# Module and Interface from the Transaction Cost Approach

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## ABSTRACT

Although module as a unit sharing multiple interfaces to interact, integrate and combine is a common definition, interface has been referred to in very few researches of modularity. Although Williamson defined transaction as the transfer of a good or service across a technologically separable interface, the characteristics of interfaces have yet to be studied by transaction cost economics researchers. The purpose of this research is to understand and describe further the mechanism of modularity from the transaction cost approach, using in particular the concept of transaction interface. The analysis of benefits/costs of modularity from the perspective of interface is proposed. We believe the importance of interface study has been increasing in proportion to the widespread dissemination of economic activities via the Internet. Modularity existing beyond the boundary of organization may likewise be explained by focusing on its interface aspects.

**Keywords:** module, interface, transaction, organizational economics

## 1. INTRODUCTION

While most neoclassical economists focused during the early part of the twentieth century on modeling production costs in a general equilibrium framework using Cobb-Douglas production functions, Coase (1937)[1] came up with his seminal ideas on the nature of the firm using partial equilibrium analysis. He cited the importance of systems attributing transaction cost as one of the key concepts in economic analysis. His ideas together with Williamson (1985)[2] built the foundation of what is now known as transaction cost economics (TCE) with empirical works in comparative institutional analysis and management. TCE is also considered to have extensive influence on industrial organization economics and management (Economides and Salop, 1992)[3], (Milgrom and Roberts, 1992)[4]. Contract theory, on the other hand, is derived from TCE.

Meanwhile, modularity as a structure of systems has been researched in various fields after the IT industry's success widely attributed to the deployment of modularity in industry and product design structures. As a general systems concept, modularity is applied to organization theories including outsourcing and contract manufacturing, the network structure in Silicon Valley (Daft and Lewin, 1993)[5], (Sanchez, 1995)[6] and so forth. In spite of its increasing popularity, however, there exists no definitive definition of modularity yet. The studies have been proceeding but the complexity of the subject needs to be further analyzed so as to take into account new deductions such as the the formulation embodying the finding that almost all systems are recognized as, "to some extent", modular (Schilling, 2000) [7]. Even in the widely-accepted definition which states that a module is a unit whose elements are "relatively" tightly and coherently connected inside and "relatively" loosely and weakly linked outside, that relativity is still shrouded with ambiguity and needs to be expounded further.

Toward the network era, as external resources acquired greater capability to cope with the need for them to be internalized, the interfaces fitted with such resources began to play important roles. Although a module as a unit sharing multiple interfaces to interact, integrate and combine is another common definition, interface has been referred to in very few researches of modularity. Although Williamson (1985) defined transaction as the transfer of a good or service across a technologically separable interface, the characteristics of interfaces have yet to be studied by transaction cost economics researchers. Transaction costs accrue with interfaces and the search for the transaction costs mechanism requires the studies on interfaces. The purpose of this research is to understand and describe further the mechanism of interfaces from the transaction cost approach.

## 2. DEFINITION OF TERMS

The terminologies should be defined precisely before the discussion.

*ENTITY:*
Entity is a person or a group of person with capability and willingness to carry out autonomic economic decision making and to enter into transactions with other entities.

*TRANSACTION:*
Transaction is the exchange of goods/services, in markets or organizations. The concept of a good includes intangible assets such as knowledge, reputation, brand, credibility and so forth. A transaction usually consists of sub-transactions.

*INTERFACE:*
Baldwin & Clark (2000)[8] defined interface as the description of how the different modules will interact, fit, connect and communicate. In this research, interface is defined as the parameters/media through which transactions are made between two entities, including:

-Connection: basic infrastructure of communication, ex)law and custom, social infrastructures such as, (a) context: measuring systems, semantic and, logic; (b) expression: natural language, text, multimedia, digital signal, protocol(IP, EDI, Rosettanet); (c) communication tool: tel, fax, telex, email; (d)medium: radio wave, sound, light, voltage.

-Information gathering: formatted information presentation and search/discovery of information about a trading party (finding, authentication, credit guarantee), about good/service (price, quality, delivery, etc.)
-Mutual understanding: Q&A, negotiation, adjustment, coordination, agreement and contract
-Exchange and Logistics: ordering, billing, clearing, payment and transfer of ownership and physical goods/services
-Inspection and Integration: monitoring/inspection, integration, training/education, evaluation, problem solving and forcible execution.

Those elements are in sequential and complementary structure from the begging through the end of a transaction. Interface also consists of fixed interface and ad hoc interface. All decisions and actions in a transaction are ruled by fixed interface and/or ordered by ad hoc interface as below.

*FIXED INTERFACE (FIF):*
Fixed interface is priori agreed rule and/or medium through which transactions are made between two entities. FIF may be explicit or implicit. Explicit FIF includes physical and social infrastructures including telecom system, hardware, durable equipment, electric signal, legal system, authentication system, credibility guarantee system, management system, etc. Implicit FIF includes reputation and ostracism and ingroup social communications networks as North (1997)[9] designated as well as custom, norm, trust, credibility, reputation, policy, strategy, philosophy, culture, threats, respects, etc. Those may be described explicitly and defined as explicit FIF. FIF becomes explicit when rules are expressed and defined clearly enough for a third person or an outsider to understand.

Fixing interface means specifying parameters/media of interface and actions in transactions. Common combination patterns of elements, media and actions (structure, sequence, etc.) are extracted from all the transactions which FIF is planned to cover and which transaction entities have to comply with to facilitate the repetition of the pattern that reduces the total cost of transaction by stimulating economies of scale and experience effect. Any element of the interface could be fixed separately or jointly, by development or procurement.

*AD HOC INTERFACE (AHIF):*
Although there seems to be no interface when activities of two components or entities have to be closely and coherently coordinated, certain kind of interface must exist for as long as those are interacting even if not defined or ruled. Ad hoc interface is order for an action in a transaction for one time usage, which is not fully ruled, agreed, programmed nor planned in advance, while FIF is used at least twice (the number of usage should compensate the costs accruing for fixing) . Williamson (1985) designated AHIF as selective intervention for uncertainties which are not able to priori fix. Milgrom & Roberts (1992) pointed out synchronization problems and assignment problems of design attributes and innovation attributes as examples of uncertainty. When a problem requires a different sequence of synchronized actions, when a problem requires the assignment of different employees with different capabilities, and when a problem requires a different information as the environment has innovated, coordination or AHIF is important. In contract theory, control rights, residual control rights and residual claims are supposed to be defined as it is impossible to complete contracts (Alchian and Demsetz, 1972)[10]. The decisions which those allocated rights make are AHIFs and the allocation itself is FIF. While FIF fixes

activities for more than once such as at the future expansions of functions or products, AHIF is more flexible and freely redesigned as the widely applicable interface is not yet known. Options/modules are specified by FIF and the selection of options/modules is AHIF while the criteria of selection are FIF. It is also needed when entities have human asset specificity (specialty). AHIF includes:
-Vertical AHIF: decision of the control right wielder who is designated by contract including fiat as selective intervention from superior on formal authority in organization (Menard, 1996)[11]
-Horizontal AHIF: recommendation/order emanating from wielders of authority in formal/informal arbitration

AHIFs are for uncertain events which are not priori specified such as transaction problems not covered or described in a contract, or a manager's intervention with respect to a subordinate. In the latter case, the manager is allowed to intervene only where his/her subordinate's behavior or its consequences go beyond the expected range. Otherwise, unnecessary interventions cause problems known as commitment problems under which pro forma FIFs are not committed by subordinates as well.

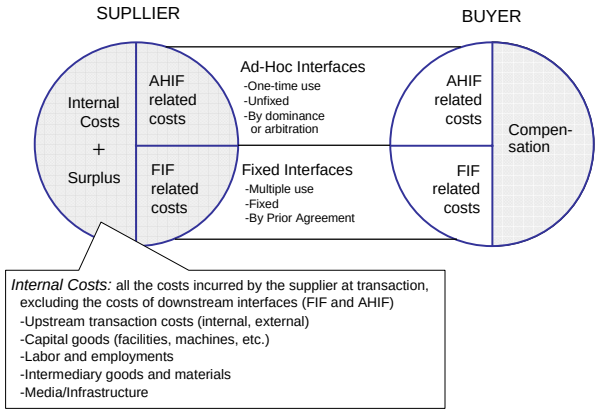
The general understanding that organizational coordination is useful especially for the interconnected design of complex products without interfaces between parts (Collis & Montgomery, 1998)[12] should be explained as the implication of AHIFs. As long as parts are physically and/or functionally connected in a structure, there must be some interface. The difference is whether it is fixed or ad hoc.

*TRANSACTION COST:*
Cheung (1998)[13] defined transaction costs are all the costs which do not exist in a Robinson Crusoe economy. Transaction costs are defined here as the costs accruing with transaction interfaces. We divided it into two categories: costs of AHIF-related activities and costs of FIF-related activities which include the allocation of development cost, switching cost and operation cost of FIF (see figure 1).

Through one transaction, only one good/service is exchanged with compensation which contains the price of the good/service and/or other types of remuneration, paying his own transaction costs to procure the good or service.

*COMPENSATION:*
Good/service is acquired at cost of compensation and the buyer's activities related with FIF and AHIF. The transaction cost of the supplier may or may not be directly inclusive of his price.

Figure 1 Definition of FIF and AHIF




*ARCHITECTURE:*
Transaction is ruled by a collection of interfaces which are layered and sequential. Architecture is designed structure of a nexus of FIFs defining the interaction of interfaces. The design consistency of architecture should avoid the excess transaction costs such as the unnecessary deployment of AHIFs.

*OPEN / CLOSE FIF:*
FIF may be open or close in terms of the right of use and the price. Close FIF requires exclusive conditions for use and/or payment of some user fees.
FIF is classified as follows:
1) Open (non-exclusive) or close right of use
2) Means to finance development and operation costs
   - charged to users (user fees and membership fees)
   - allocated to developer (developer fees)
   - not charged nor allocated but recouped from others external sources such as sponsor or advertisers targeting the users of FIF

Open FIF is more open and/or free of charge for users.

*MODULE:*
A module is an entity with autonomy and interactivity to transact with other entities under regulation of FIFs. As a module has autonomic decision making capability, it must be human (Artificial Intelligence software products with various automated capabilities are considered beyond the coverage of the current study). For instance, a bolt is a product manufactured by a module with autonomy under regulation of FIFs. The module is interactive with other modules which manufacture nuts with FIFs. In this sense, a broad definition of modules may also include module by-products (that is, module-produced goods) in order to accord with widely-accepted recognition. Entities are defined as more modular, the more dependent they are

on FIFs.

A less modular entity (including by-products), on the other hand, does not depend on FIFs. Integration model or integral architecture is recognized as the inverse structure of modularity where components are bundled into a single integrated package and not allowed to substitute (Schilling, 2000). Japanese corporations have often been referred to as an example of typical integration model. They are more dependent on AHIFs and implicit FIFs (such as customs, trust, etc.) and less on explicit FIFs such as management processes, specifications and contracts.

## 3. MODEL

### 3.1. COSTS

In this chapter, we show our terminologies and conceptual model.

*INTERNAL COST:*
The concept of internal costs cover all the costs incurred by the supplier at transaction, excluding the costs of downstream interface (FIF and AHIF) related activities. Internal costs include the costs of upstream interface related activities, purchase of goods/services such as capital goods (facilities, durable equipments), labor and employments, media, infrastructure, intermediate goods and materials, and profit for transaction (see figure 1). The analysis of internal cost management is a key to answer how economic agents should organize the transaction in order to reduce on production and transaction costs (Aggarwal and Walden, 2005)[14].

*DEVELOPMENT COST OF INTERFACE:*
Development costs are incurred in designing and constructing interfaces. This includes the purchase of durable equipment and the acquisition of infrastructure (particularly for FIF). It also includes influence costs and opportunity costs as in the case of AHIF as AHIF is not likely to be exposed nor verified.

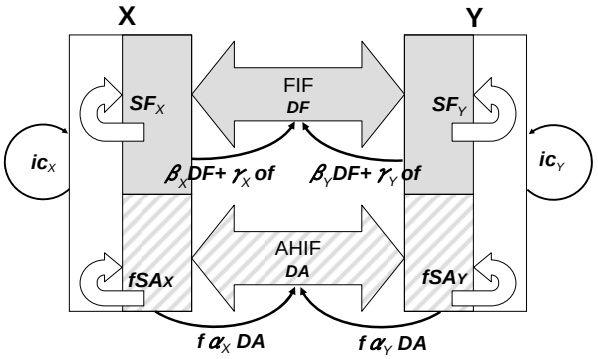
*SWITCHING COST OF INTERFACE:*
Switching cost is the cost for an entity to switch and adjust its activities to interfaces (FIF or AHIF). Switching costs include costs incurred in the conduct of activities to obtain commitment such as those related to informing, education and management, etc.

*OPERATION COST OF INTERFACE:*
Operation cost is the regularly accruing costs for operating and maintaining FIF. It includes renegotiation costs such as monitoring, evaluation and revision.

### 3.2 MODELING

We describe a proposed framework of interface in this paper keeping in mind its possible applications to various fields. The basic model shown in figure 2 delineates the essential relationships that comprise the transaction.

Figure 2 Basic Model




There are supposed to be two entities, named X and Y, engaged in a transaction whereupon the corresponding transaction costs and internal costs ($ic_i$, $i$=X or Y) are incurred. Initially, they only use AHIFs which are developed at each transaction and share the development cost of AHIF ($DA$) in a certain way ($\alpha_x+\alpha_y=1$).

So they pay $f\alpha_i DA$ ($i$=X or Y) to develop and use AHIF. In addition, they pay switching costs ($fSA_i$, $f$ is a frequency of transactions). Entities recognize the efficiency of deploying FIF upon the continued use of AHIFs. To use FIF, development cost ($DF$) and operating cost ($of$) of FIF are incurred. Here, we assume that entities X and Y share these costs and pay $\beta_i DF+\gamma_i of$ ($i$=X or Y) to develop and maintain FIF. In addition, they need to pay switching costs ($SF_i$) to adopt their operation to FIF. So the total transaction cost ($TTC$) with one interface incurred by an entity $i$ ($i$=X or Y) for a certain time period t ($1\le t\le T$) and frequency per time $f$ ($1\le f\le F$) is shown as follows:

$$TTC_i = \left(\beta_i DF + SF_i\right) + \sum_{t=1}^{T} \gamma_i of_t + \sum_{t=1}^{T} \sum_{f_t=1}^{F_t} \left( \alpha_{itf_t} DA_{itf_t} + SA_{itf_t} \right)$$

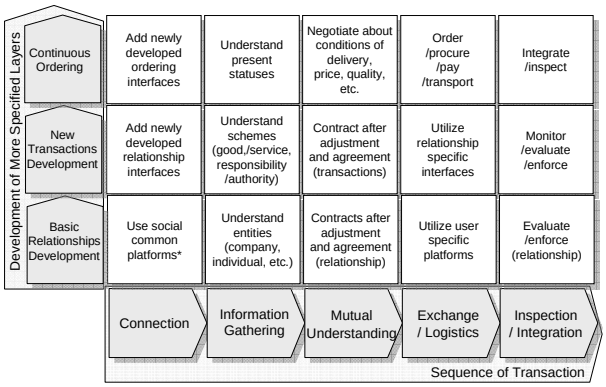
## 4. DISCUSSION

### 4.1. MULTI-LAYERED STRUCTURE OF INTERFACES

Interfaces are built up on existing interfaces and constitute multilayer (see figure 3). Customs such as natural language, measuring system and semantics exist as basic FIF without any specification from entities and

company establishes organization governance and concludes contracts on those FIFs. Their internal accounting rules and management systems are constructed on them and so on. This layered structure requires companies to expand their size in order to finance the costs related to FIF, especially in the meta-level.

Figure 3 Layers of Interfaces




Although the transactions become more efficient with the deployment of FIF and consequently the changes on and above the FIF come to be less costly (if designed and so committed), the replacement of FIF always proves to be more difficult as the switching cost of FIF is larger than that of AHIF. Especially so does the replacement of meta level FIF because it requires many other FIF to change on the FIF. This means the design of FIFs are crucial for the adaptability of entities.

### 4.2. BENEFITS OF FIF

The essential benefit of FIF is the reduction of transaction costs from fixing so that entities can reduce the cost per transaction or increase the transaction with the constant cost, which makes two consequent benefits for transaction entities: division and interaction.

-Division (separation, disintegration, disconnection): FIF efficiently decreases unnecessary transactions of AHIFs and makes both entities independent and efficient. In organization, power is delegated from a manager to a subordinate with clear responsibility and authority so that manager's selective interventions and monitoring decrease, which incentivize a subordinate by giving him/her ownership (the control right) of work (North, 1981)[15] and performance reward (Aghion and Tirole, 1997)[16], (Baker, Gibbons and Murphy, 1999)[17] reducing the risk of moral hazard at evaluation by his/her manager (Milgrom and Roberts, 1992). Both entities also can concentrate on their operational and managerial specialties (Cheung, 1998) with motivation, simplicity and economies of scale.

When U > Ca
FIF is designed and deployed as Ca > Cf
where U: Utility of interfaces
Ca: Cost of AHIF
Cf: Cost of FIF

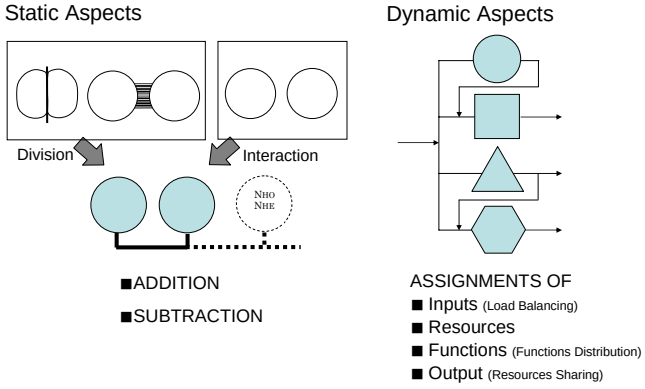
-Interaction (connection, integration, combination): FIF establishes necessary transactions for entities which are deemed too costly to exist. The Internet has enabled transactions for two entities at both sides of the globe. A president of a company set up FIF of the meeting for adjusting sales activities between two business units which are too costly to communicate due to the historical feud between them.

When U < Ca
FIF is designed and deployed as U > Cf

U is assumed to be constant notwithstanding the deployment of FIF in this research but its consequent increase should be analyzed in our future study.

In organizations, the division and the interaction are usually sought after simultaneously and the complex of interfaces constitutes the governance structure of organization or inter-corporate. The typical applications of interaction of the divided modules are in figure 4.

Figure 4 Benefits of Interfaces




From static aspects (left side of the figure), interfaces enable addition and subtraction of homogeneous and heterogeneous modules. Conjunction or integration is another expression of connection with emphasis on a certain activities. Systems have been recognized as more modular by researchers when their components can be disaggregated and recombined into new configuration with little loss of functionality (Langlois 1992)[18], (Sanchez 1995)[19]. Baldwin & Clark (2000) pointed out splitting, substitution, excluding, augmenting, inversion and porting as benefits of module. Splitting, substitution, exclusion and augmenting are concepts that comprise a combination of subtraction and addition. Inversion is a combination of subtraction and conjunction (integration). Porting is a topic related to the openness of FIF discussed below.

From dynamic aspects (right side of the figure), interfaces allocate inputs (load balancing), resources (resources allocation), functions (function distribution) and outputs (resources sharing) to discrete module. This allocation is for each flow of resources such as material, intermediate product, information, rewards, etc. Through interfaces, user A can share the resources such as information with user B and user A (himself) in the future as well. For instance, a personal filing system works as FIF which rules information input and output activities of him/her at present and in the future and he/she is able to lower the transaction cost of transferring the information from the present to the future. Katz & Shapiro (1985)[20] defined this as vertical network externalities.

Through managing interfaces like above, organization becomes change adaptive quantitatively and qualitatively to the outer environment.

### 4.3. BENEFITS TO OPEN FIF

Benefit to open FIF, that is, to permit users to use non-exclusively and/or to make it free of charge, is to facilitate the dissemination of FIF, which gives more opportunities of valuable transaction to the entities, which also benefits FIF owner.

Users and owners have different benefits of open FIF. The benefits to users are clearer. Because the specification of interface is open and the compatibility is secured, users can avert the lock-in to the owner of interface and urge the competition between owners. On the contrary, owners prefer keeping it close to hold their asset specificity (specialty) and have users dependent on them. Owners are required to satisfy the users' preference in the long term even though it is against their short term benefits. Users or owners who are interested in utilization of external resources are more positive to the openness. Open FIF will acquire more users, especially when it becomes the standard, and provide more access to external resources.

In traditional organizations, interfaces are more likely to avoid being fixed and open because employees, especially with specific (special) capabilities including managers are likely to dislike open FIFs, and employers, or FIF owners try to keep FIF close and maintain the differentiation of FIF and the value of his investment. As long as the most frequent pattern of AHIF transactions which originally do not make any differentiation, however, is appropriately fixed as FIF, it is valuable to open FIF. Transaction entities often prefer to keep FIF close from the threat that he or she may be replaced by his or her equivalent. Managers are afraid of loosing their specificity by the exposure through FIF. The expectation or preference toward the opportunities for new transactions determines the differences above. Through opening the FIF, the possible utilization of external resources is added as one of its benefits which may result not only in considerable cost reductions, but may also open up channels to a wealth of resources.

### 4.3. STANDARDIZATION OF FIF

As standards contain various interface mechanisms, there is a need to carefully analyze the concept and underlying role of standards in interface research. A good/service is defined as a standard when any (or both) of the following is satisfied: 1) utilized by a dominant number of users 2) functions as an interface (FIF). Standardizing products/services means increasing the market share of one or more of the interfaces (FIFs) of the products/services, such as the user interface, connecting or communicating interface, mechanical interface, information gathering interface, etc. These characteristics are discussed in more detail below.

The presence of a dominant number of users establishes credibility or reputation, which is also considered as an FIF as it functions as a credit guarantee system. Such an interface with a large number of users is likely to increase the users due to positive externalities and feedback. The domination also enhances the value of the product due to economy of scale and consequently increases the users again.

Standardization activities as well as the Internet have considerably decreased costs of transaction (information costs in particular) and have resulted in consumers buying from one supplier, accelerating a virtuous circle of externalities. All these positive feedbacks enable such a supplier of a good/service to increase its market share. Thus, only standardized products/services are able to win or survive market competition in a "Winner takes all" fashion.

The more strategically important the acquisition of a standard position in the market becomes, the greater the reduction in price and in exclusivity are needed to increase the market share. Patent pools such as MPEG2, the 3G technologies of mobile phones and the next generation DVD require the patent holders to keep the licenses open with the first priority on the dissemination and standardization of technologies. Due to the same reason, recent IT products with platform functions such as JAVA, XML, LINUX, etc tend to be open.
The more the prices decrease, the less conspicuous the direct benefits of acquiring a standard become. Successful standardization of FIF yields, however, some

indirect benefits by establishing and utilizing other close FIFs on the standardized FIF. The advantage of being more familiar with the FIF (technologies in particular) than any other competitors enables the product/business development utilizing the FIFs. This is widely known as the first mover advantages. The opportunities to develop a business in services to further reduce transaction costs such as in consulting, integration and education are also indirect benefits. The brand developed with the achievement of standardization also supports any kind of related business developments.

## 5. CONCLUDING REMARKS: FUTURE RESEARCH DIRECTIONS

In addition to the description of examples in the previous definition, FIF includes the following topics which will be studied in more detail in future studies.

1) IT-related issues with possibly wider applications

*IT Standards such as the Internet protocols, XML and XML related standards:*

IT including the Internet functions as interface in market or organization. FIFs are continuously being developed on the Internet and as a consequence has contributed to the reduced costs of various kinds of transactions. XML (eXtensible Markup Language) allows computers to recognize the data and communicate, interact and collaborate with each other. Many FIFs such as Rosettanet and ebXML which rule the market transactions are under development on XML. Other examples include EAI, EIP, Utility Computing, P2P protocol.

*Open Source Software:*

The software with GPL (General Public License) is open source software. As GPL requires the software developers to redistribute their software without charge, there is almost no negotiation needed for the transaction of the software. That lowers the transaction costs and disseminates the software easily to be used by other softwares.

*Platform:*

A module which functions as platform is interface as entities make transaction on or through it. OS (operating system) works as platform for a group of application software to interoperate.

*Network:*

Network is a multi-layered complex of interfaces including physical protocols (electric and mechanical), data formats, networking rules (routing and addressing), transportation rules (data compression and error correction), data transmission control rules, presentation format (font, multimedia, etc.) and application program interfaces and a huge number of business rules.

*System:*

System is composed of the rules of interaction (connection, integration, mixing, combination, conjunction) of elements (or the interacting elements themselves are referred to as well). Elements are transacting each other through the interfaces.

2) Market-related issues

*eMarketplace:*

Artificial marketplaces on the Internet (B2B and B2C) provide various contract based interfaces between suppliers and buyers of goods/services usually commercially. Authentification, credit guarantee, information provision in electronic catalog, negotiation platform, price formation (auction, etc.), logistics, insurance, various types of consulting services are provided and the transaction costs are drastically reduced.

*Contracts in markets:*

Contracts are explicitly written FIFs for transactions in market. Problems derived from uncertain events should be solved by AHIFs executed on those FIFs including arbitrators and legal systems.

3) Organization-related issues

*Interface standards at company:*

Transactions in organization are ruled by collection of standards of the organization such as management rules, business processes, management systems, etc. For example, job descriptions enable manager and workers to communicate with each other to produce agreed outcome. Accounting rules have various interface functions for all employees and company.

*Quality standards at company:*

Quality standards with specification and production process of products/services are distinguished from interface standards (Grindley, 1995)[21], (David and Greenstein, 1995)[22]. As consumers purchase and use goods/services based on the qualities such as specification of physical and performance configuration, however, those function as interfaces as well.

*Design philosophy:*

When interfaces among parts are designed, design philosophy functions as a meta interface to connect the designers even beyond company. Clark & Fujimoto (1990) designated it as “product integrity” showing the automobile as an example of a product with integrity which the common philosophy had underlined as the quality and attribute that could spell the difference between a failed and successful product development.

*Trust:*

Trust is mutually agreed meta-rule like code of conduct or custom. It enables handling uncertainties by the coordination of different short-term interests. Opportunistic betrayals will collapse the interfaces not

only with the specific transactor but also with the potential transactors and raise the transaction costs considerably in the future. As one sided exploitation or concession does not maintain the long term trust-based relationship, problem solving skills on both sides are required to handle uncertain events. Furthermore, concepts, frameworks, technologies, terminologies of problem solving should be shared in advance and those consist of complicated multi-layered interfaces. Trust may be explicit with social infrastructure such as reputation database, credibility guarantee system, etc. On FIF of trust, intangible credits and debts which are supposed to be settled in the future are exchanged as the loss on the present accounting calculation is exchanged with the future benefits or credibility.

There are many emerging aspects which justify the increasing importance of transaction interface studies. Cheung (1998) estimated that even in the present modern world, it would be difficult to find a rich country where transaction costs sum to less than half of national income. After the Internet dissemination, the potential of utilizing external resources and the efforts to establish social FIFs increase in wider and deeper scale. Obviously the inter-corporation structure like the one in the Silicon Valley has been successfully showing more competitive advantages. And furthermore standardizing FIFs becomes the important strategic target as the acquisition of standard becomes the key for success. As the fiercer competitive situation requires companies to change more rapidly at lower cost, FIFs should be more utilized, especially under the situation in which the transaction costs represent a major portion of the total marginal costs in companies and markets as software, information and knowledge of which the duplication costs are smaller and play major role in the value of goods. FIFs are the only way to decrease the costs. Although there are risks to fixing interfaces, the company who takes more risks in concentrating its investments wins the games. The year 1995 marking the Internet emergence coincided with the period of the economic decline of Japan which structurally depends on AHIFs and internal resources. Interface studies could be one of keys to the correct analysis of those phenomena.

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