most of their efforts on their expertise in marketing strategies, alliances, topics and trends. They want suppliers to focus on the technology, quality, time-to-market efficiency and supply fulfillment. On the other hand, if suppliers cannot satisfactorily fulfill these essential activities - in cases such as development schedule delay, quality issues, material shortage - the limited number of suppliers still does not guarantee that

unilateral investments will be recovered completely. Even worse, current orders are likely to be reduced immediately. In summary, LCD monitor OEM suppliers will make unilateral investments and expect these investments to be recovered and worthwhile assuming they can keep daily operations stable. Reliability and trustworthiness will be compelling for customers when extra demand or new opportunities appear.

In the case of IPC OEM suppliers, they have the same major daily operational activities as those performed by LCD monitor suppliers, and need to perform them well to win customer confidence and trust as the basis of further business opportunities and a closer relationship. However, for each project, the level of demand is much lower than for LCD monitors. This means that per unit mechanical cost will be too high to be recovered fully and possibly result in a loss. Even for the most common parts or modules, from the perspective of sunk cost, asset specificity and resource-base view, IPC suppliers will still hesitate to invest in advance unless important decisions must be made right away. In comparison, asset specificity is less important to LCD monitor suppliers because the unit cost is relatively small.

ii. Key electrical components design : to consider the feature of “Asset Specificity” as a negative sign for investments, both LCD monitor and IPC suppliers prefer having common components as many as possible. In this way, suppliers in LCD monitor and IPC industries will have positive “prior ties” with their components suppliers, and maintain the bargaining power for price negotiation. Especially IPC products have longer product life cycles. Materials costs are less important

than system integration capability and stable supply. So customers usually request for cost reduction but do not ask for increasing the design flexibility. Therefore it is important to utilize design capability and stable components supply to maintain competitive strengths.

However, in LCD monitor industry, the applications are not as many as those in IPC industry. Whenever components suppliers introduce new features, functions, or applications and some of the leading customers seem interested in, OEM suppliers are struggling to either follow the new requirement or to wait. To follow the new requirement raised by the customers, OEM suppliers expose in relatively high risks that the new requirement could fail then could lose the investments on R&D resource and materials. The only positive thing is to have customer satisfaction to enhance “prior ties” for future business in terms of volume and profits. Therefore, OEM suppliers in LCD monitor industry will provide unilateral investments rather than OEM suppliers in IPC industry.

iii. Testing equipments : In comparison with potential loss on electrical and mechanical components, the investments on testing equipments are smaller but the benefits are larger and will last longer because the most of the functions and features on the products will not disappear suddenly or change dramatically. As long as the business is confirmed and the project is started, testing requirements and equipments are the one of the important items in the project schedule and need to be checked and reviewed. In short, all of the suppliers in LCD monitors and IPC industries will invest on testing equipments without hesitation.

iv. Production scheduling : The difference between peak and slow seasons in IPC industry is not significant, so OEM suppliers do not need to reserve much extra production capacity to meet urgent demand increase. Planning tools like ERP/ MRP are also introduced for internal resource utilization, not for frequent changes on production scheduling. In the contrast, the demand difference in peak and slow seasons in LCD monitor industry may be huge. OEM suppliers watch the market demand closely and prepare additional materials and production capacity to fulfill demand upside requests from the customers. Furthermore, OEM suppliers in LCD monitor industry shall have the flexibility to adjust the daily production schedule with sufficient materials supply. Probably without governance mechanism but to consider prior ties, OEM suppliers still have to invest on these resources like materials, manpower and capacity to be ready for the opportunities.

v. Quality assurance: ISO 9000/14001/18000 、WEEE and other product quality/ environment protection requirements are the same to all of the customers. There is no over investment on these items but just to follow them in both industries.

vi. MIS : IPC OEM suppliers may invest on e-platform for internal use only; LCD monitor suppliers will spend more efforts on e-platform for different reporting purposes, data analysis, and to meet customer requests for order taking, products delivery status, customer service, etc. But mostly the system development and modification are requested by customers and the performance of investments on MIS to the customers is not very explicit. In summary no suppliers in both industries will invest on MIS proactively.

vii · Account Team build-up : it is common that customers request to set up a dedicated team (no matter it is a physical or virtual one) to serve every single key customer with full function as sales, project management, engineering, delivery, quality, even a small supporting team at front-ends. In LCD monitor industry, OEM suppliers may not see this as unilateral or relationship-related investment because: (1) it is requested by the customers and helps mutual understanding between clients and suppliers; (2) as time goes by, it is common to all of the customers to provide such standard service. In fact LCD monitor OEM suppliers do allocate some key people to serve the dedicated customer, but not the whole team.

On the contrary, IPC customers usually have enough time to develop the new products or platforms. Upon this condition IPC OEM suppliers will not really form a dedicated team for single one customer; instead, IPC OEM suppliers will utilize the manpower at the basis of workload to perform qualified service level to their customers.

Chapter 5 、 Conclusions and Management Implication

1. Conclusions

The findings and analysis of this study show the following results:

1. To review the connections between the findings and the four elements in TCE, (i) asset specificity (ii) governance mechanism (iii) resource-based view and (iv) prior ties, asset specificity is solidly supported by the findings. To consider the costs, utilization rates and efforts made on the investments, LCDM OEM suppliers are not following TCE completely for their short-term and long-term business growth. IPC OEM suppliers are more willing to follow TCE to ensure the business stability than rapid but risky growth.

As for resource-based view and prior ties, the findings support some evidence that both LCDM and IPC OEM suppliers follow TCE to respond customers' requests. But to consider the asset specificity, the relation between resource-based view, prior ties and investment behavior is not as solid as that on asset specificity. Governance mechanism is not addressed when reviewing and analyzing the entire project or product process. It does not mean no relation between governance mechanism and unilateral investments, just the research methodology does not cover this so the findings cannot support the existence of this element.

2. The findings suggest that LCD monitor suppliers act more aggressively than IPC suppliers. The possible reasons are:

- i. The number of suppliers is limited, so customers have no choice but to work with these suppliers. This allows current suppliers the confidence to invest in advance.
- ii. The product design and therefore mechanical tooling for LCD monitors is not as complicated as IPC products. The development cost and uniqueness is lower, so suppliers are willing to invest in advance.
- iii. Demand of LCD monitors is much higher than demand for IPC products. From the perspective of turnover, profits and priorities with the customers, LCD monitor suppliers are inclined to invest earlier to grab new business opportunities.

3. The so-called “unilateral” investments are not really unilateral but tied-in with positive expectations or predictions. The decision is made from either an operation process consideration or a business consideration supported by technology feasibility analysis.

If the business consideration is incorrect the corporation would make loss even in deep trouble for survival. To find out some variables which may have relations to positive expectations or predictions to ensure the business consideration without strict governance mechanism is correct should be another interesting topic for business strategy development.

4. The intention of investments is predictable and analytical. However the amounts of these investments cannot be estimated by quantitative analysis. For example one LCD monitor supplier prefers investing USD\$400,000 on one product which possibly have large quantities, but not on one model with few quantities costing USD\$100,000. On the other hand, even the investment amounts are

USD\$50,000, one IPC supplier still does not want to invest to have an order of only one thousand pieces. No matter what the final investment decision will be, there is no golden rule to expect or predict the formulas to figure out the amounts of the unilateral investments.

5. Normally Operation Management is used to explain the specialty in IPC industry, but TCE can be used as different angle to review and analyze the features in these two industries. In the research process, there are some limitations which can be extended into further studies:

i. The study only focuses on Taiwanese LCDM and IPC OEM suppliers. The findings can be extended to suppliers in the same industries but in other countries for initial cross-checking, and later to other industries for analysis and discussion. Furthermore, key activities in product design and manufacturing in different industries and markets are different. The dependent variables in different industries and markets should vary.

ii. “Prior ties” may be applied with “degree of rivalry” together to analyze the costs and benefits for the investments decisions. Concentration ratio (CR4) is one feasible measure to indicate the rivalry intensity. It is clear that LCD monitor industry is highly concentrated; in IPC industry, customers bear high switching costs to introduce new suppliers in the relatively low-concentrated industry than LCD monitor. To combine these conditions, OEM suppliers would be able to take some risks to perform unilateral investments for early business opportunities.

2. Managerial Implications

Transaction cost economics (TCE) is thoroughly studied in this paper to give a tool with theoretical framework when managers make their decisions. In fast-moving LCD monitor assembly industry, some of the OEM suppliers are centralized firms, the executives may have their own judgments on choices of unilateral investments even if the TCE suggests do or not do so. It is clear that every key activities plays important role in the whole supply chain with cost structure for OEM suppliers to the customers. And macro-economic factors like business cycle, exchange rate, raw material supply and demand, will also impact the OEM suppliers' activities and the decisions made by managers. When business cycle is positive, managers are inclined to agree unilateral investments to pursue more orders and profits. It is seldom seen but important to slow down the expansion path to look over the macro and micro economic environments for a while. On the contrary, during the slow business cycle, managers should be capable of having insights for the near future, and check the financial status of the firm, then to make right decision either to be as conservative as other competitors or to act more aggressively to gain early profits.

IPC OEM suppliers do not have to face the market change as rapidly as LCD monitor assembly OEM suppliers do. Lower demand and various applications seem the main issues for unilateral investments decisions. To follow TCE completely is safe for IPC OEM suppliers because to push more orders in traditional way seems not an easy task upon the current market demand and supply status. TCE seems to protect the IPC OEM suppliers to expose in less

risk. However, managers may consider other tactics to breakthrough the constraints. For example, alliance is a doable strategy to expand the demand with fewer efforts; and to extend the scope of alliance to the possibility of industrial standard establishment.



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Appendix. Questionnaire

Activities	Items
Major customer definition	<ol style="list-style-type: none">1. More than 5% contribution (under one of the following criteria) to your company: shipments, revenues or profits (1—yes, 2—no)2. Your company will be willing to make early investments for some new specific customers (1=yes, 2=no)
Relationship-specific investment	<ol style="list-style-type: none">1. Your company has made significant investments in <u>production and testing equipment</u> for certain major customers initially, with the potential to be applied to other customers in the future.2. Your company has made significant investments in <u>tooling and engineering design</u> initially for specific major customer, with the potential to be applied to other customers in the future.3. Your company has made significant investments in <u>information technology and logistic systems</u> initially for specific major customer, with the potential to be applied to other customers in the future4. Your company has spent significant time resources <u>learning these major customers' operational routines and building relationships with their staff.</u>5. Your company has made significant <u>adjustments in your products and production system</u> in order to adapt to these major customers' unique needs and technical specifications.6. Your company has made significant <u>adjustments in internal operation processes</u> in order to adopt these major customers' unique needs and technical specifications.7. Your company has spent a lot of <u>time and effort in coordinating the operation processes</u> of your own suppliers in order to adopt these major customers' unique needs and technical specifications. (Likert seven-point scale; 7 = extensive investment, 1= minimal investment)
Capability upgrading	<p>After working with these customers, your company has made significant improvements with respect to the following capabilities:</p> <ol style="list-style-type: none">1. Capacity turnover2. Manufacturing process capability3. Quality control capability

4. New product development capability
5. Overall managerial capability

(Likert seven-point scale; 7 = strong agree, 1= strong disagree)

Reputation enhancement

1. After starting business with these customers, the market visibility of your company has increased.
2. After starting business with these customers, the market status of your company has been enhanced.
3. After starting business with these customers, it is much easier to obtain new orders from other clients. (Likert seven-point scale; 7 = strong agree, 1= strong disagree)

