

April/May 2008

# Japan's Version of Silicon Valley as Viewed from Inter-firm Networks

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## 1. Introduction

In recent years, not a day has passed without rumor of prospective acquisitions of Internet-related companies. Many of the target enterprises are venture businesses born in Silicon Valley, which serves to remind us that the region has consistently been the epicenter of ICT ventures. It has been pointed out that it is the networks existing between venture businesses, in addition to their geographical proximity, that has enabled Silicon Valley to become what it is today. Many articles have depicted the intermediary and governance functions of venture capitalists (VC)—stakeholders of more than a single enterprise—as important and indispensable factors in the successful development of Silicon Valley.

In Japan, however, the aggregate risk money flowing into VCs amounts to only about one fifteenth of that in the U.S. It may be said, therefore, that ICT venture companies in Japan have managed to develop themselves by building up relations with large established ICT corporations rather than with VCs.

The "2007 White Paper - Information and Communications in Japan" published by the Ministry of Internal Affairs and Communications in July last year took more pages than before to analyze ICT ventures and characteristically emphasized the dependence of ICT venture businesses on big ICT companies for their capital resources as well as business

transactions.

In this analysis, the phrase, "big ICT companies" refers mainly to such corporations as NTT, NEC, Fujitsu and Hitachi. Behind individuals (most likely management executives), they are in fact the second largest category of shareholders, holding around 20% of stocks of aggregate ICT venture businesses. This has enabled venture businesses to facilitate long-term policy for capital funding. Moreover, as the sector-based breakdown of suppliers and customers indicates that established ICT companies have shares exceeding 60% among suppliers and customers alike, their presence is considered indispensable for the growth of venture enterprises.

From the viewpoint of venture businesses this might mean dependence on big ICT companies. For the big ITC corporations, however, their strong presence attests to positive involvement in this growing sector. And from the broader perspective of the ICT industry as a whole, it has been the big ITC companies that have supported the development of ICT venture businesses in Japan.

This structure significantly differs from that in Silicon Valley where VCs have been developed through intermediary functions between companies. If a "Japanese version of Silicon Valley" is to

emerge at all, it is necessary to pay due attention to such inter-firm relations which are uniquely Japanese. In the following study I examine possible forms of such a Japanese version based on the results of analysis on inter-firm networks involving 259 Internet companies located in Tokyo's 23 wards.

## 2. Investor and inter-firm networks

When applied to the analysis of inter-firm relations, network analysis offers a means of accounting for a phenomenon through the environment surrounding corporations (relation structure) rather than through their individual attributes. This enables us to visualize and quantify the external corporate environment. Though network analysis was originally developed as an analytical tool for sociology, its application to economics and business administration is increasingly noted in conjunction with the development of software for analysis.

In this study, I will first identify the "shape" of the network by producing a graphic representation of the presumably cooperative network of inter-firm relations as mediated by investors, and then analyze how the "position" of a company is correlated to corporate performance within such a network.

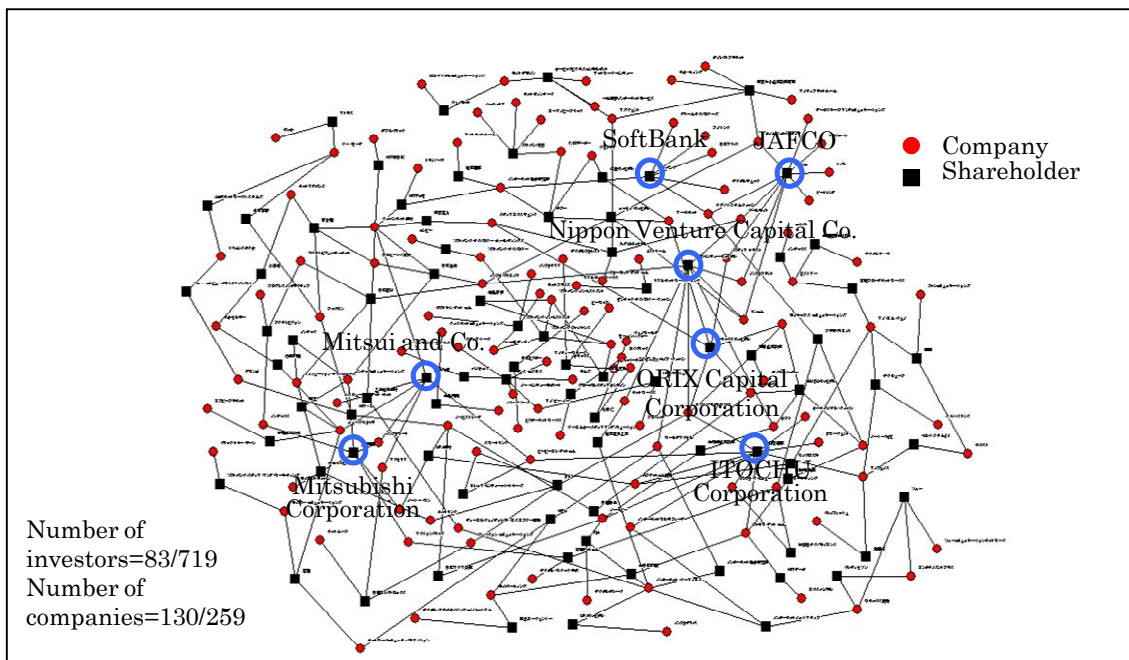
Based on the results of this analysis, I will then proceed to examine whether inter-firm networks are functioning effectively, that is to say, if investors are contributing to the improvement of corporate performance by bringing together companies they are involved with.

Graph 1 is a bipartite graph showing the relations between Internet companies and their principal investors. A bipartite graph visualizes the relations between subjects of analysis and their attributes. For this analysis, linked points (nodes) represent relations between Internet

companies and their investors. The lines linking nodes represent only the existence of relations between companies and attributes; their length is immaterial.

The corporations examined had 719 major investors in aggregate, of which 83 firms acted as intermediaries for two or more companies in bringing about inter-firm relations. Of the total 259 corporations, 130 of them were served by the above 83 as intermediaries in developing inter-firm relations.

Graph 1: Bipartite Graph of Internet Companies and Principal Investors



Source: The author

To the extent that this bipartite graph indicates, there is no investor that invests in an extraordinarily large number of companies. In other words there is no hub for the network. The investors marked by a circle are principal shareholders who invested in more than 6 Internet companies. They are venture capitalists (VCs) or large general trading companies that presumably play roles essentially equivalent to those of the VCs.

Viewing the network structure as a whole, more investors belong to general businesses rather than the VC sector. In addition, a greater number of linkages (the lines linking nodes) suggestive of a higher degree of intermediary relations are found more frequently with general business corporations than with VCs (Table 1). Furthermore, there are few investments by individuals. It shows that it is general business corporations, not VCs or angel investors that have nurtured relations between Internet companies.

The sector-wise breakdown of such business entities shows that the largest is "information" (33 companies, 53%) followed by "others" (20 companies, 32%), "media" (4 companies, 7%), "advertisement" (3 companies, 5%) and "communication" (2 companies, 3%). In other words, the majority of them are ICT-related companies.

Even leading ICT corporations such as Hitachi, NEC and Fujitsu have invested in only 3 or 4 Internet companies, and no corporations actively made investments in a large number of such companies. An entity functioning as a hub does not exist. It may be said, however, that inter-firm networks have been formed by a number of ICT companies through the function of investors as intermediaries. Although this analysis was made in 2004, the network structure is consistent with results of analysis in the aforementioned 2007 White Paper - Information and Communication in Japan.

Table 1: Breakdown of Principal Investors

	Number of shareholders	Number of linkages
VC and others	17 (20%)	64 (26%)
General business companies	62 (75%)	178 (71%)
Individuals	4 (5%)	8 (3%)

### 3. Inter-firm networks of Internet companies

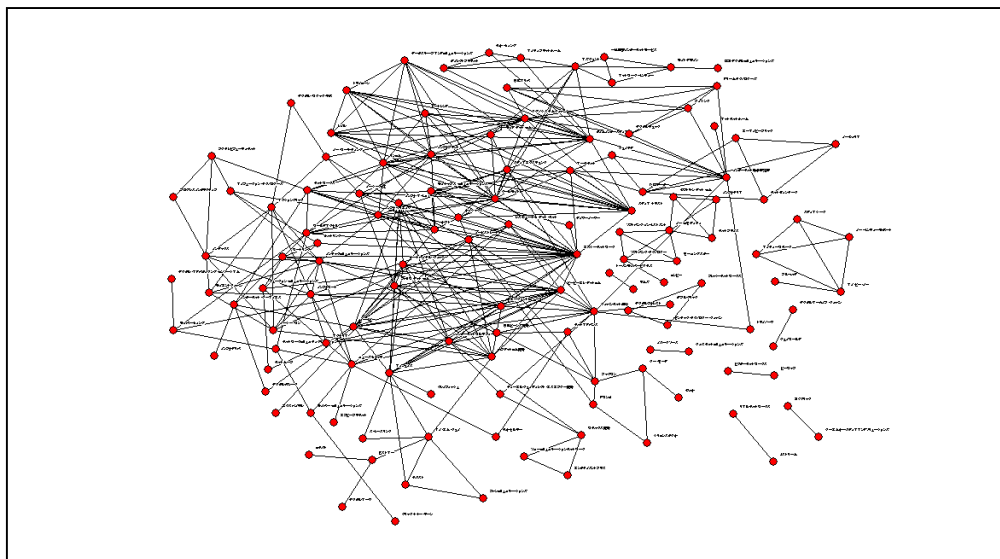
Now that the relations between investors and Internet companies have been clarified, let us proceed to extracting the structure of inter-firm networks of Internet companies so as to identify "shapes" of network as well as the positions of Internet companies therein.

The network structure showing inter-firm relations can be extracted through multiplying the matrix of company-attribute relations (obtained when the bipartite graph was made) by the transposed matrix. The matrix thus produced will represent the indirect relations between companies based on their respective attributes.

Graph 2 is visual presentation of inter-firm networks made by investors as intermediaries based on the aforementioned bipartite graph. The linked nodes in the graph are all Internet companies, whereas they are not so in the bipartite graph. As is the case in the bipartite graph, the lines represent common features in inter-firm relations and their length is irrelevant.

We have thus identified the "shape" of inter-firm relations formed by investors as intermediaries. Next I will determine the "positions" of each company within such networks by measuring the network indices of each Internet company.

Graph 2: Inter-firm networks with investors as intermediaries



Source: The author

Table 2: Measured network indices

Degree	<ul style="list-style-type: none"> <li>• How many nodes are directly linked?</li> <li>• The higher the degree, the higher the centrality (indirect effects are not taken into consideration)</li> <li>• Shows vigorous activities in the networks</li> </ul>
Farness	<ul style="list-style-type: none"> <li>• What is the minimum necessary number of steps to reach all the nodes?</li> <li>• The higher the eccentricity, the lower the centrality <sup>TM</sup> closeness</li> <li>• Shows low efficiency in reaching the whole networks</li> </ul>
Betweenness	<ul style="list-style-type: none"> <li>• How many relations are there that cannot be reached without passing through particular nodes?</li> <li>• The higher the betweenness, the higher the centrality</li> <li>• Shows the role as gatekeeper to link many nodes efficiently (via the shortest route)</li> </ul>
Eigenvector	<ul style="list-style-type: none"> <li>• To what extent are the linked nodes connected to other nodes?</li> <li>• The higher the eigenvector, the higher the centrality</li> <li>• Shows popularity of the nodes that are linked to particular nodes</li> </ul>
Constraint	<ul style="list-style-type: none"> <li>• The constraint imposed on the agent under the situation where agents are mutually separated without direct linkage in spite of linkage with others</li> </ul>

Source: The author

Table 2 gives an outline of the network indices measured in this study. Almost all of them are centrality indices and determine to what extent nodes (Internet companies in this case) are centrally located. There are various core indices, but in many instances they are based on (1) the number of linkages that nodes have, (2) the distance between nodes, and (3) the intermediary function of nodes.

#### 4. Results of analysis

I have analyzed the effect on corporate

performance by the positions of each Internet company within the network using the inter-firm network and network indices. Specifically, I have analyzed the correlation between network indices and corporate performance that shows the position of each company within its network as well as partial correlation analysis controlled by size of the corporation in terms of the number of employees and the amount of capitalization.

Table 3: Correlation between network indices and profit

	Degree	Farness	Betweenness	Eigenvector	Constraint
Investor	—	—	+	—	—

+ Significant (on both sides) at 5% level.

Source: The author

Table 3 shows the correlation (or lack of) between network indices and corporate performance revealed by the analysis. Correlation exists between only the intermediary functions and performance of corporations; there is no correlation between other network indices and performance. In addition, there is negative correlation between investor-driven intermediary functions in inter-firm networks and Internet company profit.

Any investor is an intermediary who would most likely benefit from improved performance of an Internet company of which the investor is a stakeholder. It is considered, therefore, that inter-firm networks formed by such intermediaries are practically in a cooperative relationship.

The fact that the network indices are not correlated or negatively correlated to performance in such inter-firm networks in a cooperative relationship suggests the possibility that whatever position a corporation may hold in such a network, its effects on performance are irrelevant or even harmful. It is highly possible that

inter-firm networks formed by corporate board members or investors as intermediaries are barely functioning from the viewpoint of performance improvement of Internet companies.

## 5. Implications of the results of analysis – Inadequate intermediary functions

The analysis of inter-firm networks formed by investors as intermediaries among Internet companies demonstrated the absence of VCs or angels able to function as a hub. It was then found that core indices have no correlation or negative correlation to performance. This means that no investors are offering intermediary functions between Internet companies that would have been conducive to performance improvement.

For investors, it could be more beneficial to improve performance of all the Internet companies in which they have stakes. They could be, therefore, deemed to be in a position to encourage cooperative relations among Internet companies. In other words, they are in a position to play

a role supporting corporate activities by providing companies with various resources including financial assistance, appropriate human resources and introduction to private networks.

The results of the analysis at the time of the study indicate, however, that investors are either not offering assistance to improve performance by making use of Internet company networks in which they assist as intermediaries or in the event that they tried, such efforts are not bearing fruit. That is to say, they merely continue to supply risk money in expectation of future return.

It is hard to imagine an investor offering no support to the company. It is conceivable that they merely offer support of dyadic relations between a single party (investor) and another (Internet company) and no more. Moreover, investors' behavior would be such that in the first place they might not make investment aiming at building relations among the companies they invested in, to generate cooperative relations among them and to consciously promote better corporate performance. In other words, they might not select companies to invest in where so-called "win-win" relations could be realized.

It is suspected that investors have not been functioning in this manner. They are

not strategically taking advantage of their relations with multiple Internet companies. Instead they are neglecting the intermediary functions they are supposed to perform. This being the case, Internet companies in Tokyo's 23 wards are not on the Silicon Valley type path to development that successfully takes advantage of inter-firm networks formed by investors. In the absence of such intermediary functions, our Internet companies cannot be expected to follow the path of development as their Silicon Valley counterparts. If the development of Japan's version of Silicon Valley is desired in the future, it is necessary to activate the intermediary functions for these companies of leading ICT corporations.

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